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Piano students' conceptions of learning, teaching, assessment and evaluation

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Abstract

Artistic domains of knowledge, such as music performance, have not raised the interest of researchers focused on intuitive conceptions and conceptual change. By adopting the frame of *implicit theories*, this article addresses the conceptions of learning and instruction held by students at professional music conservatories. More specifically, our aims were to study the conceptions of learning, teaching, and assessment/evaluation held by piano students at three developmental/instructional levels, and analyze whether their conceptions constituted theoretically consistent profiles. The participants, 215 students of Intermediate and Tertiary levels, were selected according to three levels of the combined variable "Age / Level of Instruction." Data was collected through a multiple-choice questionnaire, and analyzed with descriptive and non-parametric methods. The findings suggested that: a) students' conceptions tend to be more sophisticated as their age and education level increase; b) each developmental/instructional group is typically associated to different conceptions; c) three increasingly sophisticated profiles of conceptions can be identified among these students. Implications for conceptual change research and limitations of the study are discussed, and further lines of research are suggested.

Keywords: Conceptual change; Implicit Theories; Conceptions; Music students

Concepciones de estudiantes de piano sobre el aprendizaje, la enseñanza y la evaluación

Resumen

Los dominios de conocimiento artístico, como la interpretación musical, no han despertado el interés de los investigadores en concepciones intuitivas y cambio conceptual. Adoptando el marco de *teorías implícitas*, este estudio aborda las concepciones sobre el aprendizaje y la instrucción mantenidas por estudiantes de conservatorios profesionales de música. Específicamente, nuestros objetivos fueron estudiar las concepciones sobre aprendizaje, enseñanza, evaluación/acreditación

mantenidas por estudiantes de piano de tres niveles evolutivo/educativos, y analizar si dichas concepciones constituían perfiles teóricamente consistentes. Los participantes, 215 estudiantes de Grado Medio y Superior, fueron seleccionados de acuerdo a tres niveles de la variable combinada "Edad / Nivel de Instrucción". Los datos fueron recogidos mediante un cuestionario de opción múltiple, y analizados mediante métodos descriptivos y no-paramétricos. Los resultados sugieren que: a) las concepciones de estos estudiantes tienden a ser más sofisticadas a medida que avanza su edad y nivel educativo; b) cada grupo evolutivo/educativo está típicamente asociado a diferentes concepciones; c) entre los estudiantes pueden identificarse tres perfiles de concepciones de sofisticación creciente. Se discuten las implicaciones para la investigación sobre cambio conceptual, las limitaciones del estudio, y se sugieren futuras líneas de investigación.

Palabras clave: Cambio conceptual; Teorías implícitas; Concepciones; Estudiantes de música

TITULILLO: Piano students' conceptions of learning and instruction

1.- INTRODUCTION

As a result of our biological and cultural heritage, human beings spontaneously develop sets of mental representations about mind, knowledge, and the processes of acquisition and transmission of knowledge. Research on these intuitive conceptions and their process of conceptual change has almost four decades of history, having been addressed with very different samples (preschoolers, students, teachers), from many theoretical perspectives (epistemological beliefs, theory of mind, phenomenography), and therefore by means of different methodologies (interviews, problem-solving tasks, questionnaires). Regardless of the divergences among these approaches, they all seem to point out that these beliefs about the mind and about knowledge influence the ways in which people learn, teach, and interpret their own ways of knowing and others' (e.g., Hofer & Pintrich, 2002).

By adopting the framework of *implicit theories* (Pozo et al., 2006), the present article addresses the conceptions of learning and instruction held by students at professional music conservatories. To date, this population has not raised much interest among educational researchers. In Spain, the country where the present study was undertaken, some research has been conducted with music teachers (e.g., Authors, 2010; Torrado, Casas, & Pozo, 2005), but not with music students yet. In their meta-analysis of the most recent literature on intuitive conceptions and conceptual change, Murphy and Alexander (2008) point out that this strand of research "would be enriched by stepping outside of the scientific 'comfort zone' to investigate the change process in a range of academic domains" (p. 597). This was one of the motivations for us to choose the field of music performance, an academic domain in which ―to the best of our knowledge― no similar research with students has been yet published in the English language. Investigating music students' conceptions is theoretically relevant due to numerous reasons. Unlike the most investigated domains (e.g., sciences, maths), music is an *artistic* domain. Musical knowledge, in particular instrumental knowledge, is tremendously distinctive and specific because it cannot be (only) verbally or symbolically expressed. It needs to be performed, enacted. Thus, instrumental performance involves much more procedural abilities than other subject-matters. Moreover, music instruction is particularly distinctive because tuition is generally developed in one-to-one settings, which enables the study of teacher-student

relationships (Torrado et al., 2005). Finally, the second motivation for this study was applied in nature. According to current conceptual change models (e.g., Pozo, 2003; Vosniadou, 2007), if we want to foster changes in the way that music students approach their learning —as recent curricular reforms claim (LOE, 2006)—, their conceptions need to be investigated, described, and taken into account to design the most effective interventions.

1.1.- Implicit theories as a framework to investigate learning and instruction conceptions

In a recent book, Pozo and his colleagues (2006) have developed a theoretical and empirical framework for the study of learning and instruction conceptions. This framework was called *implicit theories* approach (for some publications in English, see Authors, 2010; Scheuer, Pozo, de la Cruz, & Baccalá, 2001; Scheuer, de la Cruz, Pozo, Huarte, & Sola, 2006). The influences of several well-established research lines can be easily identified in this approach, with postulates coming from theory of mind (e.g., Wellman, 1990), personal epistemologies (e.g., Hofer & Pintrich, 2002), conceptual change in specific domains (e.g., Vosniadou, 1994), and models about knowledge acquisition grounded in the implicit/explicit cognitive perspective (e.g., Karmiloff-Smith, 1992; Pozo, 2003; Rodrigo, Rodríguez, & Marrero, 1993; Strauss, 2005).

One of the most important postulates of our framework is that conceptions of learning and instruction —regardless of their degree of sophistication— constitute consistent personal theories (Claxton, 1990). Our conceptions are understood to be articulated according to the four features required for a set of mental representations to constitute actual theories: *abstraction*, *coherence*, *causality*, and *ontological commitment* (Gopnik & Meltzoff, 1997). The importance of constituting "theory-like structures of knowledge," in Vosniadou's (2007) terms, lies in the fact that these structures make it possible for subjects to formulate relatively consistent predictions and explanations about educational issues, as well as infer —more or less explicitly— different sorts of generalizations, categories, and rules from learning and teaching settings (Rodrigo et al., 1993).

From this starting point, and grounding on research about intuitive knowledge in scientific domains, Pozo and collaborators (2006) have conducted a considerable number of

studies with very different samples such as preschoolers, students and teachers in several domains of knowledge and educational levels, as well as adults (parents). The findings of these studies have pointed out the existence of three increasingly sophisticated theories: *direct, interpretative,* and *constructive.* Their epistemological, ontological, and causal assumptions are presented in Table 1.

INSERT TABLE 1

In the following sub-sections, we describe these three learning and instruction theories in-depth. Because there is no previous research in which music students' theories have been investigated, our literature review is focused on studies conducted in domains other than music. For didactical purposes, the three theories are presented according to a developmental/educational criterion, that is, following the way in which these learning and instruction theories tend to emerge and evolve from very early ages and educational levels (in particular, 3- to 4-year-old children attending pre-school). Yet readers need to take into account that all three theories can be identified at all developmental/educational levels, as clearly shown in the present study conducted with adolescent and adult music students (this idea will be stressed again below given its importance). In order to illustrate the content of the three theories within the field of music performance, some typical examples will be provided in *italics.* The examples have been taken from one of our previous projects conducted with piano teachers (Authors, 2010).

1.1.1.- Direct theory

The interview-studies conducted by Scheuer et al. (2001, 2006) have consistently showed that 3- to 4-year-old children hold the *direct* theory of learning and instruction, which is understood as the most naïve and intuitive. This theory is thought to be implicitly developed as a result of preschoolers' everyday experiences in cultural settings, and more specifically because of their engagement in formal and informal educational settings. In this early theory, very similar to Wellman's (1990) copy theory, knowledge is conceived from a radically realist epistemological perspective (Pecharromán & Pozo, 2008). According to *naïve* realism, knowledge can be objectively described as right *vs.* wrong, true *vs.* false, correct *vs.* incorrect (e.g., *"There is only one way to perform musical pieces correctly:*

Interpreters need to reproduce the exact notations written by music composers"). The psychological processes whereby knowledge is acquired are completely ignored in this theory. Thus, a simple causal relationship is established between learning conditions and final learning outcomes (e.g., *"The amount of time spent in instrumental practising is the most important and determining factor for the learning of musical pieces"*). The human mind is understood as a black —and empty— box. Ontologically, learning is conceived of in terms of states, products, or final outcomes of knowledge (e.g., *"If the student plays the musical pieces correctly in the exam, with no interruptions, no mistakes, etc. it means that she knows these pieces well and consequently she deserves a good grade"*). In the *direct* theory, in sum, the learner's role is conceived as *reproductive* and *passive* (Pérez Echeverría, Mateos, Pozo, & Scheuer, 2001).

After the age of four, children tend to develop slightly more sophisticated versions of this copy-knowledge theory (Scheuer et al., 2001, 2006). Their discourse progressively acknowledges more amount of learning/teaching conditions (e.g., quality of practice conditions, need for good models to be imitated), and the importance of certain physical, developmental, and psychological variables of the learner begin to be considered. These "advanced versions" of the *direct* theory have been also frequently identified among much older students, and more surprisingly among highly experienced teachers (see Authors, 2010; Martín et al., 2009). According to Strauss (2005), many teachers hold a direct transmission model despite having received instruction designed for them to implement the "constructivist models" currently suggested by educational researchers. This fact shows how resistant to change this early *direct* theory is.

1.1.2.- Interpretative theory

The emergence of a slightly more sophisticated implicit theory has been identified among 5- to 6-year-old (pre)school children. Researchers have referred to it as *interpretative* theory (Schwanenflugel, Fabricius, & Noyes, 1996). This theory is based on interpretative realism, an epistemological assumption slightly more sophisticated than in *direct* theory because it acknowledges the subject's active role in the knowing process (Pecharromán & Pozo, 2008). The explanations and predictions articulated from *interpretative* theory generally recognize the importance of behavioural and cognitive

factors for learning and instruction. In other words, learning and instruction are ontologically conceived of in terms of actions and processes (e.g., *"Practicing a lot is not enough to learn a piece of music correctly. To do so, practice needs to be intelligent, strategic..."*). Given the acknowledgment of both action and cognition as the "mediators" of learning, the exact and correct reproduction of knowledge is seen as an impossible enterprise. Little changes, distortions, and/or personal transformations are hence considered unavoidable (Scheuer et al., 2001, 2006). Only from this epistemological frame it is possible to understand that different people can legitimately represent the same object of knowledge in slightly different ways (e.g., *"If the student is not able to play the piece in its original tempo because of his/her technical limitations, at least s/he should try to approach the tempo to the composers' idea as much as possible"*). However, in order to avoid important distortions of reality in the final learning outcomes, an external control and management over the learner's conditions, actions, and processes is considered to be essential (e.g., *"Apart from giving grades to students, the main function of exams and auditions is finding out students' mistakes so that the teacher can correct them"*). In short, the learner in this theory is seen as an *active* and *reproductive* agent (Pérez Echeverría et al., 2001). Similar to the former theory, the *interpretative* theory has been identified among people at all developmental/educational levels (primary, secondary, and university students, as well as teachers).

1.1.3.- Constructive theory

According to the *constructive* theory, learning involves a set of sophisticated constructive processes that necessarily transform "external world" (Pecharromán & Pozo, 2008). Thus, knowledge is epistemologically understood as idiosyncratic interpretations of reality (e.g., *"Music performers need to find their personal «identity» as interpreters…"*). This theory emphasizes the importance of internal agency, self-regulation, and metacognition (Schwanenflugel et al., 1996). For learners to acquire knowledge in a constructive way, they need to be able to develop their own interpretations and/or models, which need to be socially-acceptable (continuation: *"… but, at the same time, performers need to be aware of the stylistic features of each historical epoch to make their interpretative choices in a justified way"*). Learning and instruction are ontologically

conceived from a systemic perspective, and their outcomes are causally explained in terms of interactions between both learning conditions and processes (e.g., *"Learning a music piece is much more than reproducing its notes. It requires learning how to practice that piece, how to communicate emotions with it, how to motivate oneself to practice that piece, etc."*). In a nutshell, the learner is understood as an *active* and *constructive* agent (Pérez Echeverría et al., 2001). The presence of an authentic *constructive* theory has been rarely reported among children (among the exceptions, Schwanenflugel et al., 1996), and to a small extent among older students, adults, and teachers (see Authors, 2010; Martín et al., 2009).

1.2.- Conceptual change as a process of hierarchical integration

The implicit theories approach owes its name to the first two theories (*direct* and *interpretative*), given that it is postulated that both have *implicit* cognitive nature, i.e., they are tacit and unconscious (Karmiloff-Smith, 1992). The assumptions on which these two theories are based are naïve and intuitive, being developed with no deliberate instruction. In addition, the shift from *direct* to *interpretative* theory does not require a theoretical "rupture" (i.e., a radical conceptual change), but rather the inclusion of more elements and relationships. Certainly, the "essence" of their assumptions is so similar that the change towards the *interpretative* theory is normally the product of cognitive development itself. Even though these two implicit theories have great "pragmatic potential" (Rodrigo et al., 1993), their degree of sophistication, complexity, and explanatory power cannot be compared with those of the *constructive* theory. *Constructive* theory is postulated to be explicit, conscious, and based on scientific knowledge (e.g., educational, psychological, epistemological). Its acquisition does involve a strong "rupture" with the two previous implicit theories —which are very resistant to change (Strauss, 2005)— and consequently requires a long and deliberate process of education, that is, an "instruction-induced conceptual change" (Vosniadou, 2007).

In our framework, conceptual change is understood as a process of hierarchical integration between implicit and explicit knowledge (Pozo, 2003). We consider that the development of the most sophisticated theory (*constructive*) does not require the replacement —or substitution— of the intuitive ones (*direct* and *interpretative*), but rather

the capacity to integrate multiple perspectives. More specifically, conceptual change towards constructivism requires the capacity to re-describe our implicit assumptions into more complex networks of explicit knowledge. It is precisely for this reason that different representations of the same *reality* can co-exist within the same person. Thus, these representations can be elicited differently depending on the particular constraints of the *scenarios* that we approach (Entwistle, 2007). This idea is known as "representational multiplicity." The consequence of this idea is that people's theories of learning and instruction can be composed of sets of situated/contextual conceptions based on different assumptions, constituting *profiles* theoretically "hybrid" to a certain extent. In this regard, several studies have pointed out that *interpretative* assumptions generally co-exist with both *direct* and *constructive* assumptions (Martín et al., 2009). *Interpretative* theory, therefore, needs to be conceptualized not only as a theory-of-transition towards constructivism, but also as a "hinge-theory."

Some studies have investigated the consistency levels of theories across different educational scenarios. One of these studies was conducted by Klatter, Lodewijks, and Aarnoutse (2001) with 27 sixth-grade primary students. Different dimensions were evaluated such as the purpose of school, self-regulation, and learning strategies. Three consistent clusters of interrelated beliefs were found, based on which the authors inferred three different learning theories: 1) restricted, 2) functional, and 3) developmental. In the study conducted by Peterson and Irving (2008), consistent relationships between conceptions of assessment and feedback were found in 41 secondary students. Additionally, Kember (2001) have supported the contention that university students' conceptions of teaching, learning, and knowledge (epistemological beliefs) should be viewed as interrelated sets of theoretically logical relationships. Finally, Martín et al. (2009) have studied the conceptions held by 1,716 primary and secondary teachers about five educational scenarios: teaching of concepts, procedural skills, attitudes, motivational strategies, evaluation. Cluster analysis revealed the existence of three theoretical profiles: *direct-interpretative*, *interpretative-constructive*, and *constructive.* This finding was interpreted as empirical support for the postulates of the implicit theories approach, because of three reasons: 1) because a *direct-constructive* profile was not identified, which would have showed the highest degree of theoretical inconsistency; 2) because the *interpretative*

theory was found to act like both "theory-of-transition" and "hinge-theory;" and 3) because a "pure" *constructive* profile was identified, which demonstrated the consistency of explicit knowledge.

1.3.- Context for the research

This study was carried out in Spain with students at official music conservatories. In Spain, conservatories are the only educational institutions where students can obtain officially valid music qualifications (i.e., recognized diplomas). The national curriculum for music education establishes that instrumental instruction (including its lowest levels) has specialized and professional nature (see Ley Orgánica de Educación [LOE], 2006 – which stands for General Law of Education). Thus, we might define Spanish music conservatories as specialized and professional music schools. They do not form part of the compulsory education system. For this reason, conservatory students in Spain are required to pursue their compulsory education (i.e., attend primary and high school) in parallel, at the same time they receive their music training. In other words, conservatory students are required to complete the National Curriculum for General Education (LOE, 2006), as any other student in the country.

The Spanish curriculum for instrumental education is divided into three levels: Elementary (four years), Intermediate (six years), and Tertiary (four/five years, depending on the programme chosen). Students usually begin their instrumental training when they are 8 or 9 years old. A very small proportion of them (about 5%) finish the Tertiary level. Students usually graduate (i.e., obtain their Undergraduate Degree) when they are about 22 or 23 years old. Elementary and Intermediate levels are generally taught by the same staff of instrumental teachers (with certified teacher status), whereas Tertiary level is taught by teachers with higher professional status (professors). Instrumental teachers across the whole country are required to implement similar contents and pedagogies at all educational levels. The curriculum suggests that both contents and pedagogies need to draw on constructivist learning and instruction theories.

Instrumental education is developed both individually (one-to-one private lessons) and collectively (classes of about 4 or 5 students) throughout all three levels. Besides of studying their main instrument, students are required to attend a considerable number of

theoretical and practical courses (e.g., Musical Language, Choir, Harmony, History of Music, etc.). These courses are established by the national curriculum for music education (LOE, 2006). Tertiary level students are required to choose between two majors: "Music Performance" or "Music Pedagogy." In spite of differences between these programmes, all the students must attend least a one-year-course called "Music didactics," which covers issues such as psychological learning processes, constructivist teaching models, and curricular design. Elementary and Intermediate levels do not include any similar course.

1.4.- Aims

We decided to investigate music students' conceptions about three specific scenarios: learning, teaching, and assessment/evaluation. Our target students were Spanish piano students at three developmental-instructional levels, ranging from the early courses of the Intermediate level (12-13 years old, approx.) to the last courses of the Tertiary level (23-24 years old, approx.). We chose to limit the research to students from one instrumental speciality (piano) for two major reasons: a) because we wanted to prevent the possible variation in students' conceptions due to the specific instrument played; b) because the first author of this piece is a trained pianist, and therefore a good knower of the jargon and the most common problems, difficulties, etc. that piano students generally approach. Based on the taxonomy of learning and instruction theories previously described (*direct*, *interpretative*, and *constructive*), our hypothesis was that piano students' conceptions would be progressively more sophisticated as both their age and level of education increased. The highest level of sophistication was expected to be found among Tertiary students, not only because they are older and have a higher degree of expertise, but also because of the courses they have taken in didactics and pedagogy as part of their formal education. We also aimed at analyzing whether piano students' conceptions of learning, teaching, and assessment/evaluation constituted theoretically consistent profiles, similar to those profiles identified in Martín et al.'s (2009) project. If so, our purpose was to analyze the distribution of the participants depending on their developmental-instructional group, in order to infer their conceptual change processes.

2.- METHOD

2.1.- Participants

The participants were 215 piano students at 22 music conservatories (12 Intermediate and 10 Tertiary conservatories) from 10 autonomous regions in Spain. Students were selected according to three pre-determined levels of the combined variable "Age / Level of Instruction," which was our independent variable:

- Group I: between 12 and 14 years old / 1st or 2nd course of Intermediate level.
- Group II: between 17 and 20 years old / 5th or 6th course of Intermediate level.
- Group III: more than 22 years old / 3rd or 4th course of Tertiary level.

The features of these groups of students regarding their gender and age are shown in Table 2. Focusing on Group III, 44 students (92.66%) were enrolled in the "Music performance" programme, whereas four students (8.33%) were enrolled in "Music Pedagogy."

INSERT TABLE 2

A total of 25 conservatories were invited to participate in the project (percentage of participation was 88%). Four of these conservatories were chosen due to a criterion of easy accessibility (the first author had been a former student and maintained personal relations with some members of their boards of directors). The rest (21 conservatories) were randomly selected from the entire pool of conservatories in Spain.

2.2.- Materials

A multiple-choice questionnaire composed of 16 items was designed and implemented (see Appendix). The items posed problematic situations related to music learning (4 items), music teaching (7 items), and assessment/evaluation of musical knowledge (5 items) (the difference in the number of items was a matter of content validity; as explained below, only those items in which 100% of agreement among judges was achieved were included in the final version of the questionnaire). Students were asked to suggest a solution for these problematic situations and/or give their opinion about them by choosing between three response-choices, which were based on the epistemological, ontological, and/or causal assumptions of the three above-described theories (*direct*,

interpretative, and *constructive*). Social desirability bias was avoided in all response-choices by means of two different strategies: a) either by making explicit the strengths and weaknesses that might be derived from each theory, i.e. using both positive and negative arguments in all cases; or b) by exclusively mentioning the most prototypical argument of each theory and hiding/avoiding other aspects, so that all possible solutions seemed somehow "incomplete." We made sure that the length of the three response-choices was similar in each item (note that this feature might not be present in the English translation presented in Appendix 1). Students were asked to select the response-choice with which they agreed the most, as well as the response-choice with which they least agreed. They received the instruction of answering all the items even though they did not completely agree or disagree with the three response-choices provided. Besides the random ordering of the response-choices within each item, the distribution of the 16 items was counterbalanced in three different versions in order to control for order effects.

The questionnaire was designed in three phases:

I. Drawing on an in-depth review of educational literature and many years of experience within musical learning contexts, the first author produced a broad bank of possible items to be used. These items were assessed in a focus group formed by specialists in the *implicit theories* framework, who discussed aspects such as the relevance, pertinence, and content of the items, as well as about the way in which they were formulated. This focus group had three meetings. In between these meetings, the provisional items were pilot-tested with music students specialized in instruments other than the piano, with the aim of checking correct understanding and discriminative validity of these items. The final result of this first phase (Version I) was a questionnaire composed of 18 items.

II. Content validity of Version I was assessed by eight independent judges. They all were experts in the *implicit theories* framework, and four of them were trained musicians as well. Their task was to identify which theory (*direct, interpretative,* or *constructive*) matched each of the three response-choices. Two items for which 100% of agreement was not achieved were eliminated. Some interesting suggestions made by two judges regarding subtle details of expression were taken into account

in the production of the final version (Version II). These changes did not entail any variations in the content of these items.

III. Finally, content validity of Version II was evaluated. Judges were 33 university psychology students enrolled in a specialized seminar on music learning and instruction. First, they were provided with operational definitions of the three theories (*direct, interpretative,* and *constructive*). After reading and analyzing these definitions (first individually and then jointly), the psychology students were given the questionnaire. Their task was to assess the correspondence between each response-choice and each conception, by answering YES (*Match*), NO (*Don't match*), or DOUBT (*Not sure whether they match or not*). On the basis of their answers, Hambleton-Rovinelli's index of item-objective congruence was calculated for every response-choice. All the scores were higher than .81, which indicated that our final questionnaire had a very high degree of content validity.

Considering that the questionnaire we designed may be useful for other researchers in the field of music psychology, as well as for music educators and teachers, in Appendix 1 we provide a translated version into the English language. The original version in Spanish can be found in Author (2009).

2.3.- Procedure

Once the permissions of the conservatories' boards of directors were granted, all the piano teachers were informed about the project and the procedure to administer and collect the following documents:

1) *Parental Consent*, which had to be signed in advance either by the father or mother of all minor students (< 18 years old);
2) *Personal Background Form (Anonymous)*, in which the students were asked about issues such as gender, age, and major (only applicable to Tertiary level students);
3) *Questionnaire:* Students solved it individually in their classrooms under the supervision of their piano teachers. All necessary instructions were explained in writing so that teachers did not interfere with students' answers. Both teachers' and students' participation was voluntary. No material reward was given.

2.4.- Design and methods of analysis

The design used was «Ex post facto» simple, prospective, and cross-sectional. The independent combined variable was "Age / Level of Instruction," with three levels described above. The dependent variable, that is, piano students' conceptions of learning, teaching, and assessment/evaluation, was conceptualized on the basis of three theories described above: *direct, interpretative,* and *constructive*.

In order to obtain an overview of the results obtained, descriptive statistical analysis (frequencies and percentages) were conducted considering the three scenarios both together and separately. These analyses were undertaken for the two response contexts, that is, "Most agreement" (+) and "Least agreement" (-). Then, Chi-square tests of independence and Simple Correspondence Factorial Analysis (SCFA) were carried out to explore the relations of association/opposition between the three groups of participants (I, II, III) and the three theories (*direct, interpretative, constructive*). The purpose of conducting an SCFA was to infer the conceptual change process of piano students' learning and instruction theories. A brief rationale about this analytic technique will be provided below. Finally, in order to group the participants (N= 215 students) according to the similarities in their response-choices and identify the existing profiles of conceptions, an Ascending Hierarchical Classification (AHC, or *cluster* analysis) was performed. This analysis was intended to explore the theoretical consistency level of students' conceptions of learning, teaching, and assessment/evaluation. SPAD.N version 5.0 data analysis software (manufacturer: Décisia) was used to conduct SCFA and AHA. The rest of statistical analysis were done by means of software SPSS (version 14.0).

3.- RESULTS

3.1.- General descriptive analysis

Table 3 shows the total frequencies and percentages obtained by the three groups of students in each response category (*direct, interpretative, constructive*), distinguishing between the contexts "Most agreement" (+) and "Least agreement" (-). In order to analyze the associations between the variables "Group" and "Theory," two Chi-square tests of independence were conducted. The hypothesis of independence (or null hypothesis) was rejected in both cases, by showing the existence of statistically significant associations (for

the "Most agreement" context: X^2 = 227,806, d=4, p < .001; for the "Least agreement" context: X^2 = 272,495, d=4, p < .001). On the basis of the resulting Adjusted Residuals, one asterisk (*) indicates the frequencies of students that were statistically lower than expected in each cell, and two asterisks (**) those frequencies that were statistically higher than expected.

INSERT TABLE 3

Focusing just on the asterisks, it is interesting to notice how Group II and Group III obtained the same relations of dependence with the three theories. For instance, for the "Most agreement" context, these two groups obtained response rates significantly higher than expected in *constructive* options, and lower than expected in *direct* options. Similarly, for the "Least agreement" context, these groups obtained response rates significantly higher than expected in both *direct* and *interpretative* options, and lower than expected in *constructive* options. Despite these similarities, if we focus instead on the percentages, we can observe for example that within the "Most agreement" context Group II students showed a higher preference for *interpretative* response-choices, whereas Group III showed the highest preference for *constructive* ones. Focusing now on the "Least agreement" context, we can see that *direct* options were more frequently selected by Group III than by Group II, unlike *constructive* options. On the basis of these qualitative comparisons, we could state that Group III showed a slightly higher level of sophistication than Group II. On other hand, Group I showed exactly the opposite relations of dependence described for Groups II and III. Although *interpretative* options were the most preferred within the "Most agreement" context, as they were for Group II, students from Group I obtained response rates significantly higher than expected in *direct* options, whereas *constructive* choices were significantly lower than expected. The most outstanding result concerning the "Least agreement" context in this group was the high frequency of *constructive* options (more that 50% of response-choices), which was significantly higher than expected.

3.2.- Descriptive analysis for each scenario

Table 4 shows the descriptive statistics (total frequencies and relative percentages) obtained by groups I, II, and III in each of the three scenarios considered in this study:

learning (Le), teaching (Te), and assessment/evaluation (As). Notice that codes included in the fourth column of Table 4 (e.g., LeD+, LeI+, LeC+) will be used to report the subsequent analysis and results.

INSERT TABLE 4

Based on the frequencies and percentages shown in Table 4, a Simple Correspondence Factorial Analysis (SCFA) was carried out. SCFA is a technique of multivariate analysis —specifically a variant of principal component analysis— that relates two categorical variables by projecting their relations of proximity and opposition on a factorial plane (for a complete overview, see Lebart, Morineau, & Warwick, 1984). In our case, these two categorical variables were "Group" —with three modalities: I, II, III— and "Type of answers" —with 18 modalities, that is, three theories (*direct, interpretative, constructive*) x three scenarios (*learning, teaching, assessment/evaluation*) x two contexts (*"Most agreement," "Least agreement"*)—. Codes for these 18 modalities are shown in the fourth column of Table 4. The two axes resulting from this SCFA explained 97.71% and 2.29% of the Total Inertia[1] of the contingency table, whose value was 0.08456. Eigen-values of these axes were 0.0826 and 0.0019, respectively. According to customary criteria, the interpretation of the factorial plane is based only on those modalities whose contribution to one or both axes is higher than the average value (i.e., 100 / number of modalities). In this case, all the modalities of the variable "Group" exceeded 33.3 (100/3), but only 11 modalities of "Type of answers" exceeded 5.55 (100/18). The codes of these 11 modalities have been underlined in Figure 1.

INSERT FIGURE 1

As can be observed, Axis 1 graphically ordered the three modalities of the variable "Group" (I → II → III) from the left to the right hand side of the plane, by suggesting the existence of a developmental/instructional pattern of conceptual change in students' conceptions. Three sets of statistically significant associated modalities were identified

[1] It is important to explain that *inertia* means variance in the context of correspondence analysis. Total Inertia is the sum of eigen-values and reflects the spread of the modalities around the *centroid* of the plane. Its value is proportional to the *Chi-square* statistic, which evaluates the association between two variables (in our case, "Group" and "Type of answer").

along this *continuum* (notice that the asterisk * indicates that the modality is associated with two different sets of modalities):

- The first set, which resulted associated with Group I, was composed of the following modalities:
  - *Learning*: most agreement with *direct* options (LeD+), and least agreement with *constructive* options (LeC-).
  - *Teaching*: most agreement with *direct* options (TeD+), as well as with *interpretative* options (TeI+)*.
  - *Assessment/Evaluation*: most agreement with *direct* options (AsD+), and least agreement with *constructive* options (AsC-).
- The second set of modalities, in which Group II was included, was composed of:
  - *Learning*: most agreement with *interpretative* options (LeI+).
  - *Teaching*: most agreement with *interpretative* options (TeI+)*.
  - *Assessment/Evaluation*: least agreement with *direct* options (AsD-)*.
- The third set, associated with Group III, was composed of:
  - *Learning*: most agreement with *constructive* options (LeC+), and least agreement with *direct* options (LeD-).
  - *Teaching*: most agreement with *constructive* options (TeC+).
  - *Assessment/Evaluation*: least agreement with *direct* options (AsD-)*.

The relations of association reported above indicated that, broadly speaking, the older the students and higher their level of education, the higher was the level of theoretical sophistication identified in their answers.

3.3.- Ascending Hierarchical Classification (AHC) analysis, and qualitative descriptions of the resulting classes

To identify the profiles of conceptions of learning, teaching, and assessment/evaluation existing among the students, and analyze the distribution of the students among these profiles, an Ascending Hierarchical Classification analysis (AHC) was conducted. More specifically, we used Ward's clustering method (Lebart et al., 1984), which allows the grouping of participants according to the similarities in their answers. The first step was identifying those items in which no significantly statistical differences were

found among groups of students I, II, and III, in order to exclude those items from the AHC. This identification process focused on both response contexts (i.e., "Most agreement" and "Least agreement"). Thus, Chi-square test of independence was applied 32 times (that is, 16 items x 2 response contexts). On the basis of the resulting X^2 values (with $p < .001$), differences were not found in seven cases, specifically in one case related to learning (4Le+, which stands for "4th Item, Learning scenario, Most agreement"), in another case related to teaching (1Te-, which stands for "1st Item, Teaching scenario, Least Agreement"), and interestingly in five cases related to assessment/evaluation (1As+, 1As-, 3As+, 3As-, and 4As-). The latter finding indicated the existence of remarkable similarities among the conceptions of the three groups of students concerning the settings for assessment and evaluation of knowledge. After eliminating all these cases, the AHC was applied.

Considering both the resulting hierarchical classification tree and the *dendogram* of Euclidean distances, which are not presented here due to their large size, we decided to split the sample into three classes (iteration 436, index 0.08610). Thereby it was possible to obtain three classes relatively similar in size, ranging from 52 to 83 participants. Splitting the sample in a higher number of groups (such as 4, 5, or 6) would have resulted in very small classes composed of less than 8-12 participants. The composition of the three resulting classes in terms of frequency and percentage of students is reported in Table 5. A Chi-square test allowed us to reject the hypothesis of independence between the variables "Group" and "Class" (X^2 = 87,023, d=4, $p < .001$). Based on the Adjusted Residuals highlighted in Table 5, we can observe that the frequency of Group I students was higher than statistically expected in Class 1, and lower than statistically expected in Class 2 and Class 3. Students from Group III showed the opposite associations, whereas Group II students did not significantly associate with any of the three classes.

INSERT TABLE 5

To name and characterize the three resulting classes, we decided to focus on the "Most agreement" response context. We established the criterion that, to give a profile the name of a certain theory, at least one third (33.3%) of the significantly over-represented

options should reflect that theory (in any of the three scenarios). The profiles obtained are summarized in Table 6. It is to notice that:

a) In the column called "Group % (composition)", we report in decreasing order the percentage of students (I, II, III) classified in each profile;
b) The most predominant theory/ies in each scenario has/have been highlighted in grey colour.
c) The number of over-represented items of each theory is reported (ranging from 1 to 6).

INSERT TABLE 6

If we analyze Table 6 broadly, the first thing that catches our attention is the fact that more than one theory co-exists in all three profiles. This finding is consistent with the idea of "representational multiplicity" referred to in the Introduction. The qualitative descriptions of the profiles are presented below according to a criterion of increasing sophistication. Descriptions are based on the "Most agreement" response-choices that were significantly over-represented in each profile (i.e., those whose eigen-values were higher than +1.96, with $p < .001$). Codes of these options will be presented in brackets (e.g., 1LeD+, meaning: 1st Item, Learning scenario, *Direct* option, "Most agreement" context) (see Appendix 1).

Class 1: Direct-Interpretative profile

This profile is composed of *direct* and *interpretative* conceptions. More specifically, *direct* conceptions predominate in learning and teaching scenarios, whereas *interpretative* conceptions predominate in situations for assessment/evaluation. As reported in Table 5, this class was statistically over-represented by Group I students, and under-represented by students from Group II and Group III.

- *Learning:* Class 1 members consider that rote learning procedures, focused on both automatic reproduction of musical scores and technical skills' training, are the most suitable for the learning of musical pieces (3LeD+). Related to this idea, both the scarce time for practice and the lack of persistence (i.e., learning conditions) are understood as the most important causes for the emerge of learning "difficulties"

(1LeD+). In addition, these students understand that collaborative peer-learning is positive and effective only when the student who teaches has a higher level of expertise than the student who learns (2LeI+).

- *Teaching:* These students agreed the most with response-choices in which the teacher attributes a passive and reproductive role to the learner. For instance, they think that providing students with the "correct" fingerings of musical pieces, from the very beginning of the learning process, is the best procedure to teach them how to choose these fingerings (2TeD+). In their viewpoint, teaching must be focused on the final learning outcomes instead of on the learning processes. Imitation and modelling are thought to be the best teaching strategies to help students solve their technical and interpretative difficulties (7TeD+). Members of Class 1 also think that teachers need to be in charge of selecting the tasks to be done by students, and that the most important thing to be done when assigning these tasks is to "show" students the expected final outcome (3TeD+). Finally, these students think that teachers are to focus on correcting learners' mistakes and errors. In their view, providing direct explanations and/or external instructions is the best didactic procedure to correct students' mistakes and errors (4TeI+).
- *Assessment and Evaluation:* The epistemological assumptions demonstrated by Class 1 members seem to be grounded in both radical realism (*dualism*) (4AsD+) and interpretative realism (4AsI+). For them, the main function of "evaluation" is giving grades to students, as well as finding out their mistakes so that the teacher can externally correct them (2AsI+). Concerning the object to be assessed, evaluated and graded, these students think that teachers should focus exclusively on final learning outcomes (5AsD+), or eventually give little importance to learning processes, cognitive abilities, and other kinds of general competences (5AsI+).

Class 2: Interpretative-Constructive profile

The second profile is mostly composed of *interpretative* and *constructive* conceptions, except for the teaching scenario where some *direct* conceptions were also identified. This class was similarly composed by students from all three groups (Table 5).

- *Learning:* Unlike members of the previous class, Class 2 members consider that musical learning needs to focus on both technical and interpretative aspects. Rather than processing musical scores linearly (i.e., from the first bar to the end), they think that the best way to learn how to play a new musical piece is to select and practice their most difficult sections from the beginning, so that those sections are practiced more than the easiest ones (3LeI+). In addition, their attitude regarding collaborative peer-learning is positive even in the case that learners have different levels of musical expertise. From their perspective, the very act of trying to teach and/or help a peer fosters processes of reflection and knowledge explicitation, which are very positive for student's own learning (2LeC+).
- *Teaching:* Interestingly, Class 2 members' conceptions about teaching are based on the three theories considered in this study. They hold the same conception as Class 1 students regarding the best pedagogic procedure to assign the weekly tasks (3TeD+). In their opinion, teachers must focus on externally correcting students' mistakes either by means of verbal explanations and instructions (4TeI+), or simply by imitation and modelling (4TeD+). Concerning how to teach musical fingering, they think that teachers must first encourage students to do the work by themselves, and then correct their errors by providing them with the most suitable solutions (2TeI+). Finally, although it might seem paradoxical or even incoherent with the ideas previously referred to, Class 2 members conceive that the "best piano teacher" is neither the best pianist nor the best at giving verbal explanations and/or instructions, but the most engaged in promoting students' self-reflection and personal understanding (1TeC+).
- *Assessment and Evaluation:* Like in Class 1, members of this class also hold a quantitative and corrective conception about the main functions of evaluation (2AsI+). However, they conceive that aspects such as learning processes and meta-cognitive abilities need to be considered as further "objects" of evaluation within final examinations, having the same degree of importance as final learning outcomes (5AsC+).

Class 3: Constructive profile

The third profile is composed of *constructive* conceptions, except for the teaching scenario where some *interpretative* conceptions were identified as well. Group II and III students were statistically over-represented in this class, whereas Group I students were under-represented (Table 5).

- *Learning:* Class 3 members have the same positive attitude regarding collaborative peer-learning as do Class 2 members (2LeC+). However, students from Class 3 hold a more sophisticated view concerning the best approaches for the learning of musical scores. In their opinion, interpreters need to focus on developing a holistic understanding of the music they perform, paying special attention to its artistic meaning and sense (3LeC+). Connected with this idea, the lack of personal communicative and expressive goals – in other words, the lack of personal *agency* – is conceived as the most important cause for students' learning difficulties (1LeC+).
- *Teaching:* Class 3 members chose *constructive* conceptions in most of the items on teaching presented in the questionnaire, and *interpretative* conceptions in two specific items. In their opinion, teachers should ideally: a) involve students in the selection of their own weekly tasks, by asking them to reflect on *why*, *what for*, and *how* these activities need to be undertaken (3TeC+); b) make use of students' "successes" to foster their meta-cognitive processes (5TeC+), in such a way that these processes help them deal with their learning weaknesses (4TeC+); c) use pedagogic strategies such as debates, reflective questioning, etc. to foster students' reflection about the reasons for their "mistakes" and how to overcome them (7TeC+). Consistently, Class 3 members have positive attitudes concerning students' self-assessment, as critical thinking abilities are conceived to be essential (6TeC+). Regarding how to teach the fingerings, these students seem to agree with *interpretative* conceptions (2TeI+), like Class 2 members, and also with *constructive* ones (2TeC+). According to the latter, the main focus of teaching should be placed on fostering deep learning processes rather than on final outcomes. Finally, the "best piano teacher" for Class 3 members is not always the best pianist. Besides playing the piano very well, teachers need to be able to explain clearly what students have to do at every moment, and correct their mistakes efficiently (1TeI+).

- *Assessment and Evaluation:* Unlike the former classes, Class 3 members conceive that the main function of evaluation is improving students' learning processes by promoting their self-reflection on their strengths and weaknesses (2AsC+). Regarding contexts for musical knowledge assessment, their answers tend to be grounded in *constructivist* assumptions (4AsC+). Finally, regarding the "objects" to be assessed and evaluated within final examinations settings, these students hold the same sophisticated conception as Class 2 members (5AsC+).

4.- DISCUSSION AND CONCLUSIONS

The first general conclusion of this study is that, with the progress of both age and educational level, piano students' conceptions of learning and instruction tend to be increasingly more sophisticated. Looking at the frequencies statistically lower and higher than expected presented in Table 3, we can observe that Group I students tend to agree the most with *direct* and *interpretative* theories, and the least with *constructive* theory. As far as Group II is concerned, *interpretative* and *constructive* response-choices are the most preferred, whereas *direct* options are the least preferred. Group III students show a similar tendency, although they have even a higher preference for the *constructive* theory, as well as a higher disagreement with the *direct* theory. This tendency towards increasing sophistication is coherent with the conceptual change patterns identified in other epistemic and academic domains, both in studies carried out from the *implicit theories* framework (Scheuer et al., 2001, 2006) and other approaches (for a recent review of scientific subject-matters, see Murphy & Alexander, 2008).

Analyses for scenarios have allowed us to describe the relations of association-opposition between the three groups of students and the different conceptions of learning, teaching, and assessment/evaluation (Table 4 and Figure 1). As the sets of associated modalities were described in detail in the previous section, here we are going to focus on the discussion of further issues. In our viewpoint, the distribution of modalities within the SCFA plane is quite consistent with previous studies on intuitive conceptions and conceptual change in others domains (Pérez Echeverría et al., 2001; Vosniadou, 1994, 2007). The plane suggests the existence of the following *continuum*:

- In the least theoretically sophisticated pole (left hand side of the plane), relatively close to the area where Group I is located, we find a conception (AsD+) according to which evaluation should be focused on final learning outcomes, and carried out from a *realistic* epistemological perspective. We also find another conception (LeC-) that explicitly rejects the learner's active and constructive role in the learning process. These two modalities —notice that both are *contributive* ones— are based on epistemological, ontological, and/or causal assumptions that clearly reflect the most extreme version of the *direct* theory (Wellman, 1990). It might be for that reason that both modalities were located in such peripheral locations, even far from the location of Group I.
- The second set of associated modalities (top right side), of which Group II forms part, shows an "intermediate" level of theoretical sophistication. Drawing on the location of its three contributive modalities, this set might be characterized by means of three adjectives: 1) "scattered," because of the location of these modalities; 2) "eclectic," as two of these modalities (TeI+ and AsD-) are shared with other sets; and 3) "inconsistent," since these two modalities are based on very different assumptions:
    - According to TeI+ conceptions, teaching is aimed at externally managing and/or controlling students' actions and processes, in order to help learners to reproduce "reality" in the most correct and faithful way (Pecharromán & Pozo, 2008). Due to its location, this modality might be interpreted as a "conception-of-transition" from the first set to the second one.
    - According to AsD- conceptions, assessing/evaluating should not be limited to externally determining whether students' final knowledge is "right or wrong." The location of this modality, halfway between the second and third sets, might be suggesting that the first step towards constructivism involves a process of "rupture" with epistemological realism and with ontological views of knowledge in terms of states and final products.
- Focusing on the most sophisticated set (bottom right side), of which Group III forms part, it is important to notice the proximity among its contributives modalities,

which might be reflecting *constructive* theory's high degree of consistency and coherence.

The AHC analysis has allowed us to identify three well-differentiated clusters of conceptions of learning, teaching, and assessment/evaluation, which —using Martín et al.'s (2009) terminology— have been called *profiles.* When looking at Table 6 and reading the descriptions presented above, it becomes salient that more than one theory co-exists in all three profiles. Consistent with Entwistle (2007) and Rodrigo et al. (1993), this finding shows that depending on the particular demands of each type of situation, students tend to activate in slightly different ways their epistemological, ontological, and causal assumptions. This result, which is consistent with the idea of representational multiplicity (Karmiloff-Smith, 1992; Pozo, 2003), might be indicating that piano students' conceptions are not completely consistent. However, their conceptions are not "random" either. Piano students' conceptions, as Table 6 shows, are seemingly organized in the form of relatively consistent profiles (Kember, 2001; Klatter et al. 2001; Martín et al., 2009; Peterson & Irving, 2008). This is the second general conclusion of this article.

Interestingly, all three profiles resulted to be composed of teaching conceptions slightly less sophisticated than both learning and assessment/evaluation conceptions. In this regard, it seems that students might be quite resistant to accept the idea of a teacher that, instead of modelling learners' behaviour and/or providing them with instructions and verbal explanations, tries to foster students' learning by means of reflective and proactive pedagogies. Conversely, conceptions of assessment/evaluation resulted to be comparatively the most sophisticated in all three profiles. As our analysis of the factorial plane pointed out, it might be the case that conceptual shifts from one profile to the next one were triggered by changes in those specific conceptions, which are mostly based on epistemological and ontological assumptions. These ideas beg further investigation.

Moving to our third purpose, the distribution of participants among the resulting three profiles allows us to postulate a possible path of conceptual change in piano students' conceptions:

- *Direct-interpretative.* This is the most simplistic profile. As it is exclusively composed of *direct* and *interpretative* conceptions, we assume its cognitive nature to be mostly implicit and unconscious. In this regard, the fact that it is mostly held

by the youngest students (almost 70% of Group I students) seems to be very logical, as well as consistent with existing research (Pecharromán & Pozo, 2008).

- *Interpretative-constructive.* We conceive its degree of sophistication to be "intermediate." This profile is integrated by the broad spectrum of theories, from *direct* to *constructive*. For this reason, we consider that its cognitive nature might be halfway along the implicit-explicit continuum. Moreover, the apparently inconsistent character of this profile leads us to interpret it as a "profile-of-transition" towards constructivism, in which *interpretative* theory ―the most predominant one, interestingly― might be acting as a "hinge-theory" between both *direct* and *constructive* conceptions (Martín et al., 2009). None of the three groups showed statistically significant associations with this profile. However, it is interesting to notice that most of its members belonged to Group II (Tables 5 and 6).
- *Constructive.* This is the most sophisticated profile, and hence the most theoretically consistent. Since it is mostly composed of *constructive* conceptions, we consider its cognitive nature to be explicit and conscious (Pozo et al., 2006). It is held by 50% of Group II students, and 77% of Group III students. This study does not allow us to identify the variables responsible for this difference between groups II and III, which almost reaches 30%. That is, piano students' conceptual change towards the constructive profile might be due factors such as their higher age, educational level, or level of expertise. Besides, we consider that the courses in didactics and pedagogy received by Tertiary students (i.e., Group III) might be another important factor. This argument has also been suggested in relation to novice piano teachers (Authors, 2010), whose sophisticated *constructive* answers to a written open-ended questionnaire were attributed to the education they received to achieve the position of official teachers (i.e., courses in Psychopedagogy, Didactics, Curricular Design).

Once presented the main conclusions of our study, we would like to discuss some additional issues that are theoretically very relevant to us, some of which deserve further investigation. First, it is important to notice that a "pure" *direct* profile has not been identified among our participants. This might be viewed as relatively expectable given their ages and educational levels. According to existing investigations (Scheuer et al., 2001, 2006; Wellman, 1990), said *direct* profile might be present among younger piano students,

especially among those who start their musical training at very early ages (around 4 years old). For obvious reasons, studying the conceptions of those young children would not be possible through the multiple-choice questionnaire designed for this study. It would involve the implementation of other instruments for data collection, such as interviews. Conducting interview studies with the youngest piano students would be very relevant, as we would be able to complete the description of their conceptual change processes.

On other hand, consistent with Schwanenflugel et al. (1996), our results suggest that it is possible to find *constructive* conceptions during the final years of early adolescence (12-14 years old, approximately). Certainly, as shown in Table 5, almost 7% of Group I students were classified within the *constructive* profile. It would be necessary to conduct in-depth studies of these exceptional cases to find out which variables (personal, social, contextual, etc.) could have fostered the conceptual change at such early ages (Hofer & Pintrich, 2002).

In the opposite pole, our results also indicate that it is possible to find very naïve and simplistic conceptions among the most adult students, that is, among those explicitly instructed in didactics and pedagogy (Strauss, 2005). In fact, as Table 5 reveals, more than 20% of Group III students were not classified within the *constructive* profile. In a nutshell: even thought the cognitive/instructional progress tends to be parallel to the development of increasingly sophisticated conceptions, our study shows that the conceptual change is not completely "guaranteed" given that it does not necessarily occur in all individuals (Scheuer et al., 2001, 2006).

This finding suggests the need for investigating the reasons for this resistance to develop constructivist conceptions, and implementing educational programmes focused on fostering students' conceptual change (Pozo et al., 2006; Strauss, 2005). These educational programmes should be designed and oriented not only for those adult students who are close to become teachers (remember that 23% of Tertiary students do not hold the *constructive* profile), but also for the other groups (notice that most of Intermediate students were not classified in the *constructive* profile). As argued in the Introduction, our beliefs about learning and instruction constitute extremely important mediators of our actual approaches for the acquisition and transmission of knowledge (Hofer & Pintrich, 2002; Vosniadou, 2007). Thus, if current Spanish educational law (LOE, 2006) wants piano

students to approach their learning —and their future teaching, in many cases— in more constructive ways, the conceptual change of their implicit assumptions should be addressed as a central curricular issue. In our viewpoint, this study constitute a good starting point to design effective systematic interventions.

Finally, acknowledging that all methodologies have weaknesses (Duell & Schommer-Aikins, 2001), we are aware of the fact that our study has the limitation of being exclusively restricted to the representational level, specifically to the implicit assumptions of learning and instruction. Therefore, our results should be cautiously interpreted. Besides, we consider that our project should be followed up with: a) further examinations of what these piano students actually *do* while learning —and eventually teaching— music; and b) intervention studies to foster the above-mentioned instruction-induced conceptual change (Hofer & Pintrich, 2002; Vosniadou, 2007).

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Table 1.- Assumptions of the theories of Learning and Instruction identified by Pérez Echeverría et al. (2001)

	Direct	**Interpretative**	**Constructive**
Epistemological *What is the relationship between knowledge and reality? What is the role of the subject of knowledge?*	***Naïve Realism*** Knowledge is a faithful and accurate portrait of reality. Subjects need to copy this reality.	***Interpretative Realism*** Knowledge is a faithful and accurate portrait of reality, but subjects can modify this reality through their active roles in the knowing process.	***Constructivism*** Knowledge is a construction elaborated by the subject, who builds personal models to interpret reality. These models can be more of less accurate.
Ontological *What types of ontological entities are used to interpret L&I?*	***States – Products*** L&I are only conceived in terms of states, products of final outcomes of knowledge.	***Actions and Processes*** L&I are also conceived in terms of actions and processes (e.g., cognitive, motivational), which are supposed to be externally managed by the teacher.	***Sophisticated systems*** L&I are also conceived in terms of sophisticated psychological systems (e.g., metacognitive, affective, motivational), which are supposed to be internally managed by the learner.
Causal *What relations of causality are involved in L&I processes?*	***Simple causality*** A direct and linear relationship is established between L&I conditions and outcomes.	***Multiple causality*** A direct and linear relationship is established among L&I conditions, processes, and outcomes.	***Interactive causality*** A complex and interactive relationship is established among L&I conditions, processes, and outcomes

Table 2.- Features of the three groups of students

		GROUP I	GROUP III	GROUP III
Gender:				
	Female	42	40	26
	Male	45	40	22
	TOTAL	87	80	48
Age:				
	Range (years)	12.04 - 13.96	17.10 - 19.85	22.10 - 29.30
	M (years)	13.34	18.19	24.35
	SD	0.73	1.20	2.18

Table 3.- General descriptive statistics: frequencies, percentages, and chi-square

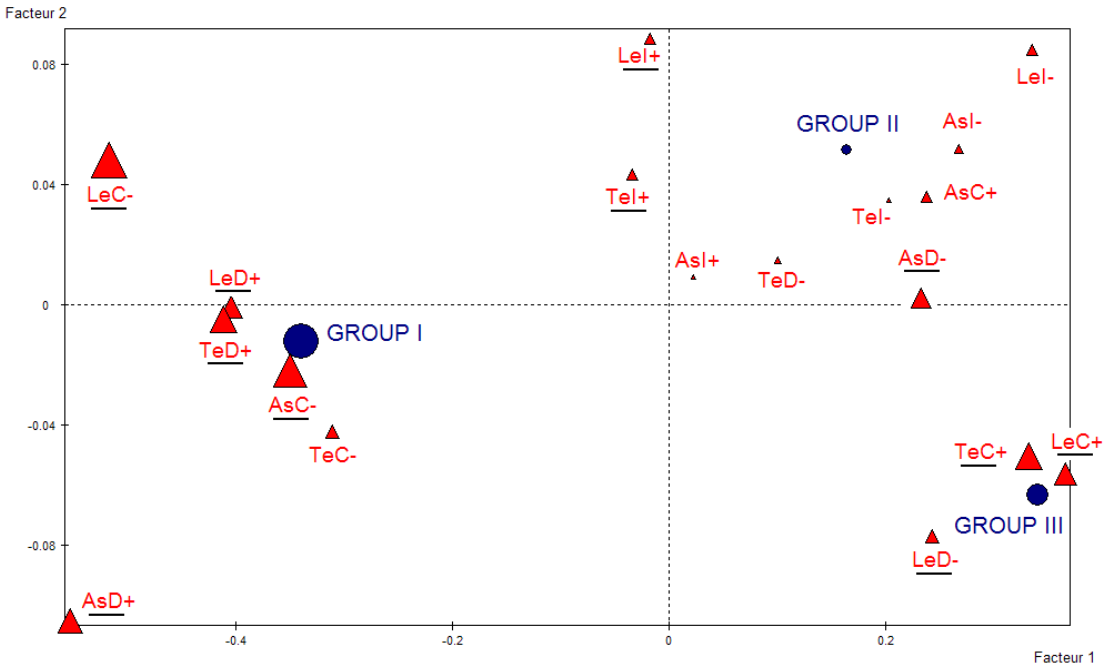
		GROUP I			GROUP II			GROUP III		
(+)	Direct	504	(**)	36,42%	220	(*)	17,18%	94	(*)	12,23%
	Interpretative	585		41,81%	556		43,43%	301		39,19%
	Constructive	303	(*)	21,76%	504	(**)	39,37%	373	(**)	48,56%
(-)	Direct	582	(*)	41,81%	748	(**)	58,43%	504	(**)	65,62%
	Interpretative	108	(*)	7,75%	190	(**)	14,84%	115	(**)	14,97%
	Constructive	702	(**)	51,72%	342	(*)	26,71%	149	(*)	19,40%

(*) Frequency lower than statistically expected (i.e., Adjusted Residual > -1.96)
(**) Frequency higher than statistically expected (i.e., Adjusted Residuals < 1.96)

Table 4.- Descriptive statistics for each scenario: total frequencies and relative percentages

				GROUP I		GROUP II		GROUP III	
Learning	+	Direct	LeD+	180	51,72%	86	26,87%	35	18,22%
		Interpretative	LeI+	87	25,00%	88	27,50%	41	21,35%
		Contructive	LeC+	81	23,27%	146	45,62%	116	60,41%
	-	Direct	LeD-	114	32,75%	150	46,87%	120	62,50%
		Interpretative	LeI-	42	12,06%	86	26,87%	51	26,56%
		Contructive	LeC-	192	55,17%	84	26,25%	21	10,93%
Teaching	+	Direct	TeD+	213	34,97%	100	17,85%	41	12,10%
		Interpretative	TeI+	267	43,84%	244	43,57%	127	37,79%
		Contructive	TeC+	129	21,18%	216	38,57%	168	50,00%
	-	Direct	TeD-	216	35,46%	314	56,07%	209	62,20%
		Interpretative	TeI-	42	6,89%	70	12,50%	43	12,79%
		Contructive	TeC-	351	56,63%	176	31,42%	84	25,00%
Assessment & Evaluation	+	Direct	AsD+	111	25,51%	34	8,50%	18	7,50%
		Interpretative	AsI+	231	53,10%	224	56,00%	133	55,41%
		Contructive	AsC+	93	21,37%	142	35,50%	89	37,08%
	-	Direct	AsD-	252	57,93%	284	71,00%	209	87,08%
		Interpretative	AsI-	24	5,51%	34	8,50%	21	8,75%
		Contructive	AsC-	159	36,55%	82	20,50%	44	18,33%

Figure 1.- Factorial plane resulting from the SCFA (*)



(*) Circles represent the modalities of the variable "Group," and triangles the modalities of "Type of answers." In both cases, the sizes of the shapes provide an analogical representation of their contribution to the factorial axis. Only those modalities of the variable "Type of answers" whose contribution resulted to be higher than the average value (100/18 = 5.55) have been underlined.

Table 5.- Composition of the classes in terms of frequencies and percentages of students (*)

		Class 1	Class 2	Class 3	TOTAL
Group I	Students	60	21	6	87
	%	68,96%	24,13%	6,89%	100,00%
	A.R.	**7,9**	,0	**-7,9**	
Group II	Students	18	22	40	80
	%	22,50%	27,50%	50,00%	100,00%
	A.R.	**-3,4**	,9	**2,6**	
Group III	Students	2	9	37	48
	%	4,16%	18,75%	77,08%	100,00%
	A.R.	**-5,4**	-1,0	**6,2**	
TOTAL		80	52	83	215

(*) Adjusted Residuals higher than +1.96 are highlighted in dark grey, and those lower than -1.96 in light grey.

Table 6.- Theoretical profiles identified among piano students

PROFILES	Group % (composition)	Learning	Teaching	Assessment & Evaluation
Direct-Interpretative	I > II > III	2 Direct	3 Direct	2 Direct
		1 Interpretative	1 Interpretative	3 Interpretative
		-	-	-
Interpretative-Constructive	II > I > III	-	2 Direct	-
		1 Interpretative	2 Interpretative	1 Interpretative
		1 Constructive	1 Constructive	1 Constructive
Constructive	III > II > I	-	-	-
		-	2 Interpretative	-
		3 Constructive	6 Constructive	3 Constructive