e-Piano, A Case of Music Education via e-Learning in Rural Zambia

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ABSTRACT

A new educational environment is emerging within the field of applied music instruction. For the purposes of testing the viability of e-learning through the study of the piano, a unique relationship was established between a teacher in suburban North America and two students (currently ages 10 and 9) in rural Zambia.

Synchronous (real time) exchanges were initiated on a weekly basis through the use of a digital piano keyboard, a computer with Internet access, web-cameras, and video-conferencing software on either end of the connection. When the Internet connection was reliable, real time learning closely replicated traditional one-on-one music instruction in which student and teacher are physically in the same room. Synchronous communication was also investigated outside of individual instruction within group environments, in which the students joined with peers from across the globe in order to enrich the learning experience.

To supersede the poor audio quality of video-conferencing software between pianos, the participants of the study used Internet MIDI, a software application that enables two piano keyboards to control, synchronize, and exchange data electronically through MIDI technology. This technology made it possible to have a purely musical conversation within the lesson. To our knowledge, by participating in the beta testing of Internet MIDI, the participants of the study were among the first in the world to have access to such long-distance MIDI connections.

Real-time communication has many benefits, but because it is completely dependent on the quality of Internet connection, it can also be a frustrating experience if the connection is poor (e.g. audio reverberation, frozen video feed, dropped calls). Thus, it was necessary to seek an alternative form of communication – time-shifted learning.

In asynchronous (time-shifted) communication, lessons were exchanged between students and teacher via pre-recorded video, in which audio and video quality were not determined by the strength of the Internet connection. Once created, videos were posted and stored in password-protected albums on a variety of social networking sites. After the video was downloaded, the student or teacher could view it offline at a self-directed pace, pausing, rewinding, and repeating as many times as deemed necessary. Although positive, this form of learning can leave holes in the learning experience as it negates live interaction.

Due to drawbacks associated with real-time and time-shifted modes of e-learning when used in isolation, this study investigated the effectiveness of combining synchronous and asynchronous forms of communication within the learning experience.

The study confirmed the viability of e-learning through applied piano instruction. Participants determined that this arrangement is functional, and is strengthened with a reliable Internet connection. The study demonstrated that the most effective learning occurred when synchronous (facilitated) and asynchronous (self-directed) modes of learning were used in tandem.

Keywords
e-Piano, Music e-Learning, Distance Education, Synchronous, Asynchronous, Applied Music Lessons, Piano Pedagogy

1. INTRODUCTION
In recent years, much research has been devoted to the topic of distance education, its comparison with classroom education, (Bernard et. al, 2004), and its potential transformative effects (Garrison and Anderson, 2003). The concept of e-learning in resource-limited rural environments has also been explored; Bai (2008) has investigated its application within disparate economic areas of China; Pais (2007) and Hoorik & Mweetwa (2008) have explored its application and implementation within rural Zambia. However, up until this point, little has been written regarding distance learning as it pertains to music.

As recently as 2003, the substantial cost of Internet connection and video conferencing hardware was prohibitive to widespread synchronous education in music (Litterst, 2003). More current research has demonstrated that distance learning in music is not only feasible (Litterst, 2007), but also functional on a basic level (Dammers, 2009).

In late 2008, a unique relationship materialized between an eight year-old student (Student "M") in the rural village of Macha in the Choma District of southern Zambia, and a music educator (Kristin Shoemaker) in North America. Teacher and student have connected via the Internet on a weekly basis, during which time applied piano lessons have been conducted in real time across 8000 miles between the Minnesota-based studio and rural Zambia. One year later, in late 2009, a 10 year-old student (Student "B") from Macha, Zambia was added to the study.

Synchronous (real time) interaction has been achieved through video-conferencing software and new technology that directly links two piano keyboards through MIDI communication.

Real time instruction has been supplemented with asynchronous (time-shifted) lessons, in which pre-recorded videos are exchanged between student and teacher. Equipment involved includes video-recording devices, video-editing software, and social networking websites for video sharing.

The objectives of the study were: 1) to test the efficacy of applied piano lessons between two geographically disparate locations, 2) to provide perspectives on the benefits and challenges of synchronous and asynchronous learning in regards to the study of the piano, and 3) and to examine the effects of these two modes of communication (real time and time-shifted) when used in combination.

For this study, data were collected in the form of video-recorded real time and time-shifted lessons, field notes, and interviews.

2. METHODOLOGY

2.1 Synchronous Learning

On a weekly basis, the teacher has connected for real time one-on-one piano lessons with each of the two students, directly linking suburban North America and rural Africa for applied music instruction. Neither of the students had any prior background with the piano instrument, so they are considered to be beginning piano students.

2.1.1 Logistics and Equipment

To establish a real time connection for music lessons, a computer with Internet access has been used on either end of the teacher–student equation. In America, the rate of information has been processed at approximately 30,000 kbs download and 1,000 kbs upload. In Africa, a shared satellite link with 100 other users, has been 8:1 contended, with download rates of 1,024 kbs,and upload rates of 256 kbs. Committed information rate has been 128 kbs download and 32 kbs upload.

Although acoustic pianos would have been a suitable option, digital piano keyboards were chosen for the current study due to portability, cost, and maintenance. Both teacher and students have had access to MIDI-capable full-sized, weighted-key, digital piano keyboards (88 keys). Each MIDI-capable piano keyboard has been directly linked to the computer with either a USB cable or MIDI-interface, depending on the instrument being used.

For real-time communication, built-in web-cameras for video and built-in microphones for audio have been used on either end of the connection. External webcams or video cameras (connected to the computer by USB or FireWire) have been used as secondary options for video feed, allowing the teacher to toggle the camera view between face and hands for teaching demonstrations. For audio, a headset has been used as an alternative source of audio input and output.

Video-conferencing software applications have been used for weekly communication, including Skype, www.skype.com for cross-platform (Mac, Windows, Linux) one-to-one video chats and audio-only conference calls, and ooVoo, www.oovoo.com for video-conferencing in groups larger than two persons.

To overcome the audio compression that occurs in video-conferencing, a direct two-way MIDI connection has been established between the piano keyboards through Internet MIDI (www.timewarptech.com). This software application enables pianos (either MIDI-capable acoustic or digital) to control, synchronize, and exchange data electronically through MIDI technology. As musical data is sent out electronically over the Internet in real-time, a piano key that is played on one keyboard will sound the same key on the remote partner keyboard, making it possible to have a purely musical real-time conversation. In this way, the audio connection through the Internet is completely bypassed when interacting musically.

To our knowledge, by participating in the beta testing of Internet MIDI, we have been among the first in the world to have access to such long-distance MIDI data transmission.

2.1.2 Benefits

In a variety of ways, synchronous e-learning at the piano has closely replicated traditional one-to-one music lessons. Once teacher and students became comfortable with the equipment (several weeks into the study), the Internet began to act as a delivery mechanism for learning. The teacher has been able to give feedback and interact with the students in order to reinforce concepts, and to nurture proficiency in technique, performing, music-reading, and critical listening. Students have continued to make progress in the acquisition of piano skills. http://www.vimeo.com/10275517

When Internet connection is less contended, initial results of the direct exchange of MIDI data through Internet MIDI have been very positive. As the software develops, this connection will become the backbone of all synchronous interaction in applied piano instruction.

In addition to the aural communication it provides through direct, electronic signals, Internet MIDI has also supplied extra visual reinforcement in learning. Within this application lies an animated keyboard, which visually transmits MIDI data by illuminating piano keys on the computer screen as the notes are played. Using a color-coded scheme the student can watch his/her screen to follow the keys that the teacher is playing remotely, and vice versa. This visual aid has been crucial for clear communication between teacher and beginning piano students.

Real time learning has been valuable for one-to-one applied instruction, but it has also afforded the option of working within larger group environments. On a somewhat regular basis, young American music students from the piano studio of the Minnesota-based teacher have joined together with the piano students in Macha, Zambia for collaborative learning.

This has been constructive for students within the format of small-group video-conferencing (http://www.vimeo.com/10275787) and within audio-only conference calls, in which students have played pieces for each other, spent time in dialogue, improvised together, and participated in educational games together. http://www.vimeo.com/10261155

Consistent with the research of Singh (2008) in India, students in Macha have displayed enthusiasm regarding peer-to-peer interaction within the group format, as this type of communication has erased all geographic boundaries, and has given all students involved a window outside of their own communities.

2.1.3 Challenges

The exorbitant cost of Internet connectivity in Macha, Zambia (Matthee et. al) has prevented a consistent, strong Internet connection. Because synchronous interaction is completely dependent on the reliability of the Internet connection, teacher and students have frequently experienced video delay, audio feedback, and dropped calls. This can become frustrating for a young student.

Based on the teacher's observations, the video delay experienced during video-conferencing between geographic locations has

impeded rapid communication, and has slowed student progress slightly.

Additionally, the latency of video and audio in video-conferencing precludes one of the most satisfying aspects of music making - playing in ensemble. Latency could be improved by replacing Macha, Zambia's satellite connection with a land (terrestrial) or sea cable, an anticipated change. However, even with minimal latency, the limitations of the Internet currently prevent perfect musical synchronicity.

2.2 Asynchronous Learning

As a result of the challenges faced in synchronous communication, the teacher and students have been forced to look beyond real-time communication to asynchronous or time-shifted learning.

Time-shifted learning, or the exchange of lessons through pre-recorded video http://www.vimeo.com/7464853, has been valuable for our project. Although it cannot replicate the spontaneous, immediate interface that real-time learning offers, time-lapsed exchanges have presented a host of benefits, perhaps even challenging the assumption that the most effective learning is in real time.

2.2.1 Logistics and Equipment

For pedagogical purposes, essential equipment for this type of communication has included video and audio recording devices (e.g. built-in web-cameras and video cameras) and basic video-editing software (Mac's software application, i-Movie).

To capture the animated piano keyboard in Internet MIDI software and the virtual musical white board built into Classroom Maestro software www.timewarptech.com, it has been helpful to use screen-capturing software for instruction. The teacher has chosen to use Screenflow by Telestream http://www.telestream.net/, an application for Mac users only.

Once the video has been created, it must be shared in order for the student/teacher to exchange the video. The comparatively large size of video files (20MB – 100MB) is somewhat prohibitive to exchanging files via email. When a video file is compressed to meet the Internet provider's requirements (either in sending or receiving), the resulting file is often poor in picture and audio quality.

Social networking websites have eliminated transferring and storage issues by allowing users to conveniently upload, share, and store files. Popular sites like YouTube, Facebook, and Vimeo can be accessed at any time, while providing many sharing and privacy options.

After exploring the aforementioned software applications and social utilities, Vimeo was selected as the primary website for posting instructional videos for the study. Vimeo's site was most conducive to working with young children in its lack of advertising, its avoidance of "tagging" videos with non-related videos of questionable content, its uncluttered interface, its privacy settings, and options for user comments. Presently, all videos are organized into password-protected groups or albums on this site, most of which are hidden from public view and comment, but readily available to those involved in the music study.

It has also been possible to create age-appropriate online communities through Vimeo in which students can post and share

videos within a selected password-protected album, and subsequently, view and comment on other students' performances. http://www.vimeo.com/8210782

2.2.2 Benefits

With the medium of pre-recorded video, the video and audio quality can be highly controlled, dependent not on the strength of the Internet connection, but on the quality of video-recording equipment available. Thus, time-shifted videos have provided a favorable alternative to the poor audio quality exchanged in video-conferencing.

In time-lapsed learning, the teacher has been able to simultaneously employ a variety of strategies to illustrate or breakdown a specific idea. Concepts have been presented with a strong visual emphasis by concurrently using Internet MIDI's animated keyboard, Classroom Maestro's music staff, music notation, and text on the screen, all with the intent of reinforcing what the student is hearing.

Mario Ajero, of Stephen F. Austin State University in Texas has pioneered using technology for this purpose, and examples can be viewed at http://mariocast.blip.tv/.

Time-lapsed instruction has provided concrete references for new concepts, accessible to the student at any time. In the presentation of any given concept, the student has been able to pause, rewind, or view the teaching repeatedly if desired, thereby working at a self-directed pace of learning.

Because the time-shifted videos can be downloaded from the Internet, it has been helpful to download the pre-recorded videos during "off-peak" times, when the VSAT Internet connection is less congested. This has hastened the process of downloading, without hampering other Internet users in the rural community.

Furthermore, this means that the student has also had the freedom to view the video without access to the Internet. Once the pre-recorded video has been downloaded from the Internet, the student has continued to work with the video, so long as the student has access to electricity.

Through time-shifted teaching, the students have had larger audiences than available in real time. When a student creates and uploads a video onto a social-networking website, it can be shared with a much wider audience than with the teacher alone. Privacy options have allowed the student to choose with whom the video can be shared. In this study, students have shared videos with the teacher's North American students, for larger audiences in studio recitals, and for the general public, as a contribution to the field of e-learning in music.

Conversely, the pre-recorded format allows the teacher to share his/her videos with a larger audience. In this way, the teacher can create a database of videos to be shared with a group of students, shifting the communication from one-to-one to one-to-many without the prerequisite of additional instructional time.

The process of creating a video has been a worthwhile endeavor for both student and teacher. In addition to gaining practical technical skills over the course of recording and posting the video, the student has also developed valuable skills for practice and performance, as multiple "takes" are often required in preparing a video of the highest quality.

From a pedagogical standpoint, the video has been a helpful evaluative tool of communicative skills, as the teacher must communicate new ideas within a limited amount of time (due to the file size of the video). Through observation of teaching, the teacher has developed a greater awareness of areas of strength or weakness within the teaching style.

Accordingly, when the student has created a video, viewing that video has offered an alternative perspective for the student, providing a window into such aspects as overall musicianship, communicative ability, technical skills, posture at the instrument, etc.

Lastly, through asynchronous interaction, it has been possible for a larger group of students (in this case, about a dozen) to form an online community by uploading videos of performances in a secure, password-protected album or group. Other students in the group have had the option of adding comments. http://www.vimeo.com/album/153469/

2.2.3 Challenges
At the current time, the most efficient option of viewing pre-recorded media in Macha is to download the video directly from the social networking site. However, long download times (due to limited bandwidth) have been a barrier to getting quick access to these videos for asynchronous learning.

Additionally, the process of uploading or downloading a video can be fairly involved, thus requiring extra adult assistance for the young students in Zambia.

Because time has been shifted in asynchronous learning, no immediate interaction or feedback is possible, and therefore, it can be difficult to nurture the process of student discovery in learning. Furthermore, confusion can result if a student is unclear about a given concept in a pre-recorded video.

3. A Combination of Synchronous and Asynchronous Learning
As Gilbert et. al. (2007) demonstrated, students were most satisfied when they experienced synergy between theory and practice. The blending of synchronous and asynchronous learning has helped achieve that synergy in our study.

Due to the lack of robust communication in real time interaction, it has been difficult for the teacher to effectively present new concepts within the live format. The students have become confused and disinterested when the quality of video or audio communication in video-conferencing has been less than ideal. Therefore, when new concepts are outlined it has been advantageous to do so within a time-shifted format.

Because the synchronous environment allows the learning to be customized to the student, and tailored to his/her unique strategies for learning, blending the time-shifted lesson with live interaction has been beneficial. The combination of these two modes of communication has proved to be most effective with both students.

During her second real-time lesson, 10 year-old Student "B" became increasingly confused with concepts of higher and lower, up and down on the page, and left and right. Because teacher and student had not yet established a common musical vocabulary, the teacher had difficulty communicating effectively with frequent audio and video interruptions in video-conferencing. The

student's body language was guarded and she looked physically strained.

As an alternative, the teacher created and posted an instructional video describing the same concepts. Student "B" worked with the video at a self-directed pace of learning, viewing it as many times as necessary and experimenting (hands-on) along with the video.

When the teacher and Student "B" subsequently met for a synchronous lesson, the student had absorbed many of the new concepts from the video, and a common musical vocabulary between the teacher and student had been established, allowing for a clear communication exchange. The synchronous lesson cleared up several blurry areas for the student, providing important follow-up to the video. More remarkable perhaps was the student's change in body language, from shifting eyes and a tense posture to a very wide grin. http://www.vimeo.com/10299298

Additionally, at the lesson that followed, Student "B" exhibited eagerness to play a short piece of music for a peer on the other side of the globe. Somewhat surprisingly, she chose to play a piece that she had learned asynchronously; prior to this event, the teacher had never heard Student "B" play this piece. Once again, the synchronous interaction offered in this real-time group lesson (with teacher and peer) seemed to provide extra incentive in order to maximize Student "B's" learning experience. http://www.vimeo.com/10260506

These observations concur with Morgan's (2001) findings in the field of e-learning:

Further, as technology develops each learning experience should be capable of being accessed in a flexible way to allow the user to driver directly what is needed, in a manner that suits their learning style.

The research of Blass & David (2003) suggests similar thoughts:

E-learning offers the opportunity of being accessible in the sense of recognizing learners' needs and designing an experience to address them.

4. RESULTS
Results in this investigative pilot study have been favorable, indicating that this new educational environment for the study of piano is viable. Real time and time-shifted learning each have merit, but in isolation, each mode of communication has significant drawbacks. The most effective learning has occurred through blending real-time (facilitated) and time-shifted (self-directed) forms of communication.

The first results of the study of piano via e-learning over the Internet have been encouraging. Student "M" and Student "B" continue to develop skills in music making, and in the process, they have had the opportunity to connect with other young musicians from different geographic locations.

Certain barriers must be overcome, including those of resources and time. For this type of learning to occur, certain equipment and materials are needed, as described above. The cost of obtaining these materials may be prohibitive. In addition, this arrangement has required adult expertise in its initial setup and some ongoing technological support. Accordingly, an adult possessing basic computer knowledge must be available to provide assistance if necessary.

It is our intent to continue this project, and to make this instruction available to more students by expanding the curriculum with supplementary pre-recorded video instruction, creating a keyboard lab with three additional digital pianos, and involving other music educators who have interest in exploring the concept of e-learning.

5. DISCUSSION

In resource-limited environments, the prospect of musical development through the study of an instrument can be sparse. In particular, children in resource-poor rural settings may have little opportunity to discover the delight of expressing the inexpressible through a musical instrument. However, new means to realizing that joy, while simultaneously growing creativity, intellect, discipline, and perseverance, are emerging.

Although we have seen many positive developments thus far, the current pedagogical arrangement is lopsided, and is regrettably, strictly from a Western musical perspective. Consequently, we are investigating other avenues in which to build a more comprehensive music education (not only for children in Macha, but also for North American students).

As we progress in our e-learning experiment, it is essential to search beyond one limited musical viewpoint. The village of Macha has a rich tradition of singing, and that continues to thrive. In fact, many traditional Tonga songs were digitally preserved through the Macha Works' Vision Community Center, but were lost in an unfortunate fire. These kinds of initiatives will be ongoing. However, in addition, it will be beneficial to cultivate other partnerships in which non-Western musical traditions are shared and taught over a period of time to those in different geographical locations with focus on teaching/learning, rather than solely on performance.

At a deeper level, new bridges will need to be investigated regarding core differences in cultures, e.g. relational versus rational mindsets. This subject matter goes beyond the scope of the current study, but is a critical component of the e-learning experience, nonetheless.

The Internet offers a multitude of possibilities for exchanging musical expertise, and perhaps a new window into many multifaceted African musical traditions. Thus, in the pursuit of unconventional pathways in the education of children through music, it is imperative that we explore alternative insights regarding educational strategies in the celebration of cultural diversity.

6. REFERENCES

[1] Anderson, R.E. (1992). Social impacts of computing: Codes of professional ethics. Social Science Computing Review, 2 453-469.

[2] Bernard, R. M., Abrami, P. C., Lou, Y., Borokhovski, E., Wade, A., Wozney, L., et al. (2004). How does distance education compare with classroom instruction?: A meta-analysis of the empirical literature. Review of Educational Research, 47(3), 379-439.

[3] Bai, M. (2008). The Rural Distance Education in Primary and Secondary Schools in Gansu, China. International Journal of Instructional Technology and Distance Learning, V.5. No. 7.

[4] Pais A. (2007). eLearning for rural communities, http://www.link.net.zm/

[5] Hoorik, P. and Mweetwa, G. (2008). Use of internet in rural areas of Zambia. http://www.link.net.zm/

[6] Garrison, D. R., & Anderson, T. (2003). E–Learning in the 21st century: A framework for research and practice. London: Routledge/Falmer.

[7] Litterst, G. (2003). I'll see you later: Teaching long distance, Star Trek style. The American Music Teacher, V. 53, 50-52.

[8] Litterst, G. (2007). Looking back to the future: Examining how we communicate. The American Music Teacher V.56 no. 5, 72-73.

[9] Dammers, Richard J. (2009). Utilizing Internet-Based Videoconferencing for Instrumental Music Lessons. Applications of Research in Music Education 2009 28: 17-24.

[10] Singh, Upasan (2008). Internet – A Technological Channel for Better Distance Higher Education in India. International Journal of Instructional Technology and Distance Learning V.5, No. 7.

[11] Matthee, K, Mweemba, G, Pais, AV, Rijken, M and Van Stam, G. (2007). Bringing connectivity to rural Zambia using a collaborative approach. IEEE/ACM International Conference on Information and Communication Technologies and Development (ICTD2007), Bangalore, India, 1-12.

[12] Ajero, M. http://mariocast.blip.tv/

[13] Gilbert et al. (2007) E-Learning: The student experience. British Journal of Educational Technology. V.38, i4, 560-573.

[14] Morgan. (2001). Thirteen 'must ask' questions about e-learning products and services. The Learning Organisation. V.8, i5, 203-211.

[15] Blass and Davis. (2003). Building on solid foundations: establishing criteria for e-learning development. Journal of Further and Higher Education. V.27, i3. 227-245