

Development of Musical Abilities: Cross-Sectional Assessments by an Online System in Primary School

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Abstract

The purpose of this study was to pilot a musical abilities test administered through an online assessment system and to examine the developmental trends of musical abilities and their relationships with some relevant cognitive and affective variables. The participants of the study were 1st, 3rd and 5th grade students. The instrument was composed of tasks measuring the successive and simultaneous dimensions of musical abilities. The results indicated faster development in the first half of the examined period. Weak correlations were found between the scores on the musical abilities test and school marks for music given by teachers as well as between actual performance and students' subjective estimation of their own performance, while a stronger correlation was found with school marks for mathematics (.51, $p < .001$).

Objectives

This study is part of a larger project undertaking to develop an online diagnostic assessment system for the first six grades of primary school. Beyond three main domains of assessment (reading, mathematics and science), several other areas have been piloted to explore the benefits of systematic assessment, and the relationships and transfer effects between the development of several abilities and skills. The objectives of the present study are (1) to explore the potentials of technology-based assessment of musical abilities, (2) to pilot the online assessment in real educational settings in classroom environment, (3) to outline the developmental trends of the examined musical abilities by comparing the achievements of several age groups, (4) to examine the relationships of the components of musical ability with some indicators of students' school achievements, and (5) to explore the relationship between musical abilities and some affective variables.

Theoretical Framework

Previous studies indicated positive transfer effects of musical abilities on a number of cognitive domains, including reading (e. g. Loui, Kroog, Zuk, Winner, & Schlaug, 2011) and mathematics (e. g. Schmithorst & Holland, 2003). However, although research on the assessment of musical abilities started a few decades ago (e.g. Wing, 1948; Hargreaves, 1986/2001), regular monitoring of the development of musical abilities in educational practice requires further research and enhancement; it especially needs valid instruments which are broadly available and easy to administer.

In the first phase of research on musical testing, two definite points of view emerged: the musician's and the psychologist's (Wing, 1970). Musical ability testing now forms one of the largest single areas of music psychology. Hargreaves isolated three main areas of musical tests. First, tests of musical ability are designed to assess musical behavior regardless of previous musical learning or experience (Hargreaves, 2001). The well-known tests which can be used with children are Seashore's musical talent tests (1919, 1960), the Kwalwasser-Dykema musical test (1930), Wing's standard musical intelligence test (1961) and Gordon's tests for children of various ages (*Audie*, 1989; *Primary Measures of Music Audiation*, PMMA, 1979; *Intermediate Measures of Music Audiation*, 1989). Hargreaves also defined two other groups: tests of musical achievement and tests of attitudes.

We supplemented Hargreaves's list with diagnostic testing, which can be defined as a formative assessment where the results of the testing could be used for fostering children's musical development. For the development of the taxonomy and framework of our instruments we build upon the work of Moles (1969). Based on his conceptual framework, musical phenomena may be divided into two main fields: successive and simultaneous processing. The component of musical abilities our framework covers are rhythmic discrimination ability, dynamic hearing, tempo discrimination, melody discrimination, pitch discrimination, polyphonic hearing, timbre discrimination and complex musical thinking.

After studying the literature of/on musical ability tests we have not found any assessment instruments that could be applied online and to numerous children at the same time during school classes. Previous research mostly focused on one or only a few components of musical abilities which were examined by increasingly accurate measuring instruments. However, well-functioning psychological methods cannot be applied successfully in elementary classrooms.

Methods: Participants, Assessment Instruments and Measurement Processes

The participants of the study were first (N=219), third (N=207) and fifth grade (N=227) primary school students selected from schools of Csongrad county (south-eastern region of Hungary).

The test was administered through the eDia online assessment platform which was developed for delivering diagnostic/formative tests. Students completed the tasks in classrooms equipped with computers in their own schools, using the operation system and browser originally installed on the computers. They read the instructions on screen and could also listened to them if they liked., Musical audio stimuli was played to the

students through headsets. The test consisted of multiple choice questions; students entered their answers by clicking the chosen alternative.

The entire test was composed of two main scales assessing simultaneous and successive dimensions of music; it contained altogether 81 items in 17 complex tasks. (Cronbach's alpha = .981). One task (4 items) examined complex musical thinking.

The components of the successive dimension which are measurable online were rhythm, tempo, dynamics and melody. This dimension was measured by 36 items in 8 complex tasks (Cronbach's alpha = .767). The components of the simultaneous dimension, which are pitch, tonality, harmony, polyphony, consonance and tone, were measured by 45 items in 9 tasks (Cronbach's alpha = .90).

The musical test was accompanied by a brief questionnaire asking students about the testing itself (how difficult and how interesting the test was, whether they liked it, their school achievements, attitudes, home environment, music related habits, and the availability of musical instruments) also administered online after the test.

Students were allowed to work on the test and questionnaire during one class period (about 40 minutes), which proved to be long enough to go through all items. There was no time limit for the individual tasks, and students were not allowed to return to previous items. Meta data and other contextual variables were also recorded, which may be analyzed later.

Analyses and Results

The data were imported from the eDia platform for statistical analyses. The distribution of the results indicated that the difficulty of the test was appropriate for the ability level of students: the means for the entire test (the sum of the two dimensions, excluding complex musical thinking) were 43%, 58% and 63% for the three age groups. According to the subjective judgments of the students, 34% found the test easy, 57% found it medium and 9% found it difficult. At the same time, 75% found it interesting, 17% moderately interesting and 8% not interesting at all. As for the subjective estimation of their own performance, 7% thought they performed poorly, 55% at medium level and 38% well.

The scores in the simultaneous dimension, as expected, were much lower than in the successive dimension. There were larger differences between Grade 1 and Grade 3 (approx. 1 std. dev.), than between Grade 3 and Grade 5 (less than 0.5 std. dev.), indicating that the measured musical abilities develop more rapidly during the first school year (see Table 1). No significant difference was found between boys and girls.

Table 1 Means and standard deviations of the test results (in percent of the maximum scores)

Grade	Successive		Simultaneous		Musical Ability	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1	55	22	34	11	43	14
3	77	22	43	11	58	15
5	82	23	47	12	63	16

A strong correlation ($r=.76$, $p<.001$) was found between the successive and simultaneous dimensions. A lower, medium level correlation ($r=.50$, $p<.001$) was found between the task measuring complex musical thinking and the entire test.

No significant correlation was found either between students' judgments of test difficulty, or their estimated and actual performance. However, a modest ($r=.11$, $p<.01$) correlation was found between the interestingness of the test and performance on the musical test.

Students' school achievements were represented by the summative marks students received at school. As these grades tend to be more indicative of the achievements of older students, we only discuss here the correlations between the marks and the musical test scores for the fifth grade students. The correlation with the average score of the successive dimension is $.41$ ($p<.001$), with the simultaneous dimension it is $.35$ ($p<.001$), and with the entire music test it is $.41$ ($p<.001$). The pattern observed here that the correlations with the simultaneous dimension and the entire test are alike (the simultaneous dimension is a good approximation for the entire test) also holds for the other variables; therefore in the following paragraphs we only report correlations with the entire music test.

In Hungarian schools, there is a subject called 'music' which aims to establish basic musical literacy, singing, and a familiarization with musical notations. The correlation between school marks for music and the scores on the musical ability test is $.41$ ($p<.001$), which indicates that teachers grading is not a good estimation of students' musical abilities. (The basis of marking is actually a different construct.) Correlations with marks in other subjects requiring cognitive skills with presumable relation to musical abilities such as second language ($r=.38$, $p<.001$) and grammar ($r=.45$, $p<.001$) are also relatively high. The strongest correlation was found with mathematics ($.51$, $p<.001$), confirming the assumption of the close relationship between mathematical and musical abilities.

As for the school-subject related attitudes, weaker correlations were found than in the case of the cognitive variables. Performance on the musical ability test correlated at $.16$ ($p<.05$) with the music subject, at $.15$ ($p<.05$) with second languages, $.16$ ($p<.05$) with grammar, and $.24$ ($p<.001$) with mathematics indicating that those having more developed musical abilities tend to like mathematics better, and this positive attitude towards mathematics is somewhat stronger than towards other school subjects.

Scientific Significance and Further Research

The empirical part of the study proved that the online assessment system was a broadly accessible and easy-to-use instrument for the measurement of musical abilities. It proved to be applicable in an average school setting, and students liked to work with it. The comparison of the different age groups indicated rapid development during the first school years, and this highlighted once again the importance and possibilities of early childhood education.

Weak relationships were found between the music marks given by teachers and performance on the musical ability test. This finding indicates that teachers may have an inaccurate picture of their students' abilities, and they may give inadequate feedback to students. This way, teaching and learning processes may not utilize students' developmental potential. Furthermore, there was a weak correlation between students'

subjective estimation of their own achievement and their actual performance on the test, indicating that the students do not have a realistic musical self-concept. Systematic objective assessments of musical abilities may contribute to resolving these problems and may help students to build a more realistic musical self-concept. The results confirmed the close relationships between mathematical and musical abilities. Further empirical studies are needed to identify the direction and mechanism of the possible transfer between these two groups of abilities.

Further research is required for examining the predictive and diagnostic value of the assessment of musical abilities. The findings of this paper also prompt for further assessments. Using objective testing instead of school marks for characterizing school achievements may improve the validity of the findings, and the online system offers possibilities for examining the relationship between the development of reading skills and musical abilities.

References

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