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Virtual piano instruction for the college learner

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Virtual Piano Instruction for the College Learner

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Abstract

This article investigates the affordability and feasibility of conducting virtual piano lessons for the college level learner. It proposes an approach that works well and requires equipment costing approximately $300 per student. We outline the pros and cons of conducting virtual piano lessons online. The main benefit is overcoming geographical distances, whereas limitations include challenges such as the instructor being able to check issues such as fingerings or dynamics. Latency is not a major problem as long as only one person is playing at any given time, as found in past work. The process of teaching and learning online requires the student to be strongly motivated, and it is helpful for instructor and student to have worked together before in non-virtual environments.

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Virtual Piano Instruction for the College Learner

In this article, we expand on the work of Kruse et al. (2013), who examined the efficacy of Skype piano lessons given by a piano professor to a music education master's level student at the University of North Texas. Kruse et al. (2013) found that virtual lessons occurred for convenience reasons: the student needed to be some non-commuting distance away and approached the professor with the idea of conducting Skype lessons. Overall, in spite of a few technological challenges such as occasional internet speed problems, the authors reported that the whole experiment was a success. In particular, they were able to control a Yamaha Disklavier remotely in one of the lessons: in this process, the student played at a remote keyboard, and the sound came out on the Disklavier at the professor's site (observers at this Disklavier site can see keys move).

Building on the themes raised in Kruse et al., this article adds contributions in three directions:

1. The approach we suggest for virtual learning involves mixing the student's voice with a piano signal, either electronic or from an acoustic piano with microphones, and routing the mixed signal directly to Zoom or Skype via an audio interface and a computer, *using affordable equipment*.

2. We report on Zoom and Skype piano lessons conducted trans-continentally, with the instructor in the United States and the student in France.

3. We report on the virtual piano lesson experience in the context of the COVID-19 pandemic.

Work on this paper began before the sudden shift to purely remote learning that occurred in essentially all universities in the spring of 2020; since then, the need for virtual instruction has increased drastically and so have the discussions about the problems of teaching online as well as some solutions. More recent developments have further addressed challenges of synchronous, remote piano instruction; we discuss them later in the article.

Two studies, conducted in an international setting with one involving a developing

country, discussed the advantages and problems of teaching online. Shoemaker and van Stam (2010) presented an example of music education via e-learning in rural Zambia, which made use of internet MIDI communication between two electronic keyboards for piano lessons, thereby bypassing the sound compression that occurs in video conferencing software. They employed both synchronous and asynchronous forms of virtual education. Koutsoupidou (2013) reported on a qualitative study involving a small number of instructors conducting virtual music education, including harp lessons (UK to US). The typical tool employed was Skype and a main problem was that latency made it impossible for teacher and student to sing together. Benefits included, of course, the breaking of geographical barriers.

Several other studies emphasized the impact of an online setting on student learning outcomes. One case discussed the experience gained by graduate students who served as instructors.

In a study on transitioning from traditional to online piano lessons for one 15- week semester, Dumlavwalla (2017) reported on the perceptions of young piano students (under 18), their parents, and their teacher on using a basic setup of a laptop or tablet, webcam and microphone. The author found that the quality of sound was an issue even with good internet access for each participant, and that it was difficult for the teacher to observe how well students implemented dynamic contrasts. It was also hard to instill rhythmic precision. The teacher reported not being able to match the same emotional connection with the student as during in-person lessons. Overall, the teacher felt the students did not meet their full potential during the online semester. Moreover, the teacher found that the students needed to be intrinsically motivated. Finally, teachers found that online lessons can foster student independence and provide educators with opportunities to try new pedagogical ideas.

In a case study of a synchronous online teaching internship, Pike (2017) reported on the experiences of piano students in a graduate pedagogy course who interned for eight weeks teaching underprivileged beginning piano students, thirty minutes per week. The equipment they used was state of the art; Yamaha Disklaviers were available to both the teacher and the student, provided by the university and by a partnership with a music store where the students went for lessons. Benefits to interns in terms of improved pedagogy appeared about half way

through the project. Interns who initially believed it impossible to teach beginners online came to realize that it was feasible, with at least one intern reported having learned how to help students become more self-sufficient. However, there were disadvantages; even with state of the art equipment, it was still impossible for the teacher and student to play together, or for the teacher to clap while the student played.

Pike and Shoemaker (2013) reported on the effect of distance learning on the acquisition of piano sight-reading skills by two groups of beginning piano students: one group (nine students) taught with face-to-face instruction and the second group (ten students) learning via online instruction. Students were given weekly fifteen minutes lessons on sight-reading for eight weeks. All students improved, and there was no significant difference in improvement between the face-to-face and online groups. However, students in the online group displayed more independence and stronger engagement than students in the face-to-face group. Typical latency limitations arose; for example, there was no possibility of clapping while the student played. The authors recommended using a MIDI connection where possible for better sound quality and suggested the possibly of adding fifteen minute weekly sight-reading lessons to a regular lesson schedule.

Common themes in these three studies point to technical limitations, but also to improved student independence and access to new pedagogical ideas for instructors.

A final study addressed the latency issue reported by a number of studies. Riley et al. (2016) reported on LOLA, a tool for Low Latency Audio Video, indicating lesser latency issues with LOLA compared with other tools such as Skype. This technology, with latencies as low as five milliseconds (Riley et al. 2016), could potentially allow a pair to play together, but the use of this free software requires special equipment which costs more than $5000.

Several main themes emerge from these studies: benefits and limitations of a virtual setting for piano instruction, technical challenges such as latency, and the cost of adequate equipment. Keeping these themes in mind, this paper presents an approach to conducting piano lessons at the college level on Skype and Zoom with a focus on affordability. The situation recounted here involves a piano professor in the Bachelor of Music program at the University of Massachusetts Lowell and a non-traditional student (i.e., an older student who is a professor

of data science in another institution with a number of interruptions in music studies over the past 35 years) pursuing a dual major in sound recording technology and piano performance. We outline the details of their experience with virtual lessons in the next section, with a description of the equipment utilized.

Experience and lessons learned

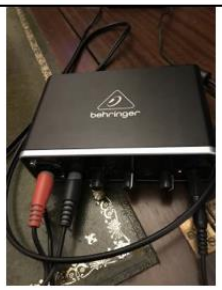
Both the piano professor and student in our study were experienced with occasional virtual lessons over several years (2017-2020). In addition, both were sufficiently motivated and technologically proficient to attempt virtual lessons when changes in learning environments and travel required it. To date, all virtual lessons have involved the instructor in the United States on a Wi-Fi internet connection, and the student in France on cable fiber optic connections in Paris and Toulouse or a cable ADSL connection in Brittany. Professor and student had worked together for an academic year before attempting virtual lessons and know each other well.

Until the summer of 2018, the lessons utilized a room microphone capturing both the student's voice and an electronic piano's speakers. This approach worked fine, but the sound quality was much higher once it became possible, beginning in the summer of 2018, to mix voice and piano signal directly into Skype. The absence of external noise on the student side (a plus in a Paris apartment building at 5 am) was also an advantage. Photos of the equipment used appear in Figures 1 and 2. Both the audio interface and mixer are very affordable, and the microphone is a good quality Shure WH20 dynamic microphone. Approximately $300 per student covered the cost of the equipment. While this cost is affordable, it is nonetheless beyond the reach of some students.

It is interesting that latency has not been an issue when only one person is playing at any given time. On the other hand, playing a two-piano work at a distance is a challenge for two reasons: latency does play a role, and only one person seems to be able to hear the other, because video-conferencing platforms such as Skype or Zoom cannot send and receive at the same time and thus prioritize one signal over the other.

Setup of lesson on Jan 6, 2019, 11pm (Professor, Boston) – Jan 7, 2019, 5 am (Student, Paris)

External mixer to mix voice andpiano signal



Audio interface to connect the mixer to the computer (BehringerU-Phoria UMC22)

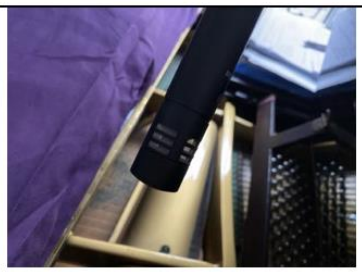
Shure WH 20 dynamic microphoneto capture voice

Standard earphones connected toaudio interface output

Still from July 31, 2020 Zoom recording, with second camera(iPhone) to capture angles

Figure 1: *Photos of equipment when using an electronic piano on the student side*

Setup of lesson on Jan 14 2020,10am (Professor, Boston), 3 pm(Student, Paris)
Acoustic piano (Schlimmel quartergrand 1990s)



Condenser microphone (AKG P170to capture both voice and piano)

Microphone setup

Still from Jan 14, 2020 Skype recording

Audio interface to connect themicrophone to the computer (Behringer U-Phoria UMC22)

Figure 2: *Photos of setup when using an acoustic piano on the student side*

Observations

Two other setups – one involving an electronic piano and one involving an acoustic piano on the student side – resulted in some different observations. These observations arise from research notes compiled after each lesson:

Virtual lesson Monday May 27, 2019 (instructor in Somerville, Mass, USA, student in Paris)

Video recording was tested on the student side on May 25. In testing a Skype video call with all equipment in place, distortion was heard on the student side in long notes in Debussy's prelude *La Cathédrale Engloutie*; this distortion disappears with earphones on the instructor

side. A hissing sound was remedied by lowering the level of piano input to the mixer to approximately 3. The stereo output level is high, at approximately 9, so that the student can hear herself play. The monitor level on the audio interface is high as well. The volume of the keyboard is about halfway up.

Observations from the piano professor:

1. I can see my student's fingers only from an angle so it is harder to check fingerings.
2. Rhythm issues need to be explained with words because if I clap it will not be exactly in time due to internet latency.
3. The sound is compressed so dynamics are harder to hear.
4. No hissing or distortion.

Observations from the student:

1. The professor had to use his cell phone as a Wi-Fi spot since his home internet broke down, but everything worked remarkably well.
2. Voice exchanges worked with no audible latency.
3. Immensely helpful solution when face-to-face lessons are impossible.

Virtual lesson Wednesday June 20, 2019 (instructor in Somerville, Mass, student in Paris)

On Tuesday June 19, a new setup with an acoustic piano (Schlimmel quarter grand from 1990s), one AKG P170 condenser microphone for both voice and piano, and one Behringer U-Phoria UMC22 audio interface (no need for a mixer) was tested; the gain was adjusted to avoid clipping in loud piano parts.

Observation from the piano professor:

Good sound quality but limitations of internet compression to judge dynamics etc., even on an acoustic piano.

Observations from the student:

1. Good sound and video, only one very brief interruption.

2. Good piano (and voice) sound on recording of session.

It is clear from these observations that with some preparation, a piano instructor can indeed conduct remote lessons quite smoothly. However, the process requires careful preparation and access to resources by the student.

Recent developments and Future Directions

From the example presented in this paper, it is very clear that virtual lessons are extremely helpful when geographical distance between instructor and student is unavoidable. The advent of the COVID-19 crisis has brought this issue to the forefront of academic practice, and at this writing, it is not entirely clear when any sort of normalcy will return to academic life and what this normalcy will consist of. Uncertainty is high, but it does seem likely that some form of virtual instruction will remain in place for the near future.

The challenges of synchronous, remote piano instruction specifically were addressed in a June 2020 webinar hosted by the Peabody Institute. Presenters Mario Ajero and Alejandro Cremaschi discussed approaches to remote instruction in class and applied lesson formats for both piano and non-piano majors. The presenters identified challenges such as inadequate internet access and no keyboard availability for some students. They also suggested a hybrid approach - synchronous and asynchronous - with students submitting videos before lessons and proposed a combination of optimized Zoom and cleanfeed.com (for improved audio streaming). Mario Ajero used a Yamaha Disklavier, which can be played remotely by any MIDI-capable keyboard.

Excellent sound and no internet problems occurred during a July 31, 2020 Zoom virtual lesson with an instructor in Arlington, Mass and a student in Dinard, France on an ADSL connection, as reported by the instructor and student discussed in this paper. The issue of limited angle vision was addressed by suspending an iPhone above the keyboard to provide

a second camera. It is quite easy to attend a Zoom session from two different devices, which makes this approach convenient.

Experience in the piano professor's studio suggests that both instructors and students see remote instruction as a second best to in person instruction, when there is no choice. Two students in the studio were able to obtain acceptable sound quality with setups similar to those described in this paper, but it is important to note that the cost of such setups, while moderate, is still beyond the reach of many. The cost of a Yamaha Disklavier is beyond the reach of most institutions.

The piano professor identified several possible advantages and limitations of the virtual experience:

1. Students have to develop a stronger capacity to self-structure their piano work.
2. More self-awareness is needed on the student side.
3. Some sound problems occurred (microphone cut-off for example), due to limited resources on student side.
4. The instructor has to anticipate physical and sound problems, making inferences from incomplete data and drawing from past in-person experience with the student.

We have seen that the latency issue is a limitation of virtual lessons, since it essentially bars playing together or clapping while a student is playing. One potential remedy might be to establish a latency-minimizing tool such as JackTrip (Chafe 2018, 2019). JackTrip (https://www.jacktrip.org/studio.html) is a tool for minimal latency in live synchronous music collaboration. This open source software application, constructed around 2010 by Chris Chafe and colleagues at Stanford University, creates room like resonances between internet end-points to try to replicate the physics that would occur if musicians played in the same room. It is useful here to remember that latency is an issue in contexts other than internet communication, for example in very large halls. JackTrip is available on Linux, OS and Windows, but setting it up is complicated.

JackTrip has been adapted to Raspberry Pi computers (low-cost credit-card size

computers that connect to a monitor and help foster computer and coding explorations by all). No known applications of JackTrip to synchronous music education are published, although JackTrip is listed as a resource by some music departments (https://music-cms.ucsd.edu/intranet/for_sp20.html).

In his Master's thesis, Angelli (2016) proposes an open-source internet-capable collaborative music production software toolkit, in which JackTrip is a component. This research does not focus on the critical low-latency needs of music performance. However, the author states, and this is key, that JackTrip can be configured with different objectives in mind, for example allowing a bit less reliability in favor of tighter latency.

Existing tools which intend to reduce latency for remote recording projects (such as Source-Connect, https://source-elements.com/products/source-connect , or the Audiomovers LISTENTO plugin, https://audiomovers.com/about_us/) do not currently allow for live synchronous teaching applications.

One possibly promising direction includes JamKazam (https://www.jamkazam.com/#), a tool that, in principle, makes it possible for musicians to play together synchronously. However, latency is still known to be an issue, and JamKazam is working on approaches to remedy the problem as of this writing.

Another option is to employ Jamulus (https://jamulus.io/), a web-based application which is easier to set up than JackTrip or JamKazam in that it does not require that the user establish a private server; instead, it provides a number of public servers to which users can connect. For example, easy "solo" functions make it possible for two groups to connect to the same server but hear only members of their own group. We have tested Jamulus for voice/piano rehearsals with satisfactory results. Latency is much improved, provided there is good internet access via an Ethernet cable. Importantly, each side can hear each other simultaneously which opens the interesting possibility that virtual lessons could run with Jamulus for sound and Zoom for video. We have tested this setup and found it to function well and better than Zoom sound, even with optimal Zoom settings.

Further future directions for research include re-examining the role of MIDI data

transmission approaches as well as combinations of in-person lessons with asynchronous AI based tools (such as Musiah, for example, https://www.musiah.com/online-keyboard-lessons.html). Finally, we suggest that, in the longer term, augmented reality may very well play a role in virtual teaching where we envisage the instructor appearing in the student space as a sort of hologram (and vice versa). Such technology carries strong potential, but further technological developments are needed. Current available VR (Virtual Reality) headsets are quite heavy on the head, and headsets such as the Microsoft Hololens are expensive as well. We may be at least ten years away from a world of hologram piano instruction, but it is possible that such time will come.

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About the Authors

Gena Greher is a Professor, Coordinator of Music Education at the University of Massachusetts Lowell where she teaches undergraduate and graduate level music classes in music methods; world music for the classroom; popular culture; curriculum design; digital audio and technology applications in music education as well as Sound Thinking, an interdisciplinary course in Computing and Music.

Her research interests focus on creativity and listening skill development in children and examining the influence of integrating multimedia technology in urban music classrooms through the lens of the music teacher education curriculum and School-University partnerships. Recent projects include: Performamatics, an NSF CPATH grant CNS-0722161 and TUES award DUE-1118435 linking computer science to the arts; Soundscapes, a technology infused music intervention program for teenagers with autism spectrum disorders; a music technology mentor/partnership with UML music education students and several local K-8 school as well as the local High School: and iPads in the Music Classroom for middle school students. She is a co-author on Computational Thinking in Sound: Teaching the Art and Science of Music and Technology, an outgrowth of an NSF funding and Sound Thinking class.

She received my Ed.D. from Teachers College Columbia University, where she was the Project Associate for the Creative Arts Laboratory (CAL), a professional development program in arts integration. As part of her work with CAL, she worked with students on the autism spectrum, as well as emotionally and behaviorally challenged students and their teachers at a New York City Public School located at Bellevue Hospital. This work involved using multi-media projects to connect with the students, integrate music into the curriculum and assess their learning.

Before entering the education profession, she was an award winning music director in advertising, working for several multinational advertising agencies producing the jingles and underscores for hundreds of commercials.

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Jacob Hiser is on the piano faculty at the University of Massachusetts Lowell, and is a collaborative pianist at Phillips Exeter Academy and Boston Children's Chorus. He is a versatile pianist and violinist who performs and studies many musical traditions from all over the world. Originally from Missouri, where he graduated from Missouri State University with a bachelor's degree in Jazz Studies, he now lives and works in Boston, having completed a master's degree program in Contemporary Improvisation at New England Conservatory. With his brother, he has performed professionally around the United States as the Hiser Brothers, and with the band Powder Mill, he has traveled as far as France to perform. During the summer, Jacob is a faculty member of two arts programs: Missouri Fine Arts Academy (a three-week summer residential program for highly motivated student artists in visual arts, theatre, dance, creative writing, and music), and Next Generation, a week-long piano/strings camp in Lawton, Oklahoma for middle school and high school students.

Dr. Brandon Vaccaro is a composer, performer, music producer, and audio engineer. As a composer, Vaccaro has received awards, commendations, and commissions from Iowa State University Carillon Festival, New York Youth Symphony's First Music program, the University of Denver, the University of Colorado, Boulder, ASCAP/SCI, the National Academy of Television Arts and Sciences, and the Motion Picture Sound Editors. As a performer and improviser, Vaccaro has been active in chamber and popular venues. He was guitarist of several innovative bands in Colorado's Front Range including Kallisti and Coefficient of Friction. He has also collaborated with S. Lyn Goeringer, Conrad Kehn (as MacroCephalic Cabal), Jesse Woods (as Ground), and Scott Schulz (as Shutter Trio). From 2007-2008, he curated a gallery series for music, sound installations, and audio/visual works in Denver titled Sound.scapes Presented by Mystery Cabal.

Vaccaro holds a Doctor of Musical Arts in composition from the University of Colorado-Boulder. He also studied at the Lamont School of Music, University of Denver and the University of Colorado, Denver. Vaccaro is currently the coordinator of Sound Recording Technology and an Associate Teaching Professor in Music at the University of Massachusetts, Lowell.

