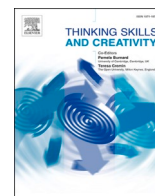


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# Thinking Skills and Creativity

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## The impact of musical improvisation on children's creative thinking

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### ABSTRACT

This article seeks to be a contribution to the defence of the development of musical creative thinking in educational settings. This research report evaluates the efficacy of a musical improvisation workshop with 8–11-year-olds ( $N = 17$ ) as aiming to develop children's creative thinking. The study was conducted with two groups of 8–9-year-olds and 10–11-year-old children over a period of three months combining collective and individual lessons. The music lessons were improvisatory activities around an upright piano as the main tool but enriched with a variety of musical instruments, objects, and proposals (musical and extra-musical assignments). Webster's Measure of Creative Thinking in Music – MCTM II (Webster, 1987, 1994) was administered before and after the six-month teaching programmes (i.e., pre-test and post-test) to assess children's creative thinking in terms of four musical factors: extensiveness, flexibility, originality, and syntax. The study demonstrated how creativity was significantly fostered in children through musical improvisation with a considerable increase of the four musical factors in both groups, with the main progress in musical originality (group of 8–9 year old) and musical syntax (group of 10–11 year old). The study also revealed that the difference between age-groups diminished after the intervention and the variability between the participants decreased after an improvisation workshop, especially in group 2 (10–11 years), indicating that because of the training, the initial differences tend to be minimized. However, individual differences highlighted the complexity of analysing the creativity paradigm.

## 1. Introduction

### 1.1. Creative thinking and improvisation as a central source of music education

Creative thinking has been considered the driving force behind all human progress (Saggar et al., 2017), necessary to thrive- and, at times, even to survive (Sternberg, 2017). The power of creativity has been vindicated from multiple contexts and fields, such as academic research, educational settings, clinical or therapeutic applications, self-help books or manuals to training entrepreneurs. Thus, the variety of definitions of creative thinking presents a kaleidoscopic state of art, also dealing with problems such as the extended popular misuse of words such as *democracy*, *freedom*, or *creativity*.

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This paper proposes a definition of musical creativity focused on musical creative thinking as the main attribute of a creative process and creative behaviour and “refers to the development of a musical output that is novel for the individual (or individuals) and useful for their situated musical performance” (Odena, 2018, p.80). According to Burnard (2012), the single concept of musical creativity is outmoded, its manifestations of multiple music creativities being considered more suitable. She suggests that musical creativity should be thought of as a situated social activity with various modes of expression and engagement, referring to multiple musical creativities.

In our educational field, an old UNESCO report (1972) already defended cultivating creativity in education:

Any education which for rational reasons concentrates on teaching so-called objective facts rather than stimulating creative desire is going against the grain of what Albert Einstein experienced. (...) What really counts is the awakening of creative enthusiasm which helps lift man to a higher level of existence (p.67).

Recent research in music education has criticized schools for missing opportunities to develop pupils' creativity (Lasky and Yoon, 2020; Welch, 2012) despite the fact that explaining creativity can help educators teach more effectively (Sawyer, 2006a) and that nurturing creative thinking in sound should be a core tenet of one's personal music teaching philosophy. This would enable students to make their own aesthetic decisions with the teacher's encouragement (Webster, 2014) Thus, the educational community should take into account the diversity of musical practices and a situated understanding of musical creativity as a rational everyday task or challenge based on persistence and effort (Odena, 2012a). Other researchers have highlighted the importance of musical creativity practices arguing for its benefits for human development and emotional health (see for example, Hallam, 2015; Welch & Ockelford, 2015).

This paper reserves for improvisation the role of experimentation in the search for musical ideas, stating their values as a source of creativity, envisioning improvisation as an impetus for creativity (Siljamäki and Kanellopoulos, 2020), thus conceiving improvisation as a process of discovery. Hargreaves (1999) argues that improvisational thinking is a central source of everyday creativity and affirms that “improvisation should be a central part of the study of musical creativity” (p. 27). And historically, composition and improvisation were blends of a music creativity tree, where the roots are a common language, but the creative and thinking processes are different. The historical importance of improvisation is not a topic that this article can cover, but for example, in European music from the Middle Ages through the Renaissance, improvisation was standard practice creating a musical line in counterpoint over a *cantus firmus*. However, the privileged status of composition in western musical tradition to the detriment of the interpreter goes back to Romanticism when the idea of “work” focused on the importance of notation despite musical events (Seoane, 2020). Most definitions of improvisation include the act of performing and at the same time creating music, thinking and performing music simultaneously and the creation of music during the act of performance (Nettl, 1998). Improvisation is the composition of a musical work as it is being performed (Alperson, 1984, p.20). Hamilton (2000) defended a concept of improvisation as the aesthetics of imperfection focusing on the process, on the performance as event. The concept of improvisation should accept that it has been an essential feature of the art of making music in worldwide contexts (Azzara, 2002; Nettl, 1974; Sawyer, 2007).

The importance of improvisational activities in education has been widely discussed by several authors who recommend it as highly beneficial for the music learner (for example: Biasutti, 2015; Campbell, 2009; Guderian, 2012; Hickey, 2009, 2015; Higgins and Campbell, 2010; Kratus, 1991, 1995; Sawyer, 2017; Swanwick, 1988; Wright and Kanellopoulos, 2010), even at the very beginning of musical instruction (Després et al., 2016). Burnard and Dragovic (2014) noted that activities based on collaborative creativity such as group improvisation enhances wellbeing, affirming that “the joint nature of the emergence of new ideas through improvisation (...) might indicate that its main domain transcends music playing and encompasses improvisation and playfulness in instrumental music learning activity” (p.12).

## 1.2. Objectives

The present paper is a report of a research evaluation which hypothesizes the efficacy of an educational intervention based on musical improvisation to develop creative thinking in children. The researcher selected improvisations and a teaching method where the teacher is a facilitator, providing tools for personal experimentation, guiding the creative process as necessary. The teacher encouraged risk-taking and worked to create a non-judgemental environment in which to evaluate the effectiveness of the proposed pedagogical approach. Thus, the main goal of this research was to demonstrate the possibility of a specific intervention to enhance musical creative thinking skills.

A secondary goal was to analyse the evolution of creative thinking and compare it between two groups of different ages: 8–9-year-olds (group 1) and 10–11-year-olds (group 2).

## 2. Reviewing the literature

After clarifying the importance of researching musical creativity and improvisation, as well as establishing useful definitions for this topic in the introduction section, the main antecedents are now examined. In this section two issues related with the present study are established. Firstly, framework 1 contemplates two areas: 1) the development of creativity from two different fields, namely, educational psychology and musical education. Experimental research focused on musical products and more recent qualitative studies examining the elements that co-influence creative experience and are relevant from the musical education field; 2) the development of creativity through musical improvisation. Here we review studies from the music education field focused on the development of creative thinking and the possibilities of musical improvisation as an educational strategy. Secondly, in Framework 2

the spotlight is on the evaluation of creative thinking in music. From the field of music education different methods are found, revising the studies based on *Measures of Creative Thinking in Music* (Webster, 1983, 1994) and other approaches.

### 2.1. Framework 1: the development of creativity throughout improvisation

How does the development of creative thinking promote a thinking skill? Understanding the origin and advantages of different kinds of creativity is necessary to cultivate diversity and offer each student the tools to develop it (Glaveanu, 2018). The evolution of creative thinking in school-age children and adolescents has received considerable attention in educational psychology literature since the 1970s. For this paper, we highlight two previous remarkable approaches, namely: creativity in specific domains (Deliege & Richelle, 2006; Gardner, 1982; Sawyer, 2006b) and the new psychological perspective which treats creativity as a socio-cultural phenomenon (Glaveanu et al., 2019).

Research on creativity and education has experienced exponential growth since the 2000s, and according to Hernández-Torrano and Ibrayeva (2020) was produced by a few institutions and countries, mostly in the United States and other English-speaking countries. Relevant research in music education argues that children's musical creativity can be developed but requires creative teaching in a learning environment where children feel safe to take musical risks and were involved in the excitement of learning music creatively (Burnard, 2013). In the same vein, Aróstegui (2012) affirms that different kinds of creative abilities are educated and developed depending on the learning context and the features of the tasks. Research from music education shows that, thanks to the musical experience, the creative products of children are characterized by a more advanced use of musical elements, showing a greater originality and musical syntax (see for example: Brophy, 2002; Flohr, 1984; Gordon, 1997; Kratus, 1989; Koutsoupidou & Hargreaves, 2009; Swanwick & Tillman, 1986).

Qualitative research in music education has focused on the factors that mainly affect creative experiences, especially the role, beliefs, and experiences of the teacher (Odena & Welch, 2012; Wiggins, 1999). To these must be added the importance of the methodology or teaching style (Burnard & Boyack, 2013; Hickey, 2009, 2015;) and the notion of teaching and learning as a form of creative collaboration (Barrett, 2014; Barrett & Gromko, 2007) focusing on collective creativity as a social experience (Burnard, 2002; Burnard & Dragovic, 2014). Qualitative studies with students in free-improvisation settings have demonstrated that participants enjoyed their music making in a safe and egalitarian space, and they enjoyed ownership of ideas and creativity amongst themselves (Burnard, 2002; Wright & Kanellopoulos, 2010).

Children's creative thinking during musical improvisation is an under-researched area, despite recent reviews that illuminate the ground covered (Larsson & Georgii-Hemming, 2019; Siljamäki & Kanellopoulos, 2020). In the field of music education few empirical studies have investigated the development of creative process through musical improvisation (Biasutti and Frezza, 2009; Biasutti, 2015; Koutsoupidou and Hargreaves, 2009; Kiehn, 2003; Rowe et al., 2015). Other relevant qualitative studies in music education have outlined the benefits of improvisation as a collective creative practice (Lage-Gómez and Cremades-Andreu, 2019; MacDonald, 2014; MacDonald, Wilson & Miell, 2012) or the improvisational nature of young children's invented song (Barrett, 2006). Others claim improvisational skill as being developmental (Després et al., 2016) and necessary to encourage children's natural capacity and thirst for creating music in different modes (Burnard, 2013), such improvisational thinking provides inspiring experiences for creative musical expression (Burnard & Boyack, 2013).

### 2.2. Framework 2: the evaluation of creative thinking

Burnard and Fautley (2014) have pointed out the importance of the assessment of creativities in music by primary and secondary teachers, indicating that this issue remains problematic, controversial and an under-researched area. Most methods to evaluate musical creativity used scoring factors that have their basis in the Guilford model (1967) reformulated by Torrance (1974) as indicators of general creativity: fluency, flexibility, elaboration, and originality. Pioneering methods created measurements to identify the creative potential or the value of creative musical products, such as Vaughan and Myers (1971), Gorder (1980), Wang and Kageff, 1985, and Webster (1977, 1983). Webster (1989) deemed that improvisation offers an important means to evaluate creative thinking skills basing his method as set out in the *Measures of Creative Thinking* (MCTM, 1983, 1994) on improvisational activities.

The *Measures of Creative Thinking in Music* (MCTM) has been used in numerous studies, from its first version (Webster, 1983), to the final version, MCTM-II (Webster, 1994). And it is probably the best-known and most thoroughly researched tool for evaluating creative thinking in music (Hickey and Lipscomb, 2006). Almost all of the studies that have used the MCTM are in the field of music education, aiming to study how it can affect personality traits in the creative development of children (Swanner, 1985), the classroom as a naturalistic environment (Wolfe and Linden, 1991) or the effects of different teaching styles on creative development (Amchin, 1995; Koutsoupidou, 2008). Other precedent studies have used the MCTM to compare the effects of intervention with a pre-post analysis: Amchin (1995) after 23 weeks of intervention, Baek (2009) with 8 weeks and Koutsoupidou (2008) with a six-month intervention. Many studies tried to research the correlation of the MCTM with other standardized measures such as *Gordon Primary Measures of Music Audiation*, resulting in no correlation or very weak correlation between the inner ear and musical creativity measured by the MCTM (Baek, 2009; Crawford, 2016; Dingle, 2006; Schmidt & Sinor, 1986; Swanner, 1985; Webster et al., 1988).

There are other different approaches to the field of music creativity assessment with current possibilities: Amabile (1983) designed a method to evaluate creative products based on the combined assessment of experts in the field, the Consensual Assessment Technique (CAT); and Hickey (2001), using that method, demonstrated that music teachers are the best judges of children's musical products. Barbot and Lubart (2012) suggested the MET (Musical Expression Test), a complex method that combines a systematic observational approach with a focus on musical exploratory behaviours and a product-based assessment of musical pieces resulting from musical

activities.

### 3. Materials and methods

The study adopted a quasi-experimental design based on the effects of a specific educational intervention focused on creative improvisations (where random and spontaneous circumstances affected the experience). This paper is presented as a report of research analysing the results of the tests (pre- and post-tests) quantitatively and through statistical analysis, evaluating the efficacy of an educational programme to develop musical creativity.

*Measure of Creative Thinking in Music- II* (MCTM-II, Webster, 1994) was selected as a specific tool to examine the development of musical creativity for many reasons. First, it provided a target in creative thinking and utilized musical improvisation activities to assess children's behaviour, so connecting it with the main purpose of this study and with the didactic proposal of the improvisation workshop. Secondly, despite the fact that MCTM-II was designed for children aged 6–10, the activities were considered suitable for our group of children (8–11 years old) and the author confirmed the appropriateness of our proposal. The pre-posttest design was considered a great opportunity to evaluate the changes in creative thinking, especially because enrolling children was difficult, and therefore, finding a control group.

#### 3.1. Participants

Seventeen children (N = 13 females and 4 males) with different musical backgrounds and abilities aged 8–11 enrolled voluntarily in a piano improvisation workshop during three months in a Music Conservatory in Santiago de Compostela (Spain). Children were distributed in two groups: group 1 (10 participants: five 8 year-olds and five 9 year-olds) and group 2 (7 participants, four 10 year-olds and three 11 year-olds). There was a single case, Davinia, a blind girl who studied at the conservatory and had started music studies at the age of four.

The children who participated in the experiment were attending lessons at the conservatory or in other private music schools of the city. The musical background and level in group 1 are basic (N = 10): three children were studying first elementary level at the conservatory (1° GE) and one child in the second elementary level (2° GE). Five children started to play the piano four months before the beginning of the workshop and one girl is trained by her father who is a musician. The four conservatory students (Sebastián, Pol, Davinia and Astrid) had an early musical training (starting at four years' old) and displayed higher musical development than the others. Nine of ten participants were at the level of first grade elementary: they were learning to read simple scores with special difficulties in treble clef and they were starting to coordinate playing with both hands.

However, the musical background and level were slightly divergent in group 2 (N = 7). Six conservatory students were at different levels (2° GE, 3° GE, 1° Professional), but one of them was officially studying saxophone (not piano) and finally, there was a private school student who started to play the piano four months before the beginning of the workshop. Both Leolo and Nube supplemented their scarce technical development with huge motivation, fast learning, and musicality. Participants of both groups had scant previous experience in musical improvisation.

##### 3.1.1. Access and ethics

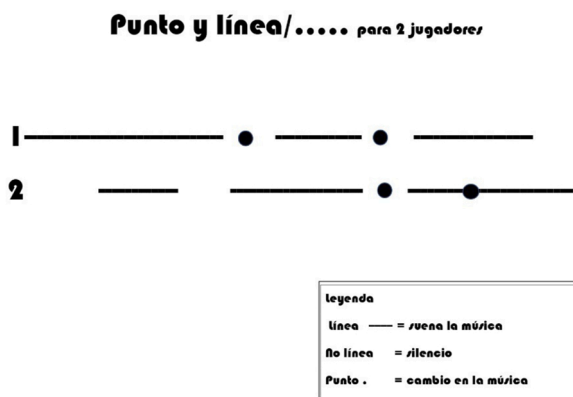
The research project was presented to the conservatory obtaining the acceptance of the Board of Directors and School Assembly. Furthermore, the approval of the Ministry of Education of Xunta de Galicia (regional government) and the Ethics Committee of the University of Granada were necessary to start the enrolment process. The conservatory sent an e-mail to parents of potential participants, being children aged 8–11 who play the piano. Public and private music schools in Santiago de Compostela (Galicia) were informed by e-mail about the development of an improvisation workshop included in a research study. Only one music school engaged actively in the project and the researcher held a meeting with teachers to present the objectives. Besides, the main difficulty to enrol participants was the scarcity of leisure time, because children in this city generally participate in many extra-curricular activities (sports, music, dance, languages, etc.).

Finally, all children and families interested in the improvisation workshop were accepted and informed about the methodology and objectives of the research project. All involved were informed about the possible benefits, and the right to withdraw from the study at any time. Assurances of anonymity (use of pseudonymous) and secure storage of data was also given (Law 15/1999 for Data Protection). Written informed consent was obtained from each child's parent and a brief questionnaire about previous musical experience was completed on behalf of each participant.

#### 3.2. Materials

*Measure of Creative Thinking in Music- II* (MCTM-II, Webster, 1994) was used as the basis for assessing the effect of the intervention programme in a pre-test post-test quasi-experimental design. This instrument was utilized as a warm-up session in a prior lesson before the beginning of the intervention, and as a closed session at the end of the improvisation workshop, creating a circular design with a sense of emotional closure.

MCTM is probably the standardized test most utilized in music education research with children, (Amchin, 1995; Baek, 2009; Baltzer, 1990; Crawford, 2016; Hagedorn, 1997; Hickey, 1995; Koutsoupidou and Hargreaves, 2009; Swanner, 1985; Wolfe and Linden, 1991) and also in a study of cognitive style (Schmidt & Sinor, 1986). The instrument has been tested for reliability and validity through data that have been collected in early studies (Swanner, 1985; Webster, 1983, 1987, 1988, 1990). According to Webster



*Note.*  
 Point and lines for two players.  
 Line: the music sounds.  
 No line: silencio.  
 Point: the music changes.

**Fig. 1.** Point and Line for two players.

*Note.*  
 Point and lines for two players.  
 Line: the music sounds.  
 No line: silencio.  
 Point: the music changes.

(1994), the inter-score reliability for the factors of Musical Originality (MO) and Musical Syntax (MS) range from .53 to .78 with an average of .70. Internal reliability measured by the Cronbach Alpha coefficients range from .45 to .80 with an average of .65 (.69 for the version of MCTM-II). Test-Re-test reliability indicates a range between .56 and .79 with an average of .76.

Measures of Creative Thinking in Music- II (Webster, 1994) as a measure of creative thinking in music was administered to each student. The test consists of ten different activities performed by the participant on a microphone, a piano and a set of temple blocks. The test measures four factors:

- (1) Musical Extensiveness (ME) - the amount of clock time involved in the creative tasks; (2) Musical Flexibility (MF) - the extent to which musical parameters (pitch, dynamics, and tempo) are manipulated; (3) Musical Originality (MO) - the extent to which the response is unusual or unique in musical terms and in the manner of performance; and (4) Musical Syntax (MS) - the extent to which the response is inherently logical and makes "musical sense" (Webster, 1994, p.3).

The evaluation of the four factors was executed carefully following the MCTM administration guidelines (Webster, 1994). Musical Extensiveness (ME) and Musical Flexibility (MF) were measured counting the actual seconds of time a child was involved in each task (ME) or assessing the factual changes of musical parameters (pitch, dynamics and tempo) by the researcher (MF). The test recommends a panel of judges for best results on Musical Originality (MO) and Musical Syntax (MS), as the rating scales combine qualitative appreciation for these factors. Thus, in this research a panel of three judges was created: the teacher-researcher and two doubly experienced teachers and improvisers. Therefore, Musical Syntax and Musical Originality were measured using a Likert rating scale of 0–4 (0 as the lowest and 4 as the highest) according to specific criteria as a basis for the assessment of MO (unusual use of words, sounds or performance) and MS (syntactical logic, elaboration and form).

### 3.3. Procedure

The pre-tests were carried out in a friendly and comfortable environment that aimed at facilitating creativity, and a period of approximately three months elapsed between the two testing sessions. The MCTM-II was carried out by all participants with the researcher in study rooms of the conservatory the week before the start of the intervention (January 2019) and two weeks after the end (end of April 2019). Each student spent between 20 and 30 min, depending on the extent of their musical response. Participants were unaware of the objective of the test; in fact, they were relaxed and excited when they arrived at their first session of the improvisation workshop. What drew our attention was that three months later they barely remembered anything about the activities of the MCTM-II, probably because the test was very short and did not last long. We would mention here that the researcher was preparing a doctoral dissertation with a mixed design that contemplated many results, encouraging an easy atmosphere with no expectations on the participants.

Each individual test was videotaped to enable the musical performance to be analysed by the researcher and the other two judges,



Fig. 2. Images from batiks utilized to improvise.

watching it as many times, as necessary. Both expert judges are recognized teachers, musicians, and improvisers who have collaborated in previous studies with the researcher (Navarro, 2012) their support being most valuable. Therefore, they were contacted by e-mail for this study and after their acceptance the necessary materials and the characteristics of the study, as well as its limitations, were presented in a meeting. Beyond being a standardized measure, the test has been a useful introductory tool for the improvisation workshop, as the children found it exciting to have a microphone, to play the piano with a ball and play a new instrument (the temple block). The materials and the activities were suitable for all participants, including the blind girl, who received oral instructions for the test.

The educational programme consisted of an improvisation workshop for 12 weeks, with one collective lesson of 1 h each week, and individual lessons programmed ad hoc, with between two to six individual hours per participant in total, especially aiming to help students with the lowest musical levels. All sessions were video recorded with two cameras for qualitative analysis and interpretation. Qualitative findings from a socio-cultural perspective focused on how the context of the creative experience co-influenced the development of creative thinking. The other factors were intrinsic motivation, family support, limitations of tonal system, pro-active environment, the importance of surprise, the role of creative teachers and the complementary function of collective and individual lessons (Navarro & Aróstegui, 2020).

The educational approach was proactive, triggering participation, enthusiasm, and self-expression. Collective and individual improvisations alternated in different proposals where the main aim of the methodology was to surprise children and engage them in activities to practice at home. An upright piano was the main tool, and, in each session, other musical instruments were introduced: percussion instruments, a digital keyboard, microphones with a speaker, a screen play or even a saxophone or a horn that two participants played.

Most musical improvisations were invented by the teacher-researcher, trying to provide adaptative, easy-to-use tools, with simple assignments working as a motivational resource. Improvisations were presented in collective lessons, although the development of many improvisations was individual. The themes and activities designed to stimulate improvisation and creative thinking were wide-ranging. Firstly, warm-up improvisations in which everyone could feel comfortable and expectant, thanks to the easy instructions, like *Journey to China* (improvising with black keys) or due to the novelty such as in *Point and Line for two players* (Fig. 1) or *ABA Song* (in which children had to create their own rules for each contrasted section A and B). Secondly, the teacher created in the classroom a place inspired by Egypt and later, by India, conducting activities such as talking about countries, dressing up and games to improvise.

In this section of the workshop, musical improvisations were based on traditional scales (Raga Bhopali or Hijaz Kar scale) and improvisations according to musical association with natural phenomena, such as the *Red Sea*, an aquatic animal, sea squall, or a free improvisation about the images and colours of a batik textile (Fig. 2). As mentioned above the proactive environment and the power of surprise were the methodology used throughout the combination of activities and proposals. Thirdly, more difficult musical improvisations based on musical concepts such as musical compositional or aesthetical ideas were introduced, such as *Minimalism* or *Alberti Bass*, creating original musical patterns and textures that engage with popular contemporary music. Finally, in the last collective lessons, experimentation with metaphorical thinking was introduced as a game: *You and I: action and emotion*, in which participants improvised music for emotions and actions in pairs that the other participants had to guess.

All the activities were designed and planned carefully by the teacher-researcher, based on her professional development and personal beliefs that highlighted the children's rights to engage in artistic experience in different contexts and with contemporary art and music. The ideas come from professional experience of more than ten years' experience in teaching musical language, piano and collective creativity seasons for children, adolescences, and adults, especially in private music schools. Most of the materials for the improvisation workshop were created specifically for this study. But some of them were tested previously in a master's thesis (Navarro, 2012), in which ten improvisational patterns were evaluated by ten experts regarding their value as creativity activators (Navarro, 2018). The musical material of one improvisation, *In A minor*, came from the book *Meditatives Klavierspiel* (Wiedemann, 1991).

#### 4. Results

The overall structure of the results section started with a statistical analysis followed by an extensive discussion, focusing on five

**Table 1**  
Participants' information and number of lessons in which each one participated.

| Name      | Age  | Piano Level | Improvisation Lessons |            |       | Music School              |
|-----------|------|-------------|-----------------------|------------|-------|---------------------------|
|           |      |             | Collective            | Individual | Total |                           |
| Sebastián | 8    | 1°          | 8                     | 5          | 13    | Conservatory              |
| Davinia   | 8    | 1°          | 12                    | 2          | 14    | Conservatory              |
| Astrid    | 8    | 1°          | 11                    | 0          | 11    | Conservatory              |
| Uma       | 8    | 0           | 11                    | 5          | 16    | —                         |
| Gabi      | 8    | 1°          | 10                    | 2          | 12    | Casa do Rock (Rock House) |
| Yolanda   | 9    | 1°          | 12                    | 3          | 15    | Casa do Rock              |
| Iria      | 9    | 1°          | 8                     | 6          | 14    | Casa do Rock              |
| Pit       | 9    | 1°          | 10                    | 3          | 13    | Cantigas                  |
| Daisy     | 9    | 1°          | 9                     | 4          | 13    | Casa do Rock              |
| Pol       | 9/10 | 2°          | 11                    | 3          | 14    | Conservatory              |
| Leolo     | 10   | 0           | 9                     | 2          | 11    | Conservatory              |
| Olmo      | 10   | 2°          | 10                    | 2          | 12    | Conservatory              |
| Nube      | 10   | 1°          | 8                     | 3          | 11    | Casa do Rock              |
| Sara      | 10   | 3°          | 8                     | 4          | 12    | Conservatory              |
| Sonia     | 11   | 3°          | 11                    | 5          | 16    | Conservatory              |
| Viola     | 11   | 3°          | 12                    | 5          | 17    | Conservatory              |
| Enma      | 11   | 1°GM        | 12                    | 4          | 16    | Conservatory              |

**Table 2**  
Results of the means and standard deviations of each factor of MCTM-II in pre- and post-evaluation.

| Factors | Pre    |       | Post   |        |
|---------|--------|-------|--------|--------|
|         | M      | SD    | M      | SD     |
| ME      | 296.94 | 97.07 | 628.00 | 223.42 |
| MF      | 34.64  | 12.67 | 53.94  | 9.03   |
| MO      | 10.33  | 3.69  | 18.09  | 2.38   |
| MS      | 5.25   | 2.33  | 9.54   | 1.03   |

Note: M: mean; SD: standard deviation. ME (musical extension): in seconds; MF (musical flexibility): maximum score available is 84; MO (musical originality): maximum score available is 24; MS (musical syntax): maximum score is 12.

points: 1) the effects of intervention, 2) comparison by groups and the evolution of the factor, 3) correlations between factors, 4) the MCTM-II as instrument, and 5) educational implications.

#### 4.1. Statistical analysis

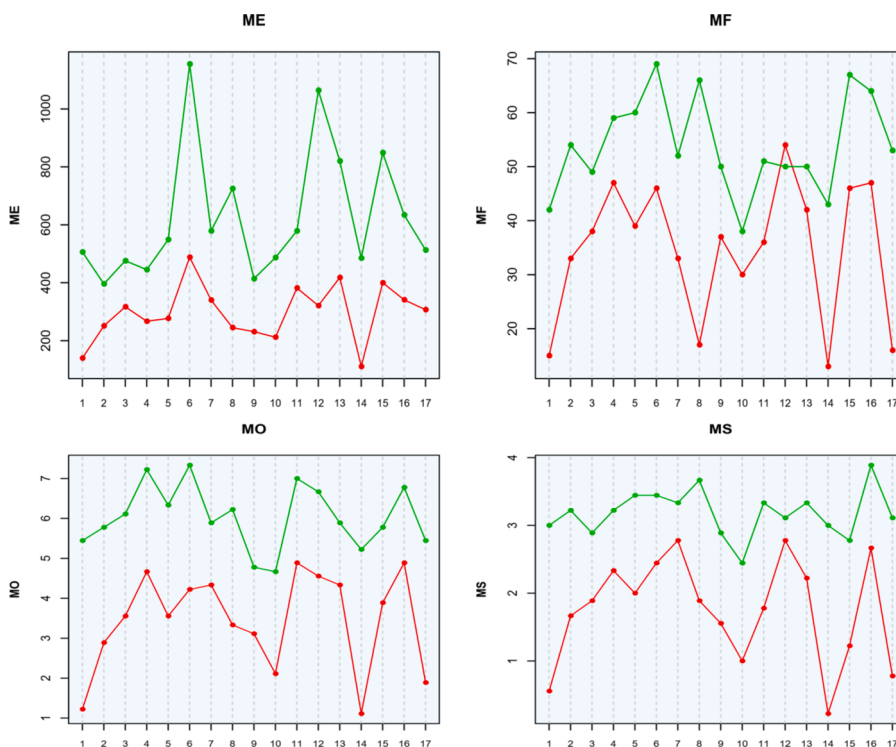
Statistical analysis was performed with the SPSS version 24 statistical package for Windows. Due to the small number of participants ( $N = 17$ ) non-parametric statistical analysis has been applied. Table 1 describes the participants' data, as well as the number of sessions in which each participant engaged.

To determine whether the distributions of scores of the groups differed significantly from each other, the nonparametric Mann-Whitney  $U$  test was used. The results showed that the two groups, in this case, paired samples had distribution differences: ME ( $U = 19.000$ ;  $p = .118$ ), MF ( $U = 28.000$ ;  $p = .494$ ), MO ( $U = 24.500$ ;  $p = .305$ ) and MS ( $U = 32.500$ ;  $p = .807$ ). Subsequently, the means and standard deviations of each of the MCTM-II factors were calculated in the pre- and post-evaluations, as shown in Table 2.

The mean shows the increase in scores in the four factors after the intervention: The musical extension (ME) increased from an average of 296.94 s improvising to 628.00 s, which is more than double; while musical flexibility (MF) evolved from an average score of 34.67 to an average score of 53.94 (representing an increase of 23 %); Musical originality (MO) increased from a pre score of 10.33 to a posttest of 18.09 (increased by 34 %); and the musical syntax (MS) was raised from 5.25 to 9.54 (an increase of 36 %). However, the standard deviation decreased markedly across all factors, except for musical extension (ME) which increased considerably (from 97.07–223.42 s).

Comparing the changes in both groups in pre- and post-test, means and standard deviation of each factor were calculated, and the Mann-Whitney  $U$  test was applied for each of the factors showing statistically significant differences in all factors (ME, MF, MO, MS) (listed in Table A1 in the Statistical Appendix).

There is a considerable difference between the mean values: group 1 (ages 8–9) maintained scores lower than group 2 (ages 10–11) in all measurements, except in the pre value of musical syntax, averaging 5.43 for group 1 and 5.00 for group 2. The widest variation between the participants of both groups is outlined in the pre-intervention test. The case of standard deviation (SD) is striking, because in group 1 it remains stable, going, for example, from a measurement of 10.69 to 9.85 in musical flexibility (MF), which is barely a difference of 0.74. However, in group 2, post measurements notably decreased, falling from a pre-SD of 15.86 to post-SD of 8.48 in musical flexibility (MF), for example. It is noticeable that musical syntax (MS) showed the highest drop in standard deviation, descending from 1.99 to 1.06 in group 1, and more than half in group 2 (from 2.99 to 1.05). Moreover, the factor of musical



**Fig. 3.** Progress of 4 factors: ME, MF, MO and MS.

Note 1: ME (musical extension); MF(musical flexibility);MO(musical originality); MS (musical syntax).

Note 2: Red: Pre-test results; green: post-test results.

Note 3: Participant-ID 1–17: numbers 1–10 belong to group 1 (aged 8–9) and numbers 11–17 belong to group 2 (aged 10–11).

extension (ME) showed a standard deviation lower in the pre- test results, the variability being greater in the post-test, evolving from 92.49–225.27 s in group 1 and from 103.20–211.74 s in group 2, which reveals that the differences in improvisation time between the participants was greater post-intervention.

Additionally, we considered it important to analyse the median, since in the case of evaluating human behavior, it is significant to keep in mind the distribution of data around this measure, which leaves an equal number of participants above and below the line. However, in this case, the difference between the mean and median data is insignificant.

A comparison was made of pre and post-test: general results of MCTM-II. Fig. 3 illustrates the different evolution of each factor for each participant.

There is a considerable difference between pre- and post-test results in the four factors. The method used to discuss one participant's score and the calculations, ratings and correlations of the factors are also set out in the Statistical Appendix.

## 4.2. Discussion

This section interprets the main findings comparing the results with other similar studies. Firstly, the effects of intervention regarding creative thinking development are examined compared to other studies. Secondly, the two group of different ages are compared and the evolution by factors is discussed. Third, the implications of correlations between creativity factors are analysed and the MCTM-II is evaluated as an instrument. Finally, educational implications are exposed as a final section with a more argumentative approach.

### 4.2.1. The effects of the intervention

Before carrying out the experiment, it was hypothesized that both groups would progress in creative thinking (based on the assessment of the MCTM-II) after the intervention period based on musical improvisation as an educational strategy. Finally, this study revealed that improvisation had significant effects on children's development in creative thinking in music, the results of all participants ( $N = 17$ ) being decisive.

Previous research based on MCTM procedure focusing on the effects of an educational programme had unequal findings. Baek (2009) showed a considerable improvement in the experimental group in all post measurements, with a significant difference in the factors of musical extension, musical flexibility, and musical originality. However, Amchin (1995) found no improvement comparing the pretest and post test results, from neither the control nor the experimental group, which was interpreted as evidence that there was



no development in their musical thinking skills as measured by the MCTM-II. Amchin (1995) suggested that the musical exercises utilized in the classroom were based on Orff instruments and rhythmic and tonal patterns, a completely different methodology than that proposed by the MCTM-II that is based on a less traditional use of sound organization. Thus, an intervention based on open proposals or less constrained assignments could more easily connect with MCTM-II activities. This present study utilized a variety of improvisational patterns, some based on musical patterns and others centered on metaphorical thinking, proposing associations with images, natural phenomena, feelings, or actions; and it can be claimed that improvisation as a didactic tool have developed musical creativity. This was demonstrated by Koutsoupidou also (2008), who showed that experimental improvisation groups achieved higher scores on creative thinking as measured by the MCTM-II.

#### 4.2.2. Comparing groups: general interpretation and assessment by factors

Another point discussed in this paper aimed to compare the development of different age groups to examine whether engaging in creative activities might enhance their creative achievement in a different way. The standard deviation (SD) has been one of the main differences between the two groups, since while in group 1 it remains stable, in group 2 it significantly decreased, indicating that the initial differences between the participants of group 2 tend to be minimized, as a result of the training.

Nevertheless, the standard deviation of musical extension (ME) increased considerably, being the only factor that did so. In general, all the participants improvised without much time differences in the pre- test, but after the intervention, they were more likely to play longer, twice the average of the extent of the musical processes, and some participants gained values so prominent that they created a great deviation from the mean (the median, 549, was lower than the mean, 628). Other investigators, such as Lindblom (2017), showed a remarkable improvement in post-test results, the increase in ME being one of the most significant changes (an average of 78 %). And as Baek (2009) found, participants exhibited a considerable increase in standard deviation from 73.52 s (pre-test) to 105.55 s (post-test). This change may be argued for as positive since the development of abilities is different in each person because the effect of training is related to the zone of proximal development (Vygotsky, 1987) and related to personalization of learning.

In contrast, in an investigation about the effects of improvisations, Koutsoupidou & Hargreaves (2009) stated that musical extensiveness was the only factor that was not affected by the intervention programme, the post intervention results not improving, and they affirmed that “the quality of a response, in terms of its level of creativity, is not related to its duration. The value of extensiveness as a measure of creative thinking should be reconsidered if revisions to the MCTM-II are made in the future” (p. 266). Probably this result was based on the age of their 6-year-old participants. Other standardized instruments for musical creativity (apart from Webster), linked musical extension with the category of fluency, such as Barbot and Lubart (2012) creating two different subscales: exploratory fluency (temporal extension) and ideational fluency (number of ideas).

Torrance (1962) defines flexibility as “the number of different categories of relevant responses”, featuring these parameters for the majority of measurements to evaluate musical creativity (Baltzer, 1988; Barbot and Lubart, 2012; Gorder, 1980; Vaughan and Myers, 1971). The guidelines of MCTM-II (Webster, 1994) propose measuring three musical parameters as evaluators of flexibility: intensity, pitch and tempo, probably because this test is designed to evaluate children without musical experience. Thus, other instruments, such as MET (Barbot & Lubart, 2012) applied more complex evaluation for this factor, basing the assessment on gestural, instrumental changes and other categories such as melodic and rhythmic variation.

The evaluation of musical syntax in the MCTM-II, concerns the sense of musical form, the syntactical logic of the performance, the elaboration, phrasing or structure, which could suggest that the group with the most musical experience should have higher scores (as affirmed by Koutsoupidou and Hargreaves, 2009). However, in the present investigation, a sense of overall form was certainly evident in children’s responses, even from the beginning, as shown by many experts’ comments<sup>1</sup> about musical syntax in pre-test assessment:

Judge 1 wrote:

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“Clear construction of musical section” (Yolanda, group 1, Space Voyage)  
 “Elaboration of voices, timbre and texture” (Sebas, group 1, Free Composition)  
 “Clear form” (Pol, Group 1, Frog Music)  
 “Spots of relative repose and creates form” (Pit, group 1, Free Composition)  
 “Sense of musical form and musical phrasing” (Nube, group 2, Frog Music)  
 “Clarity in transitions between parts” (Nube, group 2, Space Voyage)  
 “Creates a syntactical logic with multiple resources;a clear beginning and end” (Viola, group 2, Frog Music)  
 “Coherence, form and dynamics” (Olmo, group 2, Frog Music)  
 “Clear conclusion” (Viola, group 2, Free Composition)

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Judge 2 wrote:

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“Original construction using silences” (Iria, group 1, Space Voyage)  
 “Use of different elements for each scene. Good use of dynamics to suit pictures” (Astrid, group 1, Space Voyage)  
 “Good construction of musical phrases in relation to scenes” (Enma, group 2, Space Voyage)  
 “Long phrases, elaboration of musical discourse based on short musical motives” (Leolo, group 2, Free Composition)

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<sup>1</sup> In the administrative guidelines of MCTM-II (Webster, 1994), the Scoring Guidelines request judges: “For ratings of “3” or higher, briefly note the qualities that serve as the basis for your rating” (p. 20)

Musical syntax (MS) in the pre- test of group 1 (ages 8–9) was the factor that received the highest score, having a much higher average than group 2 (ages 10–11). Probably the instructions of activities, proposed as games, with characters such as a robot or a frog were closer to the tastes of children aged 8 and 9 than older children. In this sense, during the pre-test the older ones showed themselves to be more closed in their proposals, and reluctant to get into a new musical logic, MS being the factor with the worst average score in the pre-test data. However, MS was the factor that most improved in this group (2), demonstrating that the intervention had an effect in improving musical aspects that this factor of creativity entails (skills related to the development of form and musical sense). Besides, the standard deviation (SD) of musical syntax in both groups was the factor that most decreased after the intervention, descending to more than half (from .83 to .36 in its standardized measures). It can be interpreted as a consequence of training, although the children with the lowest scores enhanced their capabilities to create musical forms during three months (intervention programme), and the children with highest scores maintained their level or slightly increased it, developing the other musical factors.

It is also important to highlight the evolution of musical originality (MO) in group 1, which went from being the lowest scored factor in the pre-intervention analysis to being the highest scored factor in the post test, which could imply that an unusual way to explore musical materials, instrument and performance has actually been developed through the improvisation workshop. Interestingly, the factors with the worst score for each group (originality in group 1 and musical syntax in group 2) are the ones that have finally improved the most.

#### 4.2.3. Correlations

This study found an intense correlation mainly between originality (MO) and syntax (MS), and also between originality (MO) and flexibility (MF). MS-MO was the highest correlation in this research ( $r = .89$ ) following by MF-MO ( $r = .83$ ). In the same way, Webster (1989) previously asserted that the greatest correlation was between MS and MO ( $r = .70$ ). Similarly, in Baek (2009) MO-MS is the highest correlation ( $r = .87$ ), followed by MF-MO ( $r = .82$ ), while in Schmidt and Sinor (1986) the maximum correlation is between MO-MS ( $r = .86$ ), followed by MS-MF ( $r = .85$ ) and MF-MO ( $r = .80$ ). Therefore, we can conclude that the different MO-MS sources are the correlation that is most relevant, and in concordance with MCTM-II guidelines in which musical originality is connected with musical syntax as representative of divergent thinking (Webster, 1994).

Some studies agree with this by highlighting that their results show correlations between the different factors, which, although statistically significant, are low, and this has been interpreted as an indicator that each factor measures a different ability, and that none is self-representative of creative potential (Amchin, 1995; Baek, 2009; Baltzer, 1990). For example, in studies such as Baltzer (1990) most correlations between factors are high (being between .77 and .90), indicating that these factors are representative of similar abilities, but there are correlations that are relatively low as ME-MS ( $r = .57$ ) indicating that these factors may involve different abilities. In the same direction, the results of three previous studies (Baek, 2009; Baltzer, 1990; Schmidt & Sinor, 1986) showed that musical extension was responsible for the lowest correlations, as in our study, which could be interpreted as showing that this factor characterized a specific ability.

In this research the correlations between the factors have been acceptable, but not high or constant, revealing that the intervention has had a different effect on each of the groups (and participants), who have developed their musical creativity unevenly and differently in each of the factors (extension, flexibility, originality, syntax). For this reason, it can be concluded that these four factors represent different traits of creative thinking without the ability to represent musical creativity individually.

#### 4.2.4. MCTM-II as an instrument

Finally, the MCTM-II proved itself to be more than a reliable procedure to evaluate musical creative thinking. It worked as a stimulating instrument to start the improvisation workshop, especially because many activities were related with the methodology of an intervention programme, and the features of activities. As it was easy and flexible this tool was accessible and appropriate. However, according to the considerations of two judges and the teacher-researcher, the MCTM-II presents limitations such as outdated pictures and the use of the microphone in many activities at the beginning of the test. The microphone exerted a power of attraction on some participants but for others it was highly intimidating. Other researchers that used this test affirmed that in general children were reluctant to use their voices (Koutsoupidou & Hargreaves, 2009) and in consequence the musical extension scoring abruptly decreased in activities that required the microphone (Baltzer, 1990). Moreover, in the three final activities of MCTM-II, musical flexibility is evaluated, penalizing the participant if the three instruments (piano, voice, and temple block) are not used in musical improvisation. This resulted in the loss of many points for those who exclusively used one or two instruments.

#### 4.2.5. Educational implications

The results of the present research are aligned with contemporary educational issues. The inevitable connection between the development of creative thinking and the possibilities of musical improvisation (as a remarkable tool in educative environments), creates bridges between fields, disciplines, and methods; psychological, sociocultural, and educational approaches bring about dialogue and the interchange of knowledge from both qualitative and quantitative studies. Thus, some of the educational implications that emerged from this study are 1) improvisation as an educational strategy to develop creative thinking in music, 2) the definition of musical creativity for children as a possible everyday experience, 3) the motivation generated by improvisation as a collective practice and 4) the importance of context in which children operated.

This research seeks to contribute to supporting the idea that musical improvisation develops creative thinking. So, in music educational settings improvisation could be a useful strategy to trigger creative processes. Our results directly connect with some findings that stress the benefits of improvisation for music education. Musical improvisation is introduced as a gate to creative process

(Navarro, 2018), and according to Hickey (2009, 2015) improvisational experience should be considered as a process and not as a product. Therefore, teachers should focus on facilitating opportunities for creative expression. Expert improvisers have pointed to the values of improvisation as an incomparably liberating experience for creative expression (Després et al., 2016). In addition, other studies focusing on children have described the effects of improvisation in creative thinking as being especially stimulating for flexibility, originality, and musical syntax (Koutsoupidou & Hargreaves, 2009). Thus, improvisation as a thinking process available in music classrooms possesses many virtues: accessible, social, creative, and spontaneous (MacDonald et al., 2012), connecting with children thanks to its exploratory nature (Hargreaves and MacDonald, 2012). Finally, children's musical improvisation involves complex cognitive processes and abilities (Biasutti, 2017) offering an educational opportunity to develop general human development.

The findings of our research maintain the validity of musical creativity defined as a possible everyday experience for children, whose development is based on persistence and effort (Odena, 2018) and show how children can develop more creative products and processes. The presented definition of musical creativity referring to novelty and usefulness as requirements of creative products in a specific context (Odena, 2018) agrees with our results. In this sense, the creativity factors most developed in our study were musical originality (Group aged 8–9) and musical syntax (group aged 10–11). The measurement of originality has been assessed based on the innovation of the proposal (novelty) and syntax according to syntactical logic to adapt to task instructions (usefulness). Other previous studies also found that musical syntax develops more intensely after the age of 10 years (Brophy, 2002). In line with Coulson and Burke (2013), originality in children's improvisations is related to confidence in their own abilities and time to explore on their own.

This study, based on an improvisation workshop found that collective practice generated intense motivation in children, impacting their creative development. In this vein, many researchers have examined the main benefits of group improvisation that our study shares. Welch (2012) stated that music practiced collectively is perceived as more pleasurable and with less stage anxiety. According to the statements of Burnard and Boyack (2013), group improvisation is a process that should be nurtured in and across all school levels because for children playing together a positive environment. Generating a community of improvisers enhances wellbeing and playfulness in an instrumental learning activity (Burnard & Dragovic, 2014) and participants reported that they felt more liberated in expressing themselves musically in group improvisation (McDonald, 2017).

The importance of context in which children operate has been recognized by many researchers (Burnard & Dragovic, 2014; Csikszentmihalyi, 1996; Odena, 2012b). This study contemplated the importance of educational environment as a specific context able to empower or inhibit creative thinking, ensuring the class environment in the improvisation workshop was safe, pro-active and inspiring. Burnard (2013) defended the importance of a safe environment for taking musical risks. Hickey (2015) advocated providing children with the stimulating environment of free improvisers, psychologically safe and comfortable, egalitarian, and a place for discovery. Despite the fact that the curriculum gives little relevance to the teacher's role in musical creativity, many recent studies have focused on how teachers could develop creative thinking. We would suggest some relevant ideas that link with our findings since we consider that they are potentially challenging for a promising future. Educators should be curious and open to any new musical proposal (Odena, 2012a), innovative leaders of exploration in an environment of possibility (Burnard, 2013), promoting divergent thinking, collaboration, and self-confidence (Lasky and Yoon, 2020). Lastly, an inspiring quotation with direct educational implications: "When we go home at night, we must ask ourselves how we have allowed students to make their own aesthetic decision with our guidance and encouragement" (Webster, 2014, p.207).

## 5. Conclusion

Our findings support the results of Koutsoupidou & Hargreaves (2009), thus achieving our first goal, demonstrating the effects of improvisation on the development of children's creative thinking in music. Considering musical improvisation as a thinking skill, we are following Vygotsky's notion of a zone of proximal development by scaffolding the creative activity of each person through collaboration with others and the resources available. Introducing improvisation in musical instruction would enhance children's creative thinking in a different way, because our results suggests that despite generalization of statistical analysis, the individual results of each child were divergent, demonstrating that every participant progresses differently in musical abilities (syntax, originality, extension, and flexibility). As Hickey (1995) affirmed, a constructivist would argue that musical composition is the best method for deciphering a child's understanding of a concept, while we would argue that improvisation will offer an excellent picture of children's understanding, and thus a valid evaluative tool for teachers.

Our results also suggest that general musical training is not a guarantee of creative development, as previous researches stated (Flohr, 1981, 1985; Gorder, 1980; Hickey, 1995; Webster, 1977, 1987b), but some differences could be put forward regarding ages, namely, the progress of musical originality between 8–9 year olds and musical syntax between 10–11 year olds. The study also revealed that the difference between age groups diminished after the intervention and the variability between the participants decreased after the improvisation workshop, especially in group 2 (10–11-year-olds), indicating that as a result of the training, the initial differences tend to be minimized.

The main limitations of the present study relate to sample size, which was inevitable, due to the difficulties of children's enrolment in extra-curricular activities, even those that are beneficial, making it difficult to personalize the training through individual lessons, although we concluded that the research findings overcame these limitations. When considering the possibilities of creative behaviour and improvisational thinking, future researchers should study the specific achievements of different improvisational models in a variety of music educational settings. The psychological and educational approaches to generate innovative methodologies for studying children's creative and cognitive processes during musical improvisation should be combined.

Sternberg (2017) affirmed that schools often inhibit creativity because teachers decide not to support it and they focus on the transmission of knowledge. Some educational implications have been outlined because as educators we have the power to change the

situation and make a real contribution to the development of creative thinking in music.

### Author statement

The authors, following the journal's transparency policy, declare that we agree with the availability of the data, with the aim that they may be available, accessible to any researcher who considers interesting and useful.

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### Appendix A

#### Statistical Appendix

**Table A1**  
Findings comparing the changes in both Groups.

| Factor | Test | Groups          | M      | SD     | Z      | p    |
|--------|------|-----------------|--------|--------|--------|------|
| ME     | Pre  | 1 (8–9 years)   | 276.80 | 92.49  | -3.621 | .000 |
|        |      | 2 (10–11 years) | 325.71 | 103.20 |        |      |
|        | Post | 1               | 573.20 | 225.27 |        |      |
|        |      | 2               | 706.28 | 211.74 |        |      |
| MF     | Pre  | 1               | 33.50  | 10.69  | -3.577 | .000 |
|        |      | 2               | 36.28  | 15.86  |        |      |
|        | Post | 1               | 53.90  | 9.85   |        |      |
|        |      | 2               | 54.00  | 8.48   |        |      |
| MO     | Pre  | 1               | 9.90   | 3.13   | -3.625 | .000 |
|        |      | 2               | 10.95  | 4.57   |        |      |
|        | Post | 1               | 17.93  | 2.66   |        |      |
|        |      | 2               | 18.33  | 2.09   |        |      |
| MS     | Pre  | 1               | 5.43   | 1.99   | -3.624 | .000 |
|        |      | 2               | 5.00   | 2.90   |        |      |
|        | Post | 1               | 9.46   | 1.06   |        |      |
|        |      | 2               | 9.66   | 1.05   |        |      |

Note. M: mean; SD: standard deviation. ME (musical extension): in seconds; MF (musical flexibility): maximum score available is 84; MO (musical originality): maximum score available is 24; MS (musical syntax): maximum scores 12.

**Table A2**  
Standardized means, standard deviation, and progress of 4 factors, pre and post-test in both Groups.

|    | Group 1 (aged 8–9) |     |      |     |          | Group 2 (aged 10–11) |      |      |     |          |
|----|--------------------|-----|------|-----|----------|----------------------|------|------|-----|----------|
|    | Pre                |     | Post |     | Progress | Pre                  |      | Post |     | Progress |
|    | M                  | SD  | M    | SD  |          | M                    | SD   | M    | SD  |          |
| ME | -.77               | .39 | .46  | .94 | 1.23     | -.57                 | .43  | 1.02 | .87 | 1.59     |
| MF | -.73               | .73 | .65  | .67 | 1.38     | -.54                 | 1.08 | .66  | .59 | 1.20     |
| MO | -.86               | .63 | .74  | .53 | 1.60     | -.65                 | .92  | .82  | .42 | 1.47     |
| MS | -.69               | .70 | .73  | .38 | 1.42     | -.85                 | 1.03 | .80  | .37 | 1.65     |

Note 1: M = mean; SD = standard deviation; ME (musical extension); MF (musical flexibility); MO (musical originality); MS (musical syntax).

Note 2: Values are standardized (in negative values, the closer the number is to zero, the higher its value).

**Table A3**  
Pearson Correlation of 4 factors.

|          | ME-MF  | ME-MO  | ME-MS  | MF-MO  | MF-MS  | MO-MS  |
|----------|--------|--------|--------|--------|--------|--------|
| <i>r</i> | .663** | .757** | .631** | .831** | .754** | .894** |
| <i>p</i> | .004   | .000   | .007   | .000   | .000   | .000   |

Note 1: \*\* Correlation is significant at the level 0.01 (bilateral).

Note 2: ME (musical extension); MF (musical flexibility); MO (musical originality); MS (musical syntax).

### Pre and Post Test Results

Only one participant (number 12) in one factor (MF) lowered his score. To analyse this situation, the flexibility of the test scores should be done by assigning certain points to the use of each instrument (piano, temple block and microphone). The answers of participant number 12 (Olmo) in the post test were focused on the use of the piano almost exclusively, losing many points by not using the other instruments in his responses.

In addition, the ratings in both groups and the progress of the four factors according to standardized means (SM) and standard deviation (SD) are presented in Table A2.

Factors that most increased were MO in group 1 (ages 8–9) and MS in group 2 (ages 10–11). In addition, other striking features that can be pointed out are that the data concerning the pre-test revealed that MS was the most remarkable factor in group 1, with a significantly higher score than in Group 2. However, pre-test results in group 2 showed that the most remarkable factor was MF, followed by ME, and with a considerable difference with MS. MO was the lowest factor in pre-test measures in group 1, showing a marked rise, becoming the highest rating of this group after the intervention. Data for the post-test in group 2 showed that ME obtained the highest score and MF the lowest score (which was however the highest score factor in the pre-test) while MO and MS steadily evolved.

All correlations between the factors of the MCTM were highly significant ( $p < .01$ ). Table A3 shows that all MCTM subscale scores were significantly correlated in pre and post-test, demonstrating that the four factors are representative of the creative thinking that the test measures.

Inter-scorer reliability was assessed for MO and MS scores, because three examiners evaluated these factors, following the recommendations of the MCTM-II guidelines. The reliability test demonstrated a strong positive correlation between the scores of the three examiners: at the 0.01 level for MO (pre / post) and MS (pre) and at the 0.05 level for MS (post), showing that the scoring procedure was reliable ( $r = .76$ ).

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