

Perspectives for Music Education in Schools after COVID-19: The Potential of Digital Media*

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Abstract: Innovations in research fields related to computer music and the advancement of the music industry have also influenced the digital sector for music education. Although many kinds of educational, edutainment, and entertainment music software appeared before the pandemic and are still in use, with the COVID-19 crisis and restrictions, it seems that music education in the primary classes has not systematically and thoroughly benefited from the innovations and advances reported by science and the music industries. However, the current need to teach music online could have an effect on the use of digital media after the pandemic. We present examples from the Netherlands, Romania, and Israel that lead to observations and suggestions about the potential of digital media after COVID-19.

Keywords: music education, online music learning, singing, solfege, music literacy, primary education, voice synthesis, artificial intelligence.

Introduction

More than sixty years after humankind successfully programmed a computer to generate sounds from a digital composition, and almost forty years after the invention of a standard for sharing musical information digitally – MIDI (Musical Instrument Digital Interface), and the invention of the Internet, it can be said that digital media brought significant changes in almost all fields of music. Writing, composing, performing, recording, storing, disseminating with or without video are encompassing producing and consuming computerized music and digital media. Exceptions are those musical performances that do not use any instrument or device requiring electricity.

In the last decades, an abundance of software dedicated to the educational market has appeared, offering digital solutions for the many challenges of music education. Private companies, governmental research institutions, and academies have all started initiatives on developing digital products for music education. This demonstrates the need to update music education processes according to developmental changes in the science and music

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industries. This article describes the general potential of digital media, followed by international examples of how digital media were used for remote music learning during the COVID-19 pandemic, zooming in on music education in the Netherlands and Romania, and on an AI-based solution from Israel, for online teaching and practicing Solfege, called *Solfy*, which has already been implemented in a pilot scheme in Romania.

Digital Media in Music Education before COVID-19

Integration of Technology

Although many tremendous advances based on significant scientific research and inventions have been recorded in the field of computer music during recent decades, their influence in updating formal music education in line with these technological advances seems to be much slower – see, for example, the VEMUS (Virtual European Music School) project (Tambouratzis et al., 2008). This gap in technological integration has also been documented in other literature (see e.g. Bauer, 2014; Dorfman, 2013; Gall, Sammer, & De Vugt, 2012; Nart, 2016). It is also a fact that not all teachers embrace technology to the same degree (see e.g. Scherer, Siddiq, & Tondeur, 2019; Teo, 2011).

Potential of Digital Media

Despite the problem of technology integration, the different classifications used by music education researchers in digital media and the provided examples indicate various technological potentialities for music education. For example, with reference to Reimer's musical roles (2003), Dorfman (2013) recognizes different roles that can be addressed with technology for technology-based music instruction (e.g., composing, performing, improvising, listening, music theory, and musicology). In a similar way, Bauer (2014) recognizes various types of activities in music education that can be addressed with technology. For creating music (e.g. improvisation, composition, audiation) and music theory training, Bauer states that technology can be helpful for instructional support, as a means to think in terms of sound, and for immediate reflection on a composition, even when no musicians are around. For performing music (e.g. feedback, modeling, motivation to practice, psychomotor learning), for example, he remarks that technology can be helpful for effective musical practice, for providing exemplary performances along with feedback, for learning aural and visual skills for improving musical literacy, and for providing new rehearsal and performance opportunities. Technology can provide access to abundant media for responding to music (e.g. intuitive and informal music listening), and also for the assessment of music learning (e.g. portfolios, summative assessments, checklists, rating scales, rubrics). Bauer also covers the use of technology for instructional design and productivity for professional development.

Brown (2015) classifies different uses of music technology, namely for creation (e.g. sound recording, music production, aural awareness, and music theory training, music publishing, and music and other art forms), presentation (e.g. presentation platforms, sound reinforcement, electronic music performance, and machine accompaniment), reflection (e.g. the Internet, music scholarship, and commentary, learning online, and assessment), and implementation (e.g. administration and productivity). Focused on education in general, Lai and Bower's (2019) classification of technologies in education shows that the range has broadened even further, expanding applications to MOOCs, digital storytelling, feedback systems, programming, virtual reality, augmented reality, robotics, and blended learning.

Pre-COVID-19 Digital Media Use in Europe

The publication *European Perspectives on Music Education: New Media in the Classroom* (Gall et al., 2012) presents ICT (Information & Communications Technology) in varying levels of mainly formal music education from different European perspectives. The presented research and examples of ICT implementation show a wide variety of different technologies and approaches and differences between countries with regard to the implementation and availability of ICT. The presented applications range from digital media and portals for searching and retrieving music, information, and learning materials, and for music theory learning and musical skills training (e.g. online music learning methods, YouTube) to applications for practicing music (e.g. sequencing programs, music and video editors, notation programs). In addition, a variety of media is used in music education, ranging from CD-ROMs that accompany textbooks to mobile phones. On the other hand, there are also commonalities, especially with regard to the type of software programs that were reported. These include music notation (e.g. *Finale*, *Sibelius*, *MuseScore*), music editing (e.g. *Audacity*, *Wavelab*), MIDI sequencing (e.g. *Cubase*, *MAGIX Music Maker*, *Logic*, *Garageband*), and music accompaniment (e.g. *Band-in-a-Box*).

But which of these potentialities were more widely used during the COVID-19 pandemic? Since no research has been done on this subject, as far as we know, a comprehensive answer cannot be given. However, we can provide examples from different European contexts.

Remote Music Learning during COVID-19

Sharing Knowledge to Bridge Distances

Born of the need to find alternatives to the frontal teaching of music, the Dutch Association of Music Teachers (VLS) called on its members (i.e. music teachers trained at a conservatory with a bachelor degree in music in education) to share lesson materials, links

to online technologies, and assessments that they had used and liked for teaching music. These materials were collected on the VLS website (VLS, 2020) and are organized in six categories (translated from Dutch): 1) Music lessons at home for parents and children in primary education; 2) Teaching methods in primary and secondary education; 3) Online tools for secondary education; 4) Teaching materials for secondary education; 5) Teaching ideas from music teachers and others; 6) Final exams, secondary education special. In addition, general tips and other suggestions are provided via hyperlinks to an external blog on learning at a distance, an external *Microsoft Word*-document that contains a list of working methods and energizers for *Microsoft Teams*, and popular *Facebook* groups in the Dutch primary education and secondary education communities. Furthermore, “wise words” from one of the VLS members are shared in a video.

The hyperlink to the first category, *Music lessons at home for parents and children in primary education*, opens a web page that lists a video with suggestions for remote music teaching in primary education and twenty-three hyperlinks that link forward to instruction videos, websites, and online portals, including songs, music activities, music lessons, blogs, and tutorials. Among these hyperlinks is a link to an online music app (*Google Chrome Music Lab*), which is accompanied by a hyperlink to a video tutorial by one of the VLS members. In addition, seven hyperlinks to online portals of commercially available music education methods are provided. During the COVID-19 lockdown in the Netherlands, much of their content was offered for free. Finally, also provided are two external lists of the Dutch National Centre of Expertise for Cultural Education and Amateur Arts (LKCA) and VONCK, VLS’s partner association for arts, dance, and theater teachers. One or a few lines of explanatory text introduce all hyperlinks or items.

The second category, *Teaching methods for primary and secondary education*, overlaps the hyperlinks to online portals of music education methods and the lists of LKCA and VONCK provided in the first category and extends the list to secondary education. Hyperlinks are listed to online portals of three Dutch music education methods (*BeatsNbits*, *Intro*, *Musicbox*), one music theory and ear training method (*Earz*), and a sub-portal of the Dutch music copywriter organization (BUMA), aimed at music education.

The third category, *Online tools for secondary education*, lists digital musical instruments and studio tools. These can be subdivided into dedicated virtual instruments (i.e. *Korg iKaossilator*, *Virtual Piano*, *Virtual Piano GM*, *Online Keyboard*, and *Online Pianist*), studio and recording tools (i.e. *Ableton Live*, *Bandlab*, *Garageband*, *Soundation*, *Soundtrap*, and *Spire*), instruction videos made by music teachers for different purposes (i.e. *Bandlab*, *Garageband*, and *Soundtrap*), tools with an educational aim (i.e. *learningmusic.ableton.com* and *learningsynths.ableton.com*), and an external list of music apps, compiled by LKCA. Some of these tools are free or were free during the COVID-19 lockdown in the Netherlands. An offer is also listed for a free online workshop for students

and training and support for music teachers who want to get started with *Ableton Live*, offered by BUMA. All the listed items are introduced by explanatory text.

The fourth category lists teaching ideas from five music teachers. One of them suggests writing new lyrics on a current theme (e.g. related to COVID-19) for an existing song, using *Google Docs* from home, and having the students record their lyrics. The recordings can then be edited into one version. Another music teacher suggests using a conference tool, such as *Microsoft's Teams* or *Zoom*, to celebrate a pupil's birthday by singing a personal message and inviting house members to play along with anything that makes a sound. Yet another music teacher suggests using *Morse Code* (invented by S. Morse and A. Vail in 1838) for ear training, while another music teacher created a mix of seventeen well-known music hits for students to guess. In addition, short music-related activities to be done at home (e.g. searching for things that make sounds, calling your grandmother and playing her a song, cleaning your instrument) were suggested. Finally, reference was made to a well-known Dutch nursery rhyme songwriter for his training videos to learn how to play the ukulele.

The final category, *Final exams, secondary education special*, offers information for taking music exams during COVID-19, including hyperlinks to official websites from the Dutch government.

Digital Media Most Used during the COVID-19 Pandemic

The items mentioned on these web pages provide a broad overview of digital media that music teachers' association members in the Netherlands would recommend to others for use in their music education during the COVID-19 lockdown. When focusing on the items included in four of the six categories of the VLS website, namely *music lessons at home for parents and children in primary education*, *teaching methods for primary and secondary education*, *online tools for secondary education*, and *teaching materials for secondary education*, many items classified in the literature are represented in the digital media listed on the VLS web pages, though in varying degrees. With regard to Bauer (2014), Dorfman (2013), and Brown (2015), all categories were represented in the lists, but mostly included performing music and creating music. Regarding Lai and Bower (2019), digital instruction through instructional videos and lesson designs are strongly represented in the lists. This is not surprising, since VLS requested this. Furthermore, the digital media listed do not represent all technologies in Lai and Bower's classification. For example, no applications of virtual reality or augmented reality are referred to. Additionally, website statistics suggest that the web pages were visited throughout the entire lockdown period with a peak during the first weeks of the lockdown. This could mean that visitors continued to look for learning materials and digital tools during the lockdown. In turn, this would confirm the potential of digital media for retrieving information, which is also illustrated by the EAS publication (Gall, Sammer, & De Vugt, 2012).

Solfy: An AI Solution for Online Music Tuition

An example of a solution proposed for online music education during and after COVID-19 is the AI-based digital platform *Solfy* (<https://www.4solfy.com/>), for teaching and self-practicing Solfege. The initiative, which was led by Tzipi Koren (music teacher), Dr. Adoram Erell (expert in digital voice recognition, analysis, and processing), and Dr. Morel Koren (music teacher), received two consecutive grants from *The Israel Innovation Authority* that allowed the project to start operating. *Solfy* is still in development but is already suitable for teaching and (self-) practicing online and is offered free throughout the 2021-22 academic year, or until the restrictions imposed by the pandemic will be lifted.

It is an aid for music teachers and general teachers in approaching this subject locally or remotely and is especially effective as an interactive tool for students to practice Solfege individually at home. *Solfy* includes voice synthesis, analysis, machine learning, and new methods of learning the musical language (among others proposed in the past by Dalcroze, Kodaly, and Orff). *Solfy* “sings” Solfege with a synthesized voice from digital scores, “listens,” records, evaluates users’ performances, provides feedback, and keeps records on progress. In the classroom, the platform can be used for rehearsal and teaching, singing together for about 10–15 minutes, and giving homework, while students will use it at home for individual practice, assisted by the artificial intelligence of the platform that provides feedback on the correctness of singing Solfege. Teachers can remotely monitor the results of students’ activities asynchronous, after the students have practiced Solfege.

Description and Specifications

Solfy displays two distinct modes: *Explore* (*Solfy*) and *Practice* (*Solfege*). *Explore* does not require registration, permits trying out the teaching materials without restrictions, listening to the Solfeges (*Play*), or recording them (*Record*), but it does not provide feedback on the accuracy of the execution. The *Record* button includes a mini submenu for recording with *MIDI+beats* (MIDI generated guide and metronome sounds), with *Beats* (only metronome sounds), with *Orchestra* (orchestral accompaniment), and with *Mute* (without any audio support, but only visual).

The mode *Practice* requires registration by filling out a simple form, accessible via the *Sign In* button. Registering, under the *Group* heading, teachers (or independent users) will choose *Independent*, and students will tick the name of the *Group* created by their teacher.

In order to prepare the groups, teachers will contact *Solfy* by mail (4solfy@gmail.com) to receive a *teacher status*.

The mode *Practice* provides feedback after each recording. This requires users to wear a headset (audio headphones with a microphone), be in a quiet environment, and go through lessons and exercises progressively, according to the requirements stated by *Solfy*

in short messages. In *this* mode, students listen to a Solfege exercise (pressing *Play*) and watch the notes on the digital score. Equipped with the headset and hitting the *Record* button, they sing and record the Solfege, receiving feedback about the execution. Inaccuracies in the feedback: name of the note, pitch, duration, and intensity, will appear in the score in red. The accurate performances will appear in green and reward the user with an accompaniment, *Orchestra*, added automatically to the *Record* submenu. These accompaniments are custom-made, prepared by the composers Bogdan Focșăneanu (Romania, Canada) and Michael Dulitsky (Ukraine, Israel). The composer Inon Zur (Israel, USA) gave *Solfy* permission to use some of his musical works as Solfege exercises, including the original recordings, as *Orchestra*.

The function *Review (your work)* allows users to examine the recorded Solfege exercises, both in form of a statistical table, and in a playable music score. The statistical table displays the name of the exercise, type of audio guide used, tempo, number of successful performances, and pitch, duration, syllables, and dynamics errors. The playable music score permits reviewing and listening to past recordings, along with the feedback score received at that time.

The function *Recording (test)* allows checking the headset connection and the quality of the recording.

The function *Adapt (Solfy to Your Voice)* allows advanced users, who already know how to sing the notes, to take a short test designed to help *Solfy* build an *acoustic voice profile* necessary to evaluate the user performance.

The function *Teacher (View)* can be accessed by teachers who received a teacher *status*, and have groups of students enrolled in *Solfy*. It allows the teachers to create and organize the students into groups, to monitor and coordinate their activities remotely, giving access to students' statistical tables and their feedback in an asynchronous manner, meaning at any time after the student activity.

The Content

Solfy's content is progressively ordered in levels, lessons, and exercises. The lessons can be approached modularly, at an average rate of one lesson per week – as decided by the teacher.

A level contains 26–28 gradually staggered lessons, each lesson consisting of four Solfege exercises: two *exercises* and two *songs*. Each new lesson adds 1–2 new notions, with concrete examples, and the student needs to complete the respective Solfege exercises chronologically and consecutively in order to move on to the next lesson. Practicing the lessons from the first level, a beginner (aged 7–11) will start to understand his auditory and vocal possibilities, will learn and practice the sounds and notes *sol, fa, mi, re, do*, the *2/4 measure*, will know the *halves, quarters, eighths*, and their respective *rests*, the dynamics *forte* and *piano*, *arpeggio, legato* (tie), *syncopé*, and *counter time*.

On the second level, the students will consolidate these notions, learning new subjects: the *3/4 measure, la, si, do* (on score), and *si, la* (under the score), singing in canon and using *1-2 sharps*.

The materials on the third level consolidate the previously learned notions, adding: the *4/4 measure, 1-2 flats, modulation, transposition* (offering the same Solfege in different scales), and exercises with *three sharps and three flats*.

To proceed to the next lesson, students need to record all four Solfeges from the current lesson and succeed in at least one of them. At the same time, *Solfy* gives students who need more time for practice the opportunity to repeat during the homework, a few times a week, until they succeed.

Using Solfy in Class, Online, and in (Self-) Practice at Home

For beginners (aged 7–11), *Solfy* can be used for 10 to 12 minutes in a local or remote music lesson, as an interactive teaching material, combined with traditional methods (such as those of Kodaly, Orff, or others). Based on this, the teacher can give homework (to practice the Solfege three times a week for approximately 10 to 12 minutes each time), and to monitor students' activity through the "Teacher" function.

Teachers can implement a similar scenario, adapting teaching plans with *Solfy* according to the musical level of intermediate grade class (ages 9–12). For example, to consolidate first the materials from level one, then proceed to level 2 giving homework each week, to self-practice individually at home. For more advanced grades (ages 10–13), the general scenario is similar, the final decision being made by the teacher.

For the primary classes in vocational schools, which benefit from specialized theory and Solfege classes, *Solfy* can be considered a teacher's assistant: assisting in preparing the homework, tracking the activities, keeping records of the feedbacks and progress, and reporting on these to the teacher.

Currently, *Solfy* contains only three of the six designed study levels, to which will be added over time, collections of songs from different times and geographical locations.

Music Education during COVID-19 in Romania

Implementation of Solfy

Professor Irina Florian, Music Inspector of Iași County, authorized the use of *Solfy* as a first pilot scheme in November 2019. Professor Ciprian Juncă implemented it at the *Ion Simionescu School*, Iași, in two classes with pupils aged 11 and 12.

During the pandemic in Romania, especially in the small cities and villages, not all the schools were ready from an IT point of view to switch to online education, nor did they have experienced teachers in the field of technology. Other schools, especially from the big cities, adapted to online education in a relatively short time by using recorded music

(CD, DVD, YouTube), the music library of *Radio Romania Musical* through the national project *Listen to Five Minutes of Classical Music*, video conference solutions, and some interactive music education books. Among these online solutions, several music teachers from schools and universities under the Romanian Ministry of Education authority adopted *Solfy* as a new option.

In the period of restriction imposed by the pandemic, the number of teachers interested in implementing the platform in their classes increased promisingly, as did the same proportion of active students. *Solfy* was an immediate solution for online tuition and practice. The number of enrolled students is now eleven to twelve times higher than before the pandemic, and the number of active users increased to approximately 75 percent of those enrolled. From the learning analytics of the platform, we can see an ongoing decrease in the number of mistakes made by the beginners, who continued to make new attempts with better results after a few inaccurate recordings – which we consider gratifying. Subjectively, these data are promising for the platform developers and, objectively, to validate the solution as being useful for the wider promotion of singing by practicing Solfege.

Between March and July 2020, *Solfy* was used at the University of Oradea, Faculty of Social Humanistic Science, by students enrolled in the general teachers' courses. Dr. Muntean, who led the project, addresses in his book some of the requirements for implementation and urges the use of digital media for contemporary learning (Muntean, 2017a):

[...] All digital resources can be used as long as they respect the specific features of the students' ages and the teachers' aesthetic and didactic criteria. [...] In conclusion, we can assert that digital resources constitute a must-have for a school anchored in the contemporary world not only because they are part of everyday life, but also because they are beneficial for the education of primary school children.

In a written interview about the use of digital media during the COVID-19 crisis (2 October 2020), Dr. Monica Buhai, inspector of arts from Tulcea Country, mentions some challenges and facts:

[...] the most useful are those programs/platforms that help not only the transmission of knowledge and the formation of skills, but also the evaluation of learning outcomes. The use of information technology in the act of learning is a definite necessity, taking into account the fact that man is a social being who needs to exercise group membership, to assume collective roles, and to emphasize.

In a webinar organized in December 2020 by Dr. Diana Sârb at the National Academy of Music George Dima, Cluj, for students learning how to be music teachers, *Solfy* was presented as a new addition to the digital toolbox of future music teachers.

Teachers with special interest in singing and practicing Solfege were encouraged to join *Solfy*'s initiative and make their contribution to promoting music literacy.

Potential of Digital Media after COVID-19

The examples provided illustrate some of the potentials of digital media during the COVID-19 pandemic through suggestions of music teachers and their views and those of other actors in the field of music education. Although the contexts of music education differ from country to country and analysis has been done only loosely, some general observations can be made from this.

From the Romanian context, it is possible to understand that aspiration and motivation to use technology in music education existed before the COVID-19 crisis. The technological base conditioned the use of technology in music education.

From the Dutch context, it becomes clear that VLS members (i.e. music teachers), shared a wide variety of learning materials and lesson ideas during the COVID-19 crisis, representing many categories of digital media published in literature – but not all. Not only do the digital media listed on the web pages illustrate the potential of digital media, but the website itself also served as a digital medium and illustrates the potential of digital portals for finding and sharing learning aids. This potential of retrieving information is also highlighted in the Romanian examples. Furthermore, many digital media, including *Solfy*, were made freely available during COVID-19. Apparently, there was not only a need to discover, but also a willingness to share.

The COVID-19 lockdown forced music teachers in the Netherlands to use digital media for teaching music online because they simply had no other option. It is likely that knowledge of the digital media (experience, skills) may have increased during the pandemic. In Romania, too, the pandemic practically forced the move to teaching online and therefore made it obligatory for music teachers to learn to use the technology.

Knowledge of technology is conditional on having so-called technological pedagogical content knowledge (TPACK). In other words, the knowledge needed for a successful implementation of technology in music education (Koehler, Mishra, Kereluik, Shin, & Graham, 2014; Mishra & Koehler, 2006) also leads to the acceptance of technology (Scherer, et al., 2019). Thus, since teachers had to spend hours working with digital media during the COVID-19 lockdown, they might be more open to using digital media in music education after the pandemic. However, the opposite may be true for those teachers who had negative experiences with digital media during COVID-19. The lockdown also made it clear that synchronized music making through video conferencing platforms still presents a challenge, and that (music) education also serves a social purpose, which could be lost if solely online lessons are provided.

Finally, we hope that this article has shown the strength of collaboration through sharing ideas, learning aids, and views, which help to bring music education forward. Collaboration would also benefit the development of digital media for music education. Organizing a large pilot for technological and pedagogical tests in partnership with *EAS* members would help both. An interesting approach could be to collaborate with *Solfy* to provide a basis for systematic research, addressing the complex issues of promoting singing and music literacy in formal music education in different countries.

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