



A scale to measure educators' musical skills in early childhood education

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ABSTRACT

Evaluating skills of students training to become teachers in early childhood education (ECE) is a key measure to improve their training and, subsequently, to bring about improvements in the way they train their pupils. No research literature specifically describing a scale designed to measure educators' musical skills at the ECE level has been previously published. In view of this lack, we carried out the customary procedures for designing and validating a psychological measurement scale: on the basis of a sample of university students ($n = 209$), we created a valid, reliable tool that allows researchers to evaluate and quantify how teacher trainees perceive their own musical skills. By applying EFA, Parallel Analysis, and CFA, we observed the emergence of four differentiated categories distributed along 25 items in the questionnaire's final version. To improve and refine this tool, further research and study replication in a series of different educational contexts would be required.

1. Introduction

1.1. Skills of teacher trainees and the need to evaluate them

In learning, the main objective consists in creating new habits or ways of thinking and/or acting to face subsequent real-life situations, i. e., to establish significant relations between the world and ourselves (Muhonen & Väkevää, 2012). The teaching imparted by an educator generally serves to aid students in their learning. For learning to be more significant, comprehensible, and fruitful for the student, teaching efficacy is essential (Barman et al., 2015). Education is an essential element in the personal, professional, and economic development of human beings (Anderson, 2004), in which students become active subjects in the teaching-learning process (Muhonen & Väkevää, 2012). Every teacher's main task should therefore consist in "involving the students in the learning process and offering them assistance in their personal, social, and intellectual development" (Day & Gu, 2015, p. 15). Teaching is thus a specialized activity that not only requires experience or preparation in a determined field of knowledge, but also the capacity to create environments for the students to maximize their learning skills (Tan de-Ramos, 2011).

Although a great number of variables exert an influence on the

educational process (Muhonen & Väkevää, 2012), it would be logical to assume that teachers are one of its indispensable components, as pointed out by Calaguas (2013); without them, students would never be able to efficiently acquire the skills that are required of them. Hunt (2009) likewise points out that the effectiveness or ineffectiveness of teachers are a key component of their ability in the different areas of knowledge, which they are supposed to impart in the course of the educational process. Teacher skills are therefore one of the fundamental elements that allow students to obtain certain expected results. Indeed, for teachers to develop competencies to teach their students, as well as in terms of personal maturity and to meet curricular requirements, they need to demonstrate a mastery of the capacities they need to efficiently apply in the classroom (Carrillo, 2015; Imbernón, 2017). At the same time, teachers should have a greater level of theoretical-practical knowledge of the subject they are expected to teach in the classroom. As a consequence, professional educators should be able to adapt the conceptual and procedural content they have previously assimilated to the required level at which they are currently imparting it. In other words, the more the teacher knows about the subject, the more competence he/she will possess to reflect on that practice, and that knowledge not only includes what one is supposed to know, but how to teach it (Imbernón, 2017). Students have a right to receive the best

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possible education from teachers who are capable and proficient in their subject matter (Day & Gu, 2015). Moreover, the creativity required by teaching-learning situations helps transform problems into solutions, thereby stimulating the act of learning (Hargreaves, 2003).

It is notable that “the interest in higher education as a field of investigation has been steadily increasing since the 1950s and has now become a field of research that is just as solid as traditional areas of pedagogical investigation” (Gargallo et al., 2011, p. 10). One of the reasons for this development is that higher education in the countries of the European Union is involved in a convergence process that implies a major reconfiguration of the roles of professors and students. Currently topical theories of learning cited in documents regarding university convergence recommend a pedagogy more centered on learning than on teaching (Pozo & Pérez, 2009), and emphasize that all agents implied in every aspect of learning need to be indispensably and unavoidably evaluated: not only in the course of their professional career, but while they are still in the training phase. Instead of being limited to receiving and reproducing the knowledge transmitted by his/her professors, the teacher trainee becomes an active subject implied in the learning process. He/she should not hesitate at any time to explore, elaborate, and call pedagogical practice into question (Gargallo et al., 2007; Gargallo et al., 2011; Pozo & Pérez, 2009). The assessment of teacher skills is a systematic evaluation of teacher performance and teacher qualifications in relation to their role as educators, as well as in conjunction with certain justified institutional goals.

Although several definitions of teacher evaluation exist, they all have certain characteristics in common, as pointed out by Liu (2011). The process of teacher evaluation is systematic: it requires preparation with the purpose of achieving a determined result. Data collected in the context of teacher evaluation should be analyzed with rigorous methods that are entirely independent of the data collection method. The evaluation of teachers should be conducted with the goal of improving their personal and professional praxis, by providing them with information regarding research results and eventual needs for improvement. Likewise, as pointed out by several authors (Marzano, 2012; Marzano et al., 2011; Marzano & Toth, 2013; Tarhan et al., 2019), the evaluation of teachers is a twofold process that seeks to increase their pedagogical skills and to improve their students’ level of success. Hence, during their initial training stage, they should gradually begin reflecting upon their activities and analyzing them. If teacher trainees are asked to fill out self-reports, this is done with the goal of helping and encouraging them to become aware of new ways of implementing teaching tools while focusing on areas worthy of improvement, judging which teaching strategies are truly the most effective, updating their knowledge of the subject, and increasing their motivation in the face of obstacles (Prieto, 2007). Self-reports are thus part of the battery of elements designed to improve the training of teacher trainees and to help them monitor the extent to which they are meeting curriculum demands. Self-reports are useful in providing teacher trainees with information that helps them assess their progress during the entire course of their training trajectory. Moreover, an efficient (self-) evaluation of teacher trainees’ competencies can even enable them to continually revise the university curriculum and monitor to what extent they are meeting its demands (Tejedor, 2012).

In this sense, research in education requires that investigators have a series of tools at their disposal that may allow them to obtain evidence – tools that are necessary to help them confirm and diagnose a series of elements, including, among others, the abilities that enable educators to teach students, and that may assist them in designing and improving curricular training plans (Fernández, 2008; Gargallo et al., 2011). It is useful to have tools that help us simply and retroactively evaluate the progress achieved by teacher trainees, along with their gradual acquisition of competencies. They can also allow us *post-hoc* to compare curricula being taught by the teachers in certain subject matters and revise training guidelines. All of this is useful, even when it is achieved through self-reports, which, admittedly, are a tool which has its limits.

Their usefulness nevertheless outweighs the disadvantages (Román & Murillo, 2008), likewise in terms of criterion validity.

In ECE, musical education is an artistic, sensory, emotional, intellectual and physical experience achieved through the basic elements of sound: it can therefore be extrapolated to other curricular areas and can be applied to many different aspects of an individual’s life (Lizasso, 2017; Malbrán, 2013). The ECE stage requires a special adjustment of didactic musical resources: music is imparted transversally, as part of the entire curriculum, since child development in that stage best responds to teaching that is coordinated across all disciplines (Lozano & Hernández, 2014) in conjunction with theories of acquisition of initial musical knowledge. The research presented in this paper aimed to create a tool that would efficiently facilitate all such required information by incorporating the musical requirements of ECE teachers in the items of a self-measurement tool (didactical knowledge and didactical applications of the musical sound event; knowledge related to psychological processes; methodologies and resources; use and/or design of concrete didactic text-music applications; knowledge related to different cultures and styles), independently of the geographical context in which teaching is imparted (Oberhuemeur, 2000; Simpson, 2010).

The process of designing and validating scales seeks to obtain a valid, reliable measurement tool capable of evaluating certain attributes, characteristics, or interests (Tay & Jebb, 2017). Thus, the objective of our study is to present the design and validation of a scale that evaluated the musical pedagogical competencies of a sample of university students who were training to become ECE teachers. We retrace the design procedure and the test’s validation by a panel of experts, after which we provide a summary of the statistical analysis of the items that confirmed their factorial validity and their reliability. As evidence of construct validity, we compare the item factor scores among subjects in different academic years in with different amounts of previous musical training experience.

1.2. Scale of musical skills in ECE teacher trainees

In education it is indispensable to take the specific contexts into account in which learning takes place (Day & Gu, 2015). The variables one would need to consider are numerous, and they include those related with educational policies or curricular design. In the course of the 20th century, governments in Spain attempted to modify educational legislation with the avowed purpose of improving the quality and efficiency of the country’s educational system (Díaz & Giráldez, 2015). Thus, each university curricular plan takes into account all state requirements and the adaptations implemented by each autonomous region (*comunidad autónoma*) (Ministerio de Educación y Ciencia, 2007b).

Until now, in Spain, we have not found any specific scale that evaluates the musical skills acquired by future ECE teachers. The adaptation of scales from other educational levels to a Spanish context did not represent the best option for us, since those scales were specifically adapted and designed for the contexts for which they had been conceived. ECE curriculum in Spain obeys regulations established on a national level, and curricular compliance likewise depends on each Autonomous Community; the profession of schoolteacher is regulated, requiring the corresponding specific academic title as a condition for its exertion (European Commission, 2021; Ministerio de Educación y Ciencia, 2007b). Moreover, ECE educators in Spain are not specialized in music; they teach all subjects, but their university training includes courses with musical content (Juárez & López, 2021). In spite of these difficulties, our goal was to elaborate a questionnaire that would represent and approximate the requirements of ECE musical teaching in any geographical context, particularly since music in ECE requires certain concrete, appropriate technical elements of knowledge adapted to that level. In other words, much of the teaching content is specific to music and can be generalized (López de la Calle, 2009) to any geographical context, since, according to specialists in the matter (Niland & St. John, 2016), and despite non-substantial differences, ECE

music education progressions are related to the child's physical, psychological, and emotional development. It is nevertheless undeniable that a localized, specific use of this questionnaire will need to take certain cultural and contextual aspects into account which are restricted to each geographic area, as local curriculum is based on a series of specific factors (Chiarelli, 2006; García-Gil et al., 2017). Our research team thus sought to design and validate a scale that would compensate for the current lack in this field, particularly since we did not have any instrument at our disposal that was adjusted to the goals of our research.

Thus we designed an *ad hoc* questionnaire as material for this investigation. As a first qualitative step in the creation of a Scale of Musical Skills in ECE, we included eight emergent themes of inquiry derived from Spanish curricular legislation: specifically, from *Real Decreto* 1630/2006 (Ministerio de Educación y Ciencia, 2007a) a norm that regulates the content, objectives, and evaluation criteria that are applicable to students in the second cycle of ECE (children ages 3–6). The current Spanish legislation in terms of education is fairly recent, and has incorporated the guidelines established by the European Union in this field (López de la Calle, 2008). The Spanish study curriculum serves to regulate teaching in that cycle, and it has two functions: 1) establishing educational goals by stating their objectives, and 2) proposing a plan of action that orients the teaching-learning process to ensure that it meets the established goals. In the official curricular study plan, music is described as an enhancement of certain perceptive abilities, as well as of expressive abilities (Díaz & Giráldez, 2015). Teachers are required to follow these guidelines. The research themes related with the musical and pedagogical abilities of future ECE teachers were reflected in concrete questions we featured in the initial questionnaire:

- 1 Do you have knowledge of the theories regarding the acquisition and development of musical learning?
- 2 Have you been able to acquire the technical musical knowledge required from an ECE teacher?
- 3 Have you been able to explore the use of musical language as a means of expressing emotions and ideas?
- 4 Are you capable of addressing matters of diversity via cultural musical attributes?
- 5 Do you know some artistic musical works?
- 6 Can you provide your pupils with concrete musical and auditory experiences?
- 7 Are you capable of helping them to develop skills related with the human voice, with sounding objects, musical instruments, with body movement, and with creativity by means of attentive listening sessions and by playing with sounds and music?
- 8 To help children acquire musical dexterity, are you capable of using didactic tools such as stories and songs?

After having concretely and qualitatively reflected those emergent research themes in the above-featured general questions, we proposed to initially divide them into two different categories. The five first questions are associated with *acquired didactic musical knowledge applicable to the ECE stage*; in other words, musical knowledge and abilities that ECE university trainees have had to acquire. They not only take into account musical knowledge (conceptual, epistemological, and practical), but also pedagogical competencies acquired by the trainees in the other general assignments in their ECE study curriculum (Ministerio de Educación y Ciencia, 2007b). The three last questions can be subsumed under a category named *didactical musical applications for ECE pupils*: in other words, the question whether these trainees feel capable of applying ECE curricular content through a series of didactic proposals and learning projects.

After having applied this categorization, we proceeded to formulate questions that would reflect each of the eight above research areas: 4–5 questions per area. After having formulated the tool questions, we decided upon the questionnaire's exact format and order, as well as on the most adequate method to measure the subjects' responses. The

initial scale items were established taking into account the fact that, after an initial validation process, the scale would feature more items than it would after statistical validation. As Mazas, Fernández-Manzanal, María, and Zarza-Alzugaray (2013) point out, the most recommendable procedure is to formulate three to four questions per subject, whereby the initial questionnaire can feature at least twice the items one would deem necessary to define the category under which they are subsumed, e.g., ca. twice the items than will finally remain in the questionnaire (Carretero-Dios & Pérez, 2005). The objective in overestimating the number of items is to achieve a construct validity of qualitative evidence with the goal for the category to be correctly semantically defined and reflected by the featured items. The overriding goal is to supply evidence proving the relevance and pertinence of the chosen items: ensuring that they adequately represent each of the tool's general constructs (Sireci, 1998).

A usual method to achieve this is to consult a panel of experts, asking them to judge and evaluate each of the proposed items (Zarza-Alzugaray, Orejudo, Casanova, & Mazas, 2016). In this phase, we sent the formulated questions and their relations with the overriding categories to three Music Didactics specialists with ample experience in the ECE field and who serve on the faculties of Spanish universities; they were asked to evaluate the items in terms of ease of comprehension, suitability, and plausibility of application within the Spanish university system. Their opinions helped us clarify aspects of language use, along with certain yet unclear divisions among questions, all with the intention of adjusting each item to its corresponding reference category.

We thereby drew up a final scale of 37 items formulated in such a way that they could be grouped under eight possible subscales, all oriented toward the general objective of creating a skill evaluation questionnaire.

2. Method

2.1. Sample description

The sample comprised 209 students studying toward a *Grado* (equivalent to Bachelor's) degree to become ECE teachers. In terms of gender, 22 subjects were male (10.5 %) and 187 were female (89.5 %). The mean age was 22.63 (*S.D.* = 2.91). In terms of academic year, 30 students (14.4 %) were in their second academic year, 178 (85.2 %) were in third year, and one sole student (0.5 %) was in fourth.

Regarding mode of access to university, out of 207 valid cases, 101 students (48.8 %) entered via the Spanish University Access Tests, also called *selectividad*; 104 students (50.2 %) were admitted after having attended a series of training courses, and two students (1.0 %) passed an access examination specifically designed for aspirants older than 25. Two individuals in the sample (1.0 %) did not indicate which mode of access enabled them to gain admittance to the Spanish university system.

The sample was obtained according to the criterion of subject availability. We handed out a pen-and-paper questionnaire to students enrolled in different academic years of study who were attending music education courses at university. We were present while the students were completing the questionnaire in every classroom to which we were allowed access. We highlighted the study's voluntary nature and ensured anonymity. All students present in the classrooms completed the questionnaire.

2.2. Variables and tools

The main tool under study is the Scale of Musical Skills in ECE Educators, presented above. Apart from the customary pertinent questions regarding the trainees' age, gender, and academic year of study, we included further items for purposes of orientation. Thus we asked our respondents how they had gained access to the Spanish university system, and whether they had received obligatory musical instruction on all

educational levels up to their secondary school diploma (*Bachillerato*). We likewise included items asking whether they had trained in music on an extracurricular basis, within an institutionally regulated and approved context or not, and what level of training they had managed to conclude; a further item asked whether they had learned music autodidactically.

2.3. Statistical treatment

In our statistical validation procedure, we applied approximation according to classical test theory (Abad et al., 2011). Factor analysis allows researchers to evaluate a measurement tool's factorial structure, as Ferrando and Anguiano-Carrasco (2010) point out; it thereby also provides evidence for construct validity. Following the same authors, one of the most common approximations consists in assuming that the tentative initial approximation that extracts factors from the threefold toolkit of *principal components / Eigenvalue >1 / Varimax rotation* is accurate, albeit with certain limitations that can be subsequently corrected by applying randomization techniques and parallel analysis, as indicated in O'Connor (2000). Parallel analysis can provide a good alternative to the interpretation of extraction factors by subsequently allowing researchers to refine the scale via commonly applied multivariate analysis techniques that are widely respected within the scientific community, such as CFA (Brown, 2006; Marsh et al., 2014; McDonald & Ho, 2002). In parallel analysis, attention is focused on the number of components that represent a variance superior to that of components derived from random data (O'Connor, 2000); thus, if components are determined by comparing a traditional extraction method (as the one above-mentioned one) and the application of parallel analysis, researchers can improve the operationalization of those factors for the subsequent step of confirmatory factor analysis.

Based on the results obtained from factor analysis, we provide two additional indicators of scale validity: construct validity and convergent validity. To interpret these results, we took into account the values as they are customarily recommended in the literature. Thus, Fornell and Larcker (1981) indicate that the construct validity value should be equal to or exceed .70, whereas for convergent validity one should apply Average Variance Extracted (AVE), the value of which should be equal to or exceed .50.

In order to obtain evidence of criterion validity, we compared the entire mean scores of the scale with an extract stemming from groups of participants divided into subgroups (by cluster analysis) according to their previous musical training. The participants indicated what kind of musical training they had previously received: university training, pre-university training (ECE, primary, secondary education) in government-approved or completely private institutions of musical learning; in some cases, subjects were entirely self-trained (autodidacts). Cluster analysis classified them into two groups: one comprising 50 participants who had less previous experience in terms of musical training, and another group of 159 participants who had a greater amount of previous musical training. We also established a comparison among teacher trainees who were studying in their 2nd and 3rd academic years in university, respectively. Our hypothesis was that students who had a greater degree of previous musical training, as well as those who had a greater degree of university training (academic year) would have achieved higher scores on the questionnaire.

We used the SPSS 22.0 statistical package for descriptive analysis as well as for exploratory factor analysis; for CFA we used the SPSS AMOS 2.0 package.

3. Scale validation results

3.1. Item analysis and pertinence of factorial analysis

To ascertain reliability, the initial analysis of scale items was carried out using Cronbach's α and the correlations between the individual item

and the total of items. Statistical analysis yielded a value of .937, quite superior to the 0.7 regarded as the acceptable minimum to consider the tool as reliable for use (De Vellis, 2003). Nevertheless, certain item-total correlations did not present the minimum values required for them to be regarded as adequate (De Vellis, 2003); Item one correlated at .187 with the total scale, and Item 4 presented a correlation of only .162.

Thus, on general terms, the tool had good internal consistency. This was corroborated by the low variability of Cronbach's α ($\pm .03$) in function of item elimination. Moreover, the scale also proved to behave well according to normal parameters: it had a general mean of 3.36 (*S.D.* = .61) with a skewness of -1.45 and an overall kurtosis of .51. Furthermore, one can point out the impossibility ($p > .05$) of statistically contrasting the null hypothesis using the K-S and Shapiro-Wilk tests, as displayed in *Factor analysis*.

Thanks to the data's good fit with the normal curve, we proceeded to the analytical phase for the extraction of underlying factors. Thus, regarding exploratory factor analysis, Bartlett's sphericity test yielded a value of $\chi^2_{666} = 3938.271$ with a *p value* $< .001$, which permitted us to affirm that we were not dealing with an identity covariance matrix. Furthermore, the Kaiser-Meyer-Olkin test of sample adequacy yielded a value of .890. Both values allowed us to confirm the relevance of subjecting this tool to factor analysis.

In the exploratory factor analysis of the 37 items featured in the initial tool, yielded eight factors with Eigenvalues greater than 1, which accounted for 63.43 % of the tool's variance (Fig. 1). It can be observed how the rotated component matrix located the items with a factorial weight of $> .40$ in Table 1.

We subsequently carried out a complementary parallel analysis (Ferrando & Anguiano-Carrasco, 2010; O'Connor, 2000). Table 2 compares the Eigenvalues of the first eight factors obtained via principal component analysis with the first eight values obtained via parallel analysis. A clearly differentiating point of inflexion appeared. It was located at factor number 4, and showed that it would not be coherent to maintain Factors 5, 6, 7, and 8 (from the principal component extraction) since their Eigenvalues – and therefore the variance explained by the latter – were lower in the empirical data than in the data randomly obtained for parallel analysis. Thus we only admitted the presence of four factors which had Eigenvalues and a true explanatory capacity surpassing those obtained in a random data matrix.

With the purpose of applying confirmatory factor analysis, we found it advisable at this point to postulate a tentative model that would allow us to select and group the items under their respective categories. This would help us refine the scale in order to achieve a valid, reliable tool in both qualitative and quantitative terms.

3.2. CFA

We chose to carry out an initial approximation of the model with the eight categories we had initially postulated. The factors grouped as follows: C1 (1, 2, 3, 4, 5); C2 (6, 7, 8, 9); C3 (10, 11, 12, 13, 14); C5 (19, 20, 21, 22); C6 (23, 27, 28, 29, 30); C7 (27, 28, 29, 30); C8 (31, 32, 33, 34, 35, 36, 37).

This first model presented certain adjustment data that might be considered acceptable, but they could be improved by taking into account the minimum acceptance thresholds recommended in studies such as Brown (2006). The *CMIN/df* index was equal to 1.885, the *CFI* was .850 and the *RMSEA* was .065. Certain regression weights were not significant, as in the case of Item 4 ($p = .092$), or very low ($< .50$), as in the case of Items 1, 10, 21, and 37. On the other hand, the elevated error variance of Item 24 led us to exclude it from the model. Items 23, 25, and 26. The indexes of fit for those other items were thereby improved.

We thus obtained the model displayed in Fig. 2, which had better global indexes of fit ($\chi^2 = 554.488$; *D.F.* = 322; *CMIN/df* = 1.722 < 2.0 ; *CFI* = .918 $> .900$; *RMSEA* = .059 $< .80$; *AIC* = 722.488), along with a significant presence of each and every item. The final 8-factor model displayed the configuration as illustrated in Fig. 2.

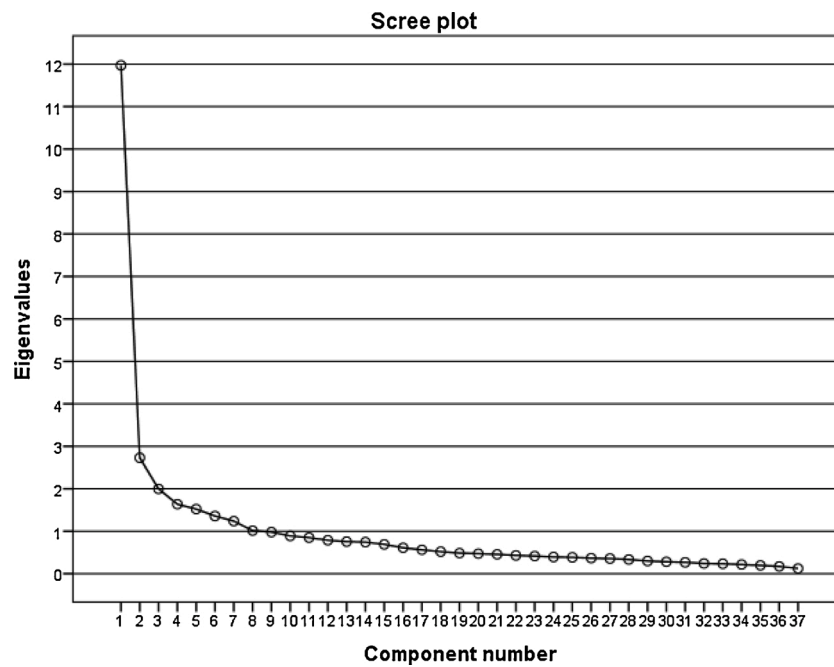


Fig. 1. Component analysis.

Table 1
Rotated component matrix.^a

	Component							
	1	2	3	4	5	6	7	8
P1								.817
P2	.757							
P3	.705							
P4							.709	
P5								
P6	.700							
P7	.578							
P8	.653							
P9							.415	
P10							.679	
P11				.417			.436	
P12				.612				
P13	.403			.466				
P14	.431			.416				
P15			.806					
P16			.826					
P17			.786					
P18			.736					
P19	.420		.410					
P20						.460		
P21						.839		
P22			.437			.440		
P23					.754			
P24					.814			
P25					.591			
P26		.462						
P27	.475			.424				
P28				.679				
P29				.756				
P30				.639				
P31		.568						
P32		.565		.465				
P33		.647						
P34		.703						
P35		.611						
P36		.722						
P37		.466				.622		

Extraction method: Principal component analysis.
 Rotation method: Varimax (with Kaiser normalization).
^a The rotation has converged in 8 iterations.

Table 2
Eigenvalues of 8 factors.

Root	Principal Component Factor Analysis	Parallel Analysis
1	11.970	1.90307582
2	2.730	1.79006168
3	1.996	1.70304916
4	1.638	1.62956922
5	1.522	1.56549702
6	1.358	1.50303450
7	1.238	1.44692800
8	1.016	1.39509090

Although this model already presented moderately acceptable indexes of fit, we found that it would be pertinent to try out a new approximation based on the number of factors suggested by the results of parallel analysis, the scales' theoretical content, and the item distribution in the EFA. We thus grouped the items under four categories, according to where they presented more weight in the rotation. C1 (10, 11, 12, 13, 14, 23, 24, 25, 26, 27, 28, 29, 30); C2 (1, 2, 3, 4, 5, 6, 7, 8, 9); C3 (19, 20, 21, 31, 32, 33, 34, 35, 36, 37); C4 (15, 16, 17, 18, 22).

This new model presented relatively good indexes of fit: they could nevertheless be improved, since the model's initial version had not yet been refined and still contained all the items of the questionnaire ($CMIN/df = 2.226$; $CFI = .784$; $RMSEA = .077$). If we focus on regression weights, Item 4 does not significantly support the model ($p = .074$). Further items had relatively low regression weights ($< .50$) in relation to the model (Items 1, 4, 5, 10, 21, 22, 35, and 37); we eliminated them to achieve better refinement and fit, with the purpose of exclusively maintaining those items that present powerful weights and associations with regard to the factorial distribution. We likewise eliminated items whose modification indexes featured very high covariance: several items of this sort were redundant and were explained by the significant presence of the other questions. Thus, we eliminated Items 19, 20, 14, and 29. In so doing, we had to control covariance between Items 2 and 3 to improve this model's fit.

The resulting model, depicted in Fig. 3, presented satisfactory indexes of fit ($\chi^2 = 508.254$; $D.F. = 268$; $CMIN/df = 1.896$; $CFI = .905$; $RMSEA = .066$; $AIC = 622.254$). All included items have significant standardized regression weights superior to .50 (Fig. 3).

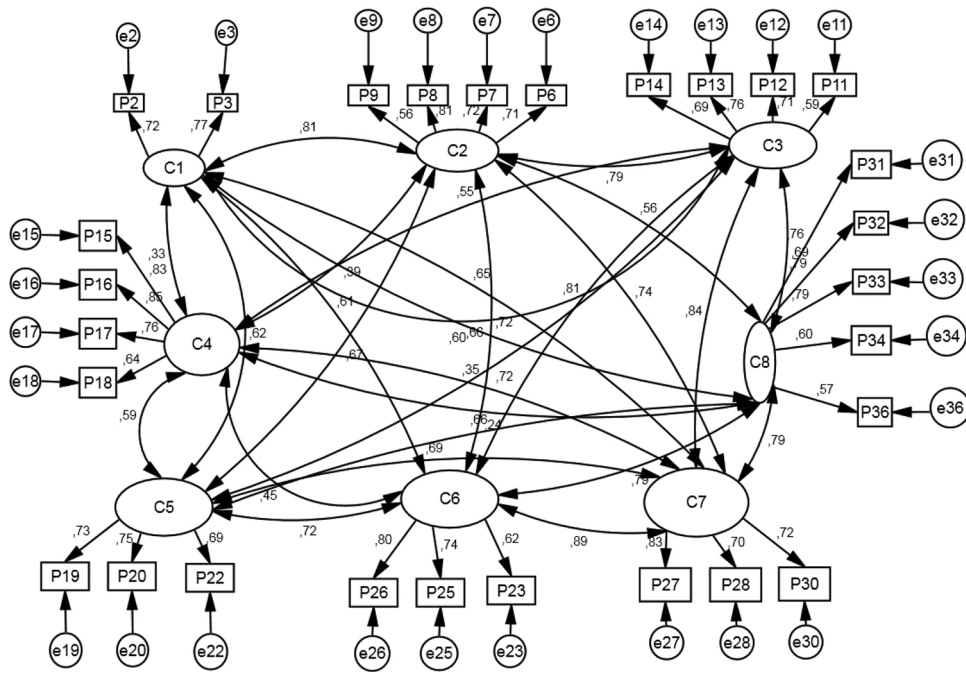


Fig. 2. Eight-factor model.

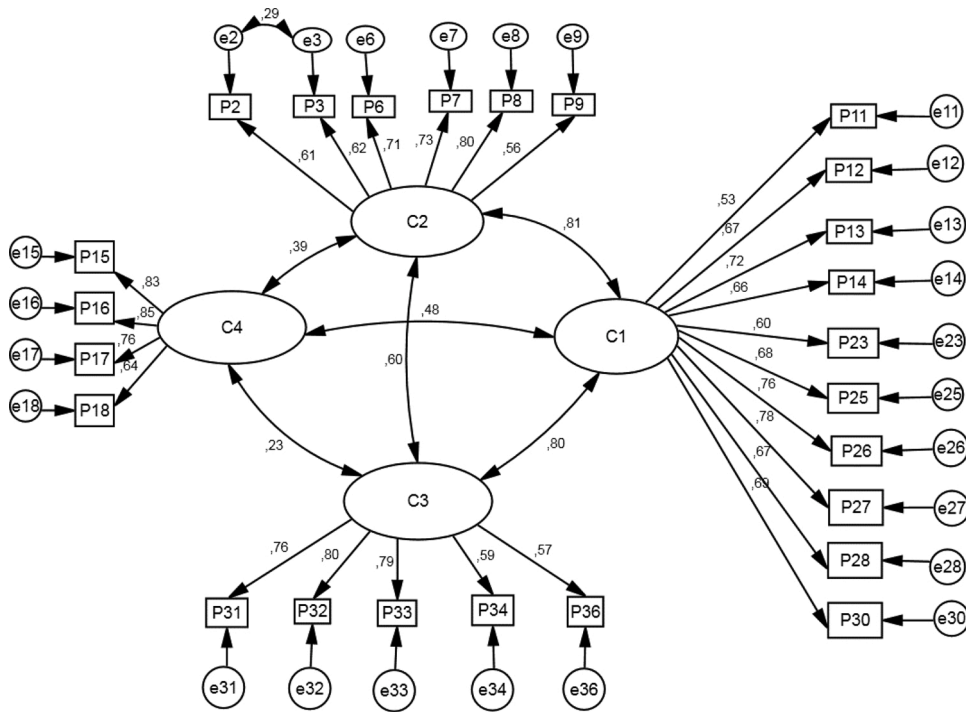


Fig. 3. Four-factor model.

At this point, if we compare the two refined confirmatory factor models, the eight-factor model, and the four-factor model, they both present good indexes of fit. The test of significant differences between the models revealed a difference between χ^2 that amounted to $\Delta\chi^2 = 46.234$, whereas the difference between degrees of freedom amounted to $\Delta df = 54$; the level of significance $p = .765$ would suggest that the models were not significantly different in terms of fit. The four-factor model was the obvious choice due to its greater parsimony.

It was thus logical to suppose that the four-factor model better fitted the data reported by the students, and that we should consider, in view

of future studies, that the items' categorical distribution responded to that shown in Fig. 3. Thus, C1 (Cronbach's $\alpha = .892$; $Rho = .460$; $AVE = .894$) was made up of Items 11, 12, 13, 14, 23, 25, 26, 27, 28, and 30; C2 (Cronbach's $\alpha = .829$; $Rho = .455$; $AVE = .832$) was composed of Items 2, 3, 6, 7, 8, and 9; C3 (Cronbach's $\alpha = .825$; $Rho = .499$; $AVE = .830$) comprised the items 31, 32, 33, 34, and 36; and C4 (Cronbach's $\alpha = .854$; $Rho = .599$; $AVE = .855$) englobed Items 15, 16, 17, and 18. The resulting questionnaire contained 25 items, all of which had a strong presence and a strong capacity to explain future ECE teachers' abilities associated with music education.

3.3. Definitive scale

As mentioned above, the definitive questionnaire statistically reflected a four-factor model comprising 25 items (Cronbach's $\alpha = .929$). The eight initially postulated emergent areas of inquiry derived from Spanish curricular legislation (*Real Decreto* 1630/2006) applicable to students in the second stage of ECE (ages 3–6), fit the resulting model well; the 25 definitive questionnaire items likewise covered those eight areas of inquiry.

Concretely, taking the Spanish educational context into account, and after having subjected the model to pertinent qualitative analysis, we ascertained that the resulting category C2 corresponded with the original questionnaire's first category: *knowledge related to psychological processes; methodologies and resources for ECE*. It comprised six items, made up of the new, re-numbered Items 1, 2, 3, 4, 5, and 6. Category C1 was equivalent to a second original category, which encompassed *didactical knowledge and didactical applications of the musical sound event to ECE*. In the final, definitive version, it comprised ten items: 7, 8, 9, 10, 15, 16, 17, 18, 19, and 20. The *use and/or design of concrete didactic text-music applications for ECE* corresponded with a third category, equivalent to C3 and composed of five items: 21, 22, 23, 24, and 25. Finally, C4 coincided with a fourth category, *knowledge related to different cultures and styles*, made up of four items 11, 12, 13, and 14.

In agreement with our hypotheses regarding criterion validity, apart from the four subscales, the students in their 2nd academic year achieved significantly lower scores than those in 3rd academic year on C1 ($\bar{X}_2 = 29.46$; $\bar{X}_3 = 34.11$; $F_{1-206} = 8.783$; $p = .003$) and C2 ($\bar{X}_2 = 14.23$; $\bar{X}_3 = 20.05$; $F_{1-206} = 37.891$; $p = .000$), whereby the differences in C3 and C4 were not significant. In other words, the scale detects accumulative increments in pedagogical training that the students receive as years go by, yet does not measure musical competencies that are not taught in university, but which stem from pre-university musical experience. This is confirmed through the analysis of the groups created through cluster analysis. It is revealing to note that students with less musical training experience achieve lower scores than those with a greater amount of musical training experience on C1 (30.58 vs. 34.28; $F_{1-207} = 8.175$, $p < .001$), on C2 (16.54 vs. 20.06; $F_{1-207} = 18.050$, $p < .001$), and on C3 (16.63 vs. 18.05; $F_{1-207} = 4.138$, $p < .001$), whereas the reverse occurs on C4 (12.96 vs. 11.76; $F_{1-207} = 4.334$, $p < .001$). In other words, students with musical training achieve higher scores on the pedagogical scales (C1 and C2), and they are capable of transferring their musical knowledge to training practice (C3). Curiously, however, they do not display a broader cultural musical knowledge than their counterparts.

We also see how the four categories are significantly ($p < .05$) interrelated. Thus, $r_{c1-c2} = 0.806$; $r_{c1-c3} = 0.803$; $r_{c1-c4} = 0.475$; $r_{c2-c3} = 0.596$; $r_{c2-c4} = 0.394$ and $r_{c3-c4} = 0.233$.

4. Discussion

As a result of this procedure, we were able to obtain a reliable, validated scale that can be used to evaluate the musical competencies of ECE teacher trainees. Four dimensions are brought to light: two are clearly associated with the pedagogical sphere, and the two others with the technical-musical sphere. The two pedagogical dimensions are more highly related to one another, and less with the musical ones. Moreover, we obtained evidence of scale validity by comparing score means between subjects enrolled in different academic years, and with different degrees of self-reported previous musical training. In other words, this is a reliable, validated scale designed to evaluate the musical skills of university students who are studying to become ECE teachers.

It is designed to be applied in any geographical context, since it is based on two related concepts. On the one hand, as we mentioned above, this scale is adjusted to the 3-to-6-year-old child's global development (in line with international authors, despite certain eventual geographical divergences – Llari, 2020 – which international users of this scale

will need to take into account and adjust accordingly, as occurs with all data gathering tools). On the other hand, it reflects a legislative curricular framework that stipulates which learning elements should be acquired in the second stage of ECE (Ministerio de Educación y Ciencia, 2007a), which, in turn, is based on psychopedagogical principles that reflect child development at those ages. All in all, a particular adaptation of this tool outside a Spanish context will need to take local geographic and cultural aspects into account that bear an influence on the child's development, and, therefore, on the curriculum (Leite et al., 2018; Stenhouse, 1981). It is well known that cultural and artistic aspects form an essential part of human development: artistic education, and music education in particular, is based on such universal constituent elements, which play a primordial role (UNESCO, 2006).

The validation process's key importance lies in the fact that no similar study attempting to establish parameters for the acquisition of musical skills on the part of university students studying to become teachers at this concrete educational level has hitherto been carried out in Spain or abroad.

In the refinement stage applied to this model, we opted to assume the validity of the four-factor model over that of the eight-factor model. The reasoning for this choice is as follows. In validation procedures via structural equation modelling (SEM) aiming to reduce factors and obtain high-order components, the explanatory capacity and fit displayed by the components is one of the prime criteria to be taken into account, as explained by Sarstedt et al. (2019). When no significant differences can be found between two models in terms of fit, one should prefer the most parsimonious one, as Xie and Yu (2019) likewise point out: "simpler models usually provide better forecasts than more complex ones".

As mentioned earlier, the acquisition and development of skills has revealed itself to be a top-priority educational necessity, since recent changes in the production and application of knowledge have led to unavoidable transformations in the way knowledge is imparted in the classroom (Fernández, 2008; Gargallo et al., 2011). According to Acuña et al. (2011), current educational requirements should not only ensure that students adapt to the specific requirements of the subject they are studying, but also to wider demands in society and on the labor market. Competency-based education (CBE) should take into account all agents implied in teaching and learning: both the individual who is learning (since education is geared and oriented toward the pupil) and also the professional, who is involved in ongoing training to learn to solve conceptual, procedural and attitudinal problems in real-life educational situations (Imbernón, 2017; Ruiz, 2009). Higher education is frequently criticized for not establishing sufficient concrete connections between instruction – usually imparted in a declarative manner – and the posterior situations faced by the trainee on the professional field (Zabala & Arnau, 2007). Our scale takes competency acquisition and its categories into account: not only for teacher trainees, but also the competencies specifically required to teach ECE pupils. Regarding the first, the tool we designed takes into account the key competencies stipulated by the EHEA (European Higher Education Area) and applies them, particularly in terms of their acquisition for academic and professional purposes (Rodríguez, 2007). Regarding the second, the tool includes the pedagogical competencies reflected in Spanish ECE curriculum (Ministerio de Educación y Ciencia, 2007b), and it features them within the category of "Didactical musical applications for ECE pupils", evaluating whether the teacher trainees have acquired them.

Thus, even the EHEA is promoting competency-based teaching in universities, as manifest in partial efforts carried out in several Spanish institutions (Ion & Cano, 2012; López, 2011; Tejada, 2012). Studies in this domain point out that "regulatory pressure and increasing competition [...] have acted as a driving force in major changes in teaching methodology", in such a way that "a more exact specification of teaching objectives, assignment of resources, media support, and external inspection and evaluation have all facilitated the process", while, on the other hand, "the ambiguity perceived by the teaching body, their lack of training, and the lack of internal coordination [among others] have

made this process more difficult” (González et al., 2014, p. 161). Thus, it would be crucial to offer concrete initial training programs. The ongoing training of schoolteachers is a cornerstone of this transformation, working in harmony with European projects including the Lifelong Learning Program or the “European Universities’ Charter on Lifelong Learning” drafted in 2007 at the Ministers of Education summit in London (Navas, 2010). Apart from being able to follow a concrete initial training program, trainees will need to observe the context and culture within which they carry out their educational activity and, therefore, observe the reality within which the activity takes place, and in function of which the purpose it is carried out (Mas & Olmos, 2016). This will give rise to more reflective practices that qualify teachers to implement transversal teaching of other academic subjects, to have better knowledge of the current social and professional world, and to be familiarized with teamwork practices (Morales & Chacón, 2018). This aspect can also be viewed as one of the limitations of the scale presented herein, since it is based on general aspects of child development, thereby leaving it up to future tools to incorporate more restrictive socio-cultural aspects of each region where they are applied (Paliwal & Subramanian, 2006). Among the skills which the EHEA deems of the greatest value and worthy of reinforcement, one can count “the act of planning the teaching activity, as well as further developing teaching and evaluation” along with “the importance of fomenting academic-professional skills in the student body, connecting theory with practice, orienting trainees, providing follow-up for their work, and encouraging their autonomous learning capacity” (Álvarez et al., 2009, p. 274).

Competency research is a frequently recurring theme (cf. Gargallo, 2016). Regarding which skills are required from ECE educators, the Spanish White Book of the *Grado en Magisterio* Degree mentions at least thirty teacher competences, including communicative, emotional, intercultural competences – certain studies point out that the latter are not sufficiently present in university training (Carrasco et al., 2009; Gil et al., 2016; Latorre & Blanco, 2010) – as well as psycholinguistic and digital competences (some of these aspects have been addressed in partial studies such as those by Gabarda et al. (2017), and Gómez et al. (2017). Furthermore, the above-mentioned Spanish regulation “highlights the importance of language, the development of skills, techniques, and procedures to learn how to do things, as well as the globalization of elements, along with observation and communication from a psychological perspective” (Andújar, 2016, p. 115). All these general competencies should be the object of in-depth study. Although they affect all students, in our study we only included some of them, since we were specifically focusing on musical abilities.

Regarding the musical skills required from ECE teachers, the importance thereof derives from the subject’s transversality in all curriculum years, as well as its close relation with the child’s environment. Despite this, university curricular study plans tend to compartmentalize subjects, thereby precluding a global approach in the first years of teacher training (Díaz & Giráldez, 2015; Juárez y López, 2021). Although we are well aware of this transversality, we opted to focus our attention in this study on the portion of curriculum devoted to specifically musical education, even though its field of application can be extended to many other areas. Cózar et al. (2015) point out that ECE teachers are more aware of their students’ musical needs than is the case of primary school teachers; thus, they possess somewhat greater musical skills, since they also use them as an interpersonal, affective means of relating with the children. The studies we have reviewed point out the need to use music to explore competences that take “holistic abilities, habits, attitudes, and knowledge” into account, along with professional skills (Matos, 2013, p. 224). That is why the questionnaire designed in this study emerged from a revision of the curriculum set out for generalist teachers.

Recent studies point out that ECE teachers state that they feel more comfortable when working with vocal or rhythmic exercises, as well as presenting song or dance repertoire: these are all aspects they regard as essential in helping schoolchildren develop the skills required by

legislation (García & Bernabé, 2019). Further studies suggest that musical skills are an ideal means of addressing and developing emotional competences (Campayo & Cabedo, 2016), emphasizing the relation between musical art and emotional self-regulation (Skanland, 2013) and even between musical performance and the acquisition of emotions (Schellenberg and Mankarious, 2012). Such a transversal type of formation requires that the established curriculum be subjected to a fundamental reconsideration in order to ensure that trainees can carry out daily musical activities with their pupils (Bisquerra & Pérez, 2007).

5. Conclusions

The present study responds to the need to learn more about the development of skills in teacher training (Acuña et al., 2011; García & Bernabé, 2019): concretely, in this case, skills associated with musical expression.

We obtained a final 4-factor model capable of explaining the students’ self-perceived competencies. It can be of use for researchers and for teachers to help them more reliably evaluate the capacities of ECE trainees. Thus, in this first approximation of the scale, we obtained four major areas of content and knowledge in terms of competency (C1: *didactical knowledge and didactical applications of the musical sound event to ECE*; C2: *knowledge related to psychological processes; methodologies and resources for ECE*; C3: *use and/or design of concrete didactic text-music applications for ECE*; C4: *knowledge related to different cultures and styles*).

The four areas defined in the scale encompass the entire range of requisites required by the Spanish national legal framework, but we are also aware, as mentioned above, that our tool could be extrapolated to other contexts with the purpose of enhancing and enriching academic production in this area and of inspiring further transcultural studies. Transcultural studies in general, and those related with music, in particular, have the purpose of analyzing the potential points of encounter among different contexts, encouraging internationalization as well as pedagogical synergies. Studies such as the one by Lasauskiene and Sun (2019) managed to span thoroughly distant contexts: in their specific case, contrasting school music concepts in Lithuania and in China: they concluded that the differences between the school music education concepts in the two countries are practically insignificant. At the end of the 20th century, certain transcultural studies used scales, such as the one carried out by Chen et al. (1995), comparing students in East Asia and North America. More recent transcultural research featuring specifically music-oriented scales includes studies by Randles (Randles & Ballantyne, 2018; Randles & Muhonen, 2015; Randles & Smith, 2012; Randles & Tan, 2019). We thus find that our validated scale could likewise contribute to further add to the body of knowledge on this subject.

Our study has certain limitations. 1) it is a self-report questionnaire, thus implying the eventual possibility that the subject’s response might reflect his/her desires more than reality, or that the response might not be sufficiently sincere; 2) the measure is carried out in retrospective, retrieving information from the student’s memory. It is not a direct measure that applies in the moment a task is being carried out. 3) our study does not compare its information with the students’ results/grades in music assignments; 4) the scale would need to be appropriately modified in each national context in order to take specific cultural and social aspects into account; 5) although the scale is devised for generalist teachers, it does not transversally encompass other curriculum areas, limiting itself instead to examine music in an isolated way.

The study nevertheless also presents advantages: the questionnaire is relatively short and can be applied with ease. It is built from solid construct data with good internal reliability/consistency. Teacher trainees can even use it as a tool to monitor their self-perceived learning progress (Moyles, 2001).

Future prospects suggest that the results from this questionnaire should be combined with data from other tools such as the grade obtained by students in their college music assignment, or associated with

the permeability of music as an assignment with other subjects of university learning, as pointed out by several specialists in their studies (Fuentes et al., 2020; González-Montesinos & Backhoff, 2010; Hortigüela-Alcalá et al., 2015; Meroño et al., 2018; Núñez & Reyes, 2014; Timarán, Moreno, & Luna, 2011); likewise approaching evaluation as a means of acquiring knowledge, and evaluation as an opportunity to critically reflect on everything one has learned, of potentializing one's learning (Álvarez-Valdivia, 2008), and of making a contribution to pedagogical change while helping improve educational quality (McDowell et al., 2011).

Future efforts should be devoted to applying this questionnaire in several different national and international contexts. Before it is applied on an international scale, it should be tried out in several Spanish universities to gain further in-depth knowledge of the students' perceptions. Our validated scale intends to contribute to a culture of critical reflection and to call current educational practice into question, both within Spain and beyond its borders (Fullan, 2016). In our sample, students with previous musical training obtained higher scores on the pedagogical scales (C1 y C2), and were capable of transforming their musical knowledge into practical education (C3), despite the fact that they did not have broader knowledge of musical culture than their colleagues. These results point toward a potential lack of educational equity in the Spanish system, thereby showing the necessity of doing further research on this subject.

When the data will have been generalized on a national level, the questionnaire can then be applied internationally with the purpose of achieving greater progress in terms of study objects, and to confirm if the resulting data is similar in other countries, thereby enabling comparisons between educational programs or revisions of official curricular guidelines.

Musical knowledge can be separated, on occasion, from its didactics; however, in subjects such as music, teacher trainees should attempt to unify them and try to ascertain which elements of musical knowledge we should be introducing in the classroom. This would finally lead to efficient, fundamental changes in the concepts and systematization of music as taught in university education faculties (cf. Young, 2013), and those changes that would ideally be maintained over time. Achieving comparisons among national and international education programs would represent an important advance in musical education research regarding the ECE level. Certain difficulties associated with disparate elements stemming from different countries and cultural contexts can certainly arise, but would likewise help to fully prove this scale's usefulness. Priority should be given to the international aspect as opposed to specificity.

Although much research remains to be carried out and much work still needs to be done, the validation of this tool represents the attempt to make a contribution to music educational improvement.

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