PROMOTING SINGING AND MUSIC LITERACY

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Abstract
Music education is an integral component of school curricula in (almost all) education systems worldwide, though naturally in different manners and to varying degrees in every country. Like all priority curricular subjects, music classes provide rich opportunities for skills and knowledge acquisition while also offering a respite from most other subjects' aural-visual modalities (adding singing by ear, or from the score, besides the spoken and written language). This respite can be mentally and physically relaxing and provide engaging entertainment that can rejuvenate the students' attention and intellectual faculties between other classes. The article will briefly present a digital, interactive, and integrative sight-singing training program supported by artificial intelligence, which, integrated into the traditional system of public music education, could promote vocal singing and music literacy training through the practice of solfege, beginning in primary school. We strongly believe that this newly proposed training solution has a great potential for improving and simplifying the access to music literacy training in schools; however, its implementation may be complex and require time, energy, imaginativeness, and patience. This article analyzes multiple aspects of promoting music literacy in education, offering views from three high education institutions.
Keywords: music literacy, singing, solfege, teachers continue education

Introduction
In the primary cycle, the general teacher entrusted with the musical education of generations of children is rarely a professional music teacher. The issue has been a hot topic debated and researched at various levels. In Germany and Latvia, music teachers are responsible for music education in elementary schools because of the particular specificity of the object of music and its importance in education. Ireland, Portugal, Estonia, and Poland have a hybrid of general teachers and specialists. In Italy, Austria, the Czech Republic, Slovakia, Slovenia, Cyprus, and Romania, music education in primary school is accordingly with the level of music training of the general teachers. In Romania, a specialized music teacher is responsible for pupils' music education beginning in the 5th grade.

The primary school curriculum includes music education in the educational process for all students. However, not in all countries does the curriculum mention what degree of specialized training teachers must have to teach music in the first grades of primary school. Moreover, in some countries, the curriculum specifies the aims of music education but does not specify how to achieve them.

The curriculum in force in Romania is based on competencies and, among other competencies, mentions singing, playing, and knowledge of the music language elements (grades 1 to 10), and "operation with reading and writing elements and musical language"[1] (grade 5 and above). However, the program does not explicitly mention the level of musical language knowledge expected to be reached at the end of each year of study and does not recommend music literacy as an end in itself—though it does not prohibit approaching this activity and achieving this goal.

According to the results obtained in primary music education, a generally accepted consensus has been formed stating that the level of musical training of teachers teaching in the first introductory classes is lower than the professional level of training for other subjects. Therefore, in this case, initiatives for training and self-improvement of teachers who teach music in primary school become a necessity that can not be postponed.

The pace of change

Children starting school this year will be retiring in 2070. No one has any idea of what the world will look like in ten years, let alone in 2070. There are two major drivers of change - technology and demography [...] technology - especially digital technology - is developing at a rate that most people cannot properly grasp [...] some pundits are calling it the biggest generation gap since rock and roll. [...] We've learned to use digital technology - laptops, cameras, personal digital assistants, the Internet - as adults, and it has been something like learning a foreign language. Most of us are okay, and some are even experts. We do e-mails and PowerPoint, surf the Internet, and feel that we're at the cutting edge. But compared to most people under thirty and certainly under twenty, we are fumbling amateurs. People of that age were born after the digital revolution began. They learned to speak digital as a mother tongue (Robinson, 2009).

If this is the pace of change in society imposed by the evolution of digital technologies, it is expected that its influences will break through the walls, sometimes too thick of schools, and be felt in school music education - generally traditionalist and conservative.

In the first year of primary school, students quickly learn the alphabet (letters and diacritics), the phonological system, numbers up to one hundred (with basic arithmetic operations), and begin to study a foreign language, managing without much effort to acquire this knowledge. This reality suggests that in addition to literacy and numeracy, it will be possible to talk about music literacy starting with the first grade, especially when there are teaching aids based on modern technologies specially designed to serve this goal.

Dedicating 10 minutes per week to study musical language and solfege with the „teaching assistant" *Solfy* - in the discipline of *music and movement* - can bring a theoretical benefit of approx. 30-45 minutes of guided vocal singing and solfege practice at home (individual study). This promising theoretical calculation must be considered a firm invitation addressed to teachers in the education system to translate this hypothesis into a concrete, constant educational practice.

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[1] http://programe.ise.ro/Portals/1/Curriculum/2017-progr/63-Educatie%20muzicala.pdf

Modern technology and traditional music education

Trying to provide a modern teaching solution to the persistent objective problems of primary school music education, a group of enthusiasts is developing a digital, interactive, artificial intelligence-based program called Solfy. Introducing this digital program in schools integrated with the traditional programs in force can promote primary school vocal singing and music literacy. The program contains gradual studies lessons and progressively staggered solfeges, arranged hierarchically for *beginners* and *advanced users*.

Solfy is for primary and high school pupils, vocational school students, pedagogy students, future teachers, and general music lovers. The teacher may only need to demonstrate the program for 10 minutes in the classroom with a laptop and projector while students watch the notes on the projector screen and sing the solfege from the previous lesson together for five minutes. For the following five minutes, the teacher can introduce the solfege exercises of the new task and assign homework: individual/personal practice with Solfy (using headphones with a microphone), three times a week, each time for 10 minutes—or more. Progress will depend on the time invested in practice! For primary school pupils, the frequency of training may be one lesson per week or two, while for those in music schools or students in the pedagogical path, two lessons per week - or more.

Implementing the Solfy program in the education system can bring many benefits.

For the teacher: permanent access to teaching materials, interactive, integrative, and gradually staggered; the possibility to give individual study lessons; and remotely monitor and coordinate the results of students' practice. Introducing the program in the educational process will help promote vocal singing and musical literacy, increase the teacher's (and school's) prestige and improve the status of music as a mental and emotional discipline. As a result, new and enriching music activities will run in schools, such as singing groups and choral ensembles.

For the student: individual practice at home, personalized progress, and immediate feedback; the ability to review and correct previous records, self-assessment, self-esteem, and self-confidence; new possibilities for individual and collective singing/playing activities.

For the school and the education system: individual and personalized study outside of school will add countless hours of guided practice to the education system without an additional budget for front hours.

Solfy was presented at international meetings, such as the National Musicology Colloquium[2] in Iasi (2020 and 2021), the Conference of European Associations for Music in Schools (EAS, Germany - Freiburg[3], March 2021), the Regional Conferences of the International Society for Music Education (ISME, 2021: Zambia - Lusaka[4], July; Mexico - Cancun[5], August; Japan - Tokyo[6], September), Szeged[7] Cultural Festival, October 2021, and others. In addition, articles have been published describing the program, how to work with it in the classroom and at home,

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[2] http://muzicologie.ro/
[3] https://eas-music.org/archive/2021-freiburg/
[4] https://www.pasmae.africa/programme/
[5] https://www.isme-conferences.org/uploads/1/1/4/9/114996981/agenda_isme__1_.pdf
[6] https://apsmer2021.jmes.me/programs/
[7] https://u-szeged.hu/download.php?docID=122232

and how to monitor and coordinate students' activity remotely, asynchronously. These include *Perspectives for Music Education in Schools after COVID-19: The Potential of Digital Media*[8],[9] (co-written with members of the European Associations of Music in School, EAS) and *Solfy: An IA Teaching Support for Updating School Music Education*[10], in fact, a dialog on Solfy and music education in primary school with Dr. Diana Pop-Sârb, from the National Academy of Music "Gheorghe Dima," Cluj-Napoca and Dr. Adoram Erell, Solfy co-founder. Furthermore, recommendations on the use of the program in schools have appeared, among others, in the blog of the *International Center for Music Education Research*[11] (iMerc) led by Prof. Graham Welch and Prof. Evangelos Himonides[12], and at the *Music Mark*[13] *Association of England*, which selects and offers educational resources through its virtual pages.

Promoting teacher training

Romanian national education law no. 1/2011, updated in August 2018[14], *"provides the framework for the exercise under the authority of the Romanian state of the fundamental right to lifelong learning [...] The mission assumed by Law is to form, through education, the mental infrastructure of Romanian society, following the new requirements derived from Romania's status as a member state of the European Union and from functioning in the context of globalization."*

The General Provisions, Art. 4 (p. 2) specifies: "The primary purpose of the education and training of children, young people, and adults are training skills." During the 153 pages of the Law, the term "skills" appears 109 times, mentioning among others: "d) digital skills of using information technology as a tool for learning and knowledge; e) social and civic competences; f) entrepreneurial skills; g) awareness and cultural expression skills; h) the competence to learn how to learn.

Section 2, Initial and Continuing Education; Teaching career (page 105), art. 245 (1) states, "For teaching, management, guidance, and control staff, continuing education is a right and an obligation [...] and art. 245 (6), completes "The teaching staff, as well as the management, guidance and control staff in pre-university education, is obliged to participate regularly in continuous training programs, to accumulate, at each consecutive interval of 5 years, considered from the date of passing the final examination in education, at least 90 transferable professional credits."

The level of competence targeted by the programs and activities of continuous training/improvement is evaluated according to:

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[8] https://www2.biu.ac.il/hu/mu/min-ad/2021/Benno-Spieker_Morel-Koren_Potential_of_Digital_Media.pdf
[9] https://www.bmu-musik.de/fileadmin/Medien/BV/Positionen/Perspectives_for_music_education___MTA-network.pdf (pages 53-59)
[10] http://tic.edituramediamusica.ro/reviste/2021/1/ICTMF_ISSN_2067-9408_2021_vol_12_issue_1_pg_no_021-032.pdf
[11] The International Music Education Research Centre - https://www.imerc.org/
[12] http://imerc.blogspot.com/2020/07/solfy-online-interactive-platform-for.html
[13] https://www.musicmark.org.uk/resources/providers/solfy/
[14] https://www.edu.ro/sites/default/files/legea-educatiei_actualizata%20august%202018.pdf

- the ability of the teacher to mobilize, combine and use the knowledge and skills, general and professional skills, and competencies autonomously following the evolution of the national curriculum and the needs of education.
- the teacher's ability to cope with change, complex situations, and crises.[15]

"In the field of modern education of the last decade, an axis of major importance is that of continuing education of adults, which must be directly related to validation in the service," says Gerard Vaysse, one of the leading specialists in the field. He comes to specify that the purpose of continuous learning is to prepare citizens for lifelong learning because the Europe of the 21st century will be that of knowledge. Furthermore, the researcher formulates the idea that this process presupposes a Copernican revolution in the professional consciousness and tends that the one involved obtains lasting effects in the practice of the profession. Therefore, the key objectives of lifelong learning in European countries are to increase the quality of the education system[16].

> In Israel, leading music educators have written a national curriculum for grades 1–12 [...] The document establishes national guidelines for a graduated, comprehensive program and outlines what children are expected to know by the end of grades 3, 6, and high school. Music in elementary school includes three interactive content areas: listening and appreciating, performing through singing and playing instruments, and creative music-making. The high school program [...] includes theory, ear training, solfège, and harmony, as well as varying degrees of performance. While providing clear objectives, this document respects the independence and autonomy of individual initiatives and, as such, provides guidelines rather than a set syllabus (Portowitz, 2010).

Teachers in the Israeli public school system must be certified by recognized music teaching programs. Due to a lack of certified teachers, amongst other reasons, many schools (in some districts, up to 30% of public schools) don't include music studies in their curricula. Therefore, it is relatively common for first-year college students to have highly varied musical theory backgrounds. Some students have extensive musical training from *after-school vocational music schools* or high-school music programs, and others have had learned music by ear or are proficient in non-western musical traditions. This situation mandates personalized learning tracks to ensure the students' progress, where each student advances according to their level. Implementing the Solfy technology enables students to progress at their own pace under the supervision of a teacher who monitors their participation in the program. At the college level, the progress is rapid, and it is expected that the students will complete the program during their studies.

Public schools with music studies are equipped with computers to instruct primary school students in the basics of music technology. After completing the Solfy program, music teachers would guide their students in using the program, thus improving their musicality, singing skills, and music sight-reading capabilities, strengthening the musical ear and other music skills.

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[15] https://eacea.ec.europa.eu/national-policies/eurydice/content/continuing-professional-development-teachers-working-early-childhood-and-school-education-61_ro
[16] https://eduform.snsh.ro/baza-de-date-online-cu-bune-practici-pentru-educatie-incluziva-de-calitate/noi-solutii-pentru-perfectionarea-cadrelor-didactice

The Israeli Ministry of Education organizes continuing education courses at various levels during the academic year, offering music teachers opportunities for continuing professional development.

Solfy: a didactic solution recommended for students, actual and future teachers

In March 2020, Dr. Loredana Muntean from the Department of Educational Sciences, University of Oradea[17], began to use Solfy as a possible solution for continuing the educational process during the restrictions imposed by Covid-19. In a short time, nearly 70 students adopted the program and worked independently until the end of the school year. As a result, Solfy was in use in 2020-2021, and it is still in use in the current scholarly year when students receive credits according to the number and quality of recorded solfege.

In the 2021-2022 school year, Solfy was introduced to the Jerusalem Pedagogical College[18] by the Director of the Music Department, Dr. Sarah Weidenfeld. Then, together with the teachers, Ms. Yaffa Szamet and Dr. Naama Ramot, Solfy was implemented in the students' pedagogical path.

The following graphs represent the total number of students from the two academic institutions (The Oradea University and the Jerusalem College). We considered a group of 140 students, of both sexes, of different ages (between 20-47 years old), and especially of different levels of musical training.

Figure one follows the number of registered logs in three months (October - December 2021). The first 104 solfeges belong to the 26 lessons from the first level of difficulty in the Solfy program, and the next 112 solfeges belong to the 28 lessons from the second level of difficulty. Out of the 140 users, we can see that 50% progressed quickly to the middle of the first level (the first 60 solfeges), the proportion of users who in this interval of three months reached the end of the second level being 7%.

Figure 2 graph shows the average recorded solfeges, pitch, duration, and note name errors. "Avg recordings per exercise" is the average number of records until the next exercise. It is around 5-6 per exercise and does not increase in more advanced activities than towards the end. This probably indicates that although the solfeges are becoming more complex, the students have learned to cope with the increasing difficulty. "Avg pitch errors" means the average pitch errors, which do not increase or decrease with more advanced exercises. "Avg timing errors" and "avg syllable errors" mention duration and, respectively, name errors. It can be seen that there are more pitch errors than duration or note names.

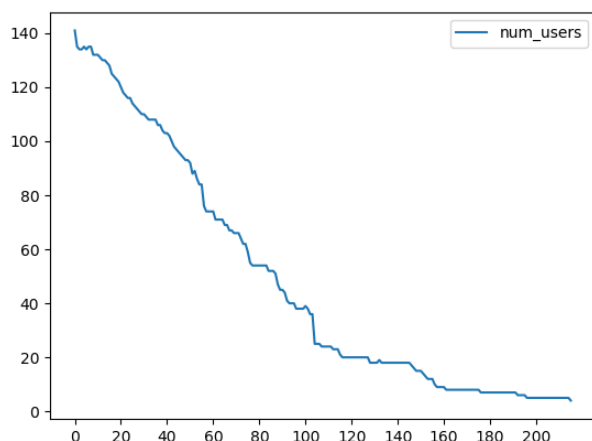[17] https://socioumane.uoradea.ro/ro/departamente/stiinte-ale-educatiei
[18] https://www.michlala.edu/
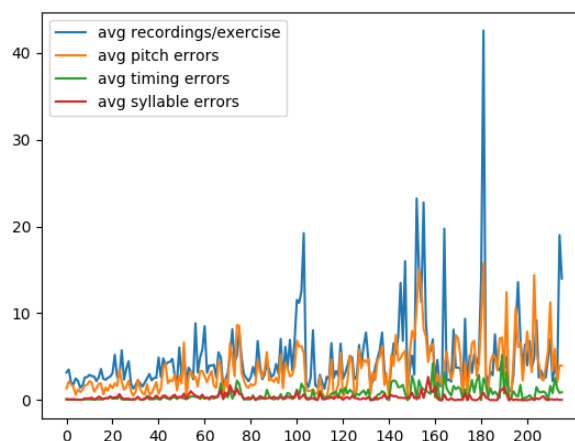
Figure 1 – *Registered logs*

Figure 2 – *Averages of solfege activities*

It is possible that by the end of the 2021-2022 school year (end of August), most students will complete the second level of the Solfy program and continue to the next level. This will give them the self-confidence that when they begin their teaching career, as a teacher in school, they will implement the program in their classrooms and use it in complete symbiosis with the traditional methods and contents.

Solfy: a safe platform for individualized musical literacy training among students of electroacoustic music

Remote education has proliferated in academia since the outbreak of COVID-19 in 2020, and its rapid implementation forced educators to quickly devise new ways to optimize their classrooms in this new mode. While online and blended education formats and technologies have been developing for decades, the immediacy of the shift in teaching mode allowed, in fact, demanded quick experimentation with new communications and educational software (Bond, 2020; Toquero, 2020; Oliveira et al., 2021). In this context, Solfy has been introduced to students of electroacoustic ear training at Concordia University in Montreal to assist in developing their musical literacy and aural skills. As a result, Solfy quickly emerged as a valuable and emotionally safe platform for students to train their aural skills and musical literacy individually.

Electroacoustic studies at Concordia University center on the acousmatic tradition is a rigorous theoretical framework for developing sound artists, sound designers, electronic musicians, and audio professionals. Students joining this program arrive with diverse levels of musical literacy and hearing abilities. The program focuses primarily on developing their sonic aural skills (i.e., frequency, loudness, spatial, and timbral discrimination), inspired by perception studies and auditory scene analysis (Bregman, 1990; Tsabary, 2012). Additionally, all students must reach a functional ability in tonal and metric hearing, making them conversant in musical theory, notation, and instrumental composition.

The extreme diversity in musical backgrounds and skill levels among students of electroacoustic studies at Concordia University has steered the electroacoustic ear training course design towards individualization of the skill acquisition process through methodical home practice (Tsabary, 2013), utilizing various aural training tools and software, some

designed by students (Tsabary, 2019). Furthermore, being in the highly technological field of electroacoustics, this student body is also strongly technologically-literate by definition and very accustomed to software-based learning environments, making the introduction of Solfy seamless.

Among the most common comments in students' reports are those that describe a sense of shame for not feeling as strong as other students in aural musical skills. In classroom solfege exercises, students are often apprehensive and distracted by a sense of inadequacy and exposure, which prevents them from delegating the required attention to their immediate aural task of singing the right notes. On the other hand, an individualized home-practice-centered skill acquisition process is designed to be safe and inclusive to students of all ability and confidence levels. In addition, this process allows them the necessary time to tackle emerging blocks and challenges along the way without worrying about how their (felt) inadequacy reflects on their image among their peers and teachers.

According to students' reports and answers to surveys, the essential requirements for this individualized aural skill acquisition environment are speedy, specific feedback, a gamified reward mechanism, and a diversification of the practice activities (Tsabary 2013; 2019). Solfy is well-positioned to provide these requirements. In the context of the electroacoustic ear training at Concordia, diversification is achieved by utilizing Solfy among other software environments (e.g., Inner Ear, Abaci, Auralia, Teoria.com, and others) for training various aural skills.

Perception and production

Diversification in the aural training environment can help alleviate boredom and break away from the frustration of getting stuck without measurable progress in some exercises. Another form of diversification is a multimodal approach to aural training, specifically through the "perception vs. production" dichotomy familiar in speech perception training (Koo, 1970; Cleland et al., 2019; Liu et al., 2020). The perceptual (e.g., identification, dictation, transcription, etc.) and the productive (e.g., solfege, production of specific parameters on an instrument, imagining, and composing) training modes complement each other and enrich the manners of ear training students approach their aural skill acquisition. In essence, singing solfege can help when students get stuck and frustrated with melodic dictation, especially when having difficulty remaining engaged with the task at hand or maintaining attention on the heard signal. Furthermore, switching to singing solfege can help in rejuvenating engagement levels due to the interactive nature of the feedback loop between hearing one's voice and adjusting *"precise vocal motor control to make sure that the vocal output matches the intended notes or melodies"* (Kleber & Zarate, 2014, p.5).

In our observation, electroacoustic students with minimal formal training in music literacy struggle with melodic dictation more than with most other tonal skills, even when their interval recognition and rhythmic dictation skills are at sufficient levels. According to conversations with students, this results primarily from attentional and working memory resource depletion (Chen et al., 2018; Kahneman, 2013); as the tasks of notating music, listening to intervals, listening to rhythm, and orienting oneself in the tonal and metric settings result in a state of

cognitive overload for students who are not yet sufficiently skilled to combine all these tasks in a time-dependent flow.

Solfege allows a production-based channel for musical training, where students sight-sing to develop their familiarity with melodic patterns and contours in a tonal context and the flow of metric notation. Solfege in the classroom is unquestionably valuable and can be fun, but it has not proven effective among students of electroacoustic studies who struggle with this skill because the tempo and pace of classroom solfege do not allow them to benefit from it. Working with Solfy allows the necessary individualization of speed, allowing students to develop comfort with associating notated music and melodic sequences at their own pace. In time, patterns – especially stepwise sequences – become more speedily recognizable and therefore free up working memory and attentional resources for students to recognize intervals and tonal relationships.

Navigating difficulty levels
This individualized learning environment depends on students' ability to self-manage and adjusts difficulty levels in their various home practice sessions. Students have varying approaches to difficulty-level navigation. Some like to start at the basics and move forward as they succeed in each level, while some get bored with this approach and prefer to jump to a high degree of difficulty and navigate their way back to where they are comfortably challenged.

In its earlier stages, Solfy allowed only linear progress of difficulty levels (i.e., one could only increase practice difficulty levels after completing all the ones below). Therefore, it did not allow the free navigability that electroacoustics students at Concordia were looking for. Adding free navigation required a rethinking of a fundamental element of the software design—its A.I. learning mechanism designed to adapt to individuals' recorded voices (their intonation, register, rhythm, note name pronunciations, and the acoustics of the recording situation). Furthermore, the software's A.I. was initially designed to operate behind the scenes, collecting data during the linearly arranged practice sessions; therefore, free navigability demanded another way to collect these data. For this purpose, Solfy developers Morel Koren and Adoram Erell added a dedicated "Adapt your voice" module, which provided the necessary methodical data for the software's A.I. before opening free navigability for all Levels.

Typically, electroacoustic students who are beginners in music theory, ear training, and notation can quickly succeed in sight-"humming" of written melodies, mainly when the tunes are based primarily on stepwise motion. However, being required to sing note names demands another attentional load, which they sometimes find confusing. Solfy trains students in developing a comfort with connecting notation and sound, and once they acquire this skill, attentional and working memory resources for more challenging melodies are freed up. Of note, solfege in the bilingual Montreal has an additional consideration regarding naming notes: Francophone students use the typical "do-re-mi-fa-sol-la-si," while Anglophone students replace the "si" with a "ti." It appears that Solfy's A.I. can handle this diversity.

Immediate feedback

As previously reported, a training environment's ability to provide immediate feedback to students has been shown to be most effective in maintaining students' sustainable engagement and learning. Solfy delivers such feedback at the end of each drill, where red notes indicate specific pitch inaccuracies, red note-names record incorrect note pronunciation, and red dynamic symbols draw attention to not following volume instructions. With a small number of errors, the exercise is deemed successful, and students have the choice of whether they wish to redo or proceed to another solfege. In addition, flawless performances are incentivized in Solfy through replaying the recording of the student's singing accompanied by a midi orchestra. This specific and immediate feedback allows students to focus and correct specific errors—a crucial component of skill development and individual practice (Hallam, 2001; Waggoner, 2011). This gamified but safe environment—being permitted to move forward or retry as many times as one likes and incentivized through reward—makes for a helpful training environment for students finding their comfort with new skills in a home-practice setting. This type of individual attention and pacing is not typically available in the classroom.

Conclusions

Singing solfege is a difficult task and is usually practiced mostly in vocational music schools where the students also learn to play a musical instrument and use it as intonational support. However, studying solfege in the general education system is a rare or almost non-existent practice for objective reasons. Under these conditions, changes can be initiated top-down by the ministers, bottom-up by the teachers, or both. Implementing Solfy in schools, starting with primary grades, may pave the way for music literacy for the majority who cannot afford private music lessons.

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