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IMPROVING MUSIC PRACTICE WITH A MOBILE LEARNING SMARTPHONE APPLICATION

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ABSTRACT

Learning musical instruments requires a significant amount of independent, unsupervised effort by students in the current post-secondary pedagogical context. A vital role of the teacher is therefore to help a student improve at the art of independent practice. The theory of contextual interference in skills learning has demonstrated better retention, but its essence of interleaved practices demands even more discipline in its execution. To respond to such a challenge, we developed an iPhone application for music students of our university to assist them with the planning, execution, and tracking of interleaved practice. The app allows users to create templates, log/record practices, and review practice outcome, and has a potential for social interaction and big-data analysis; it can also be used in many other areas of skill learning.

KEYWORDS

m-Learning, Music, Contextual Interference, Interleaved Practice

1. BACKGROUND

Applied study of an instrument is a central component of many post-secondary music programmes in North America. The format of a student's applied instruction commonly consists of an hour-long one-on-one lesson given weekly by the same faculty member throughout the duration of the degree. Students are responsible for learning and polishing multiple challenging pieces of music while also developing a wide variety of technical and musical skill sets. The vast majority of this process is independent because there is typically minimal, if any, feedback from the teacher outside of the weekly lessons. A vital role of the teacher is therefore to help a student improve at the art of independent practice. We have developed a prototype iPhone application to help musicians practice more effectively and are in the process of significantly upgrading the application while also creating an online platform for social interaction and shared learning.

2. CONTEXTUAL INTERFERENCE

"The contextual interference effect is a learning phenomenon where interference during practice is beneficial to skill learning. That is, higher levels of contextual interference lead to poorer practice performance than lower levels while yielding superior retention and transfer performance" (Magill and Hall, 1990).

An effective way to benefit from the contextual interference effect is to frequently alternate the material being practiced, which is know as interleaved practice, as opposed to the traditional routine of completing each task in a single block before moving on. Carter and Grahn (2016) showed the increased retention through interleaved practice by advanced clarinetists. Explaining its counter-intuitive impact, they wrote that interleaved practice "involves more effortful processing, resulting in increased long-term learning." There has been a considerable amount of research demonstrating improved retention of skills in various disciplines including basketball (Landin et al., 1993), badminton (Goode and Magill, 1986), mathematics (Rohrer et al., 2015), electrocardiogram diagnoses (Hatala et al., 2003), and other areas.

While the effortful processing improves retention, it can also be difficult for students to find the discipline to undertake interleaved practice. Due to the poorer in-practice performance noted by Magill and Hall, it can feel like more progress is made during traditional blocked practice, even if retention is frustratingly lacking the following day. Another drawback is that planning and tracking a balanced and complete interleaved practice routine can be an onerous task, especially in a complex field such as music. It is simpler to complete a block of ten minutes for a skill, working on finger speed for instance, than it is to return to the skill multiple times for short bursts, all in varied and balanced rotation with other skills that also need to be tracked. Our application is designed to alleviate this challenge.

3. RATIONALE FOR THE PRACTICE APP

Figueiredo et al. (2016) highlighted that today's students are of "the generation of digital games and social networks. We cannot ignore that they are no longer the same for which the education system was designed a few decades ago. See, for example, the prospect of Heide and Stilborne (2000), for whom 'the technological revolution has produced a generation of students who grew up with multidimensional and interactive media sources. A generation whose expectations and world views are different from those that preceded it' (p. 27). In this context it is wise to consider the integration of digital media and mobile devices (tablets, phablets, smartphones), allowing students to set personal goals, to manage educational content and to communicate with others in the right context."

Many musicians are already in the habit of using mobile applications during daily practice, but not commonly for the planning, tracking, or improvement of practice. Applications have replaced and significantly upgraded the functionality of what used to be common stand-alone devices such as a tuner (for pitch) and metronome (for pulse and rhythm). Other applications provide further functionality such as recording, playback (some can adjust the speed and/or pitch of existing tracks on playback), decibel readers for volume, and specialized pedagogical games or drills. In a broader scope, there is a known market for mobile applications that help users with many aspects of self-improvement such as fitness, nutrition, sleep, and daily planning. This highlights the potential desire for and benefits of an application that could help musicians improve their practice effectiveness.

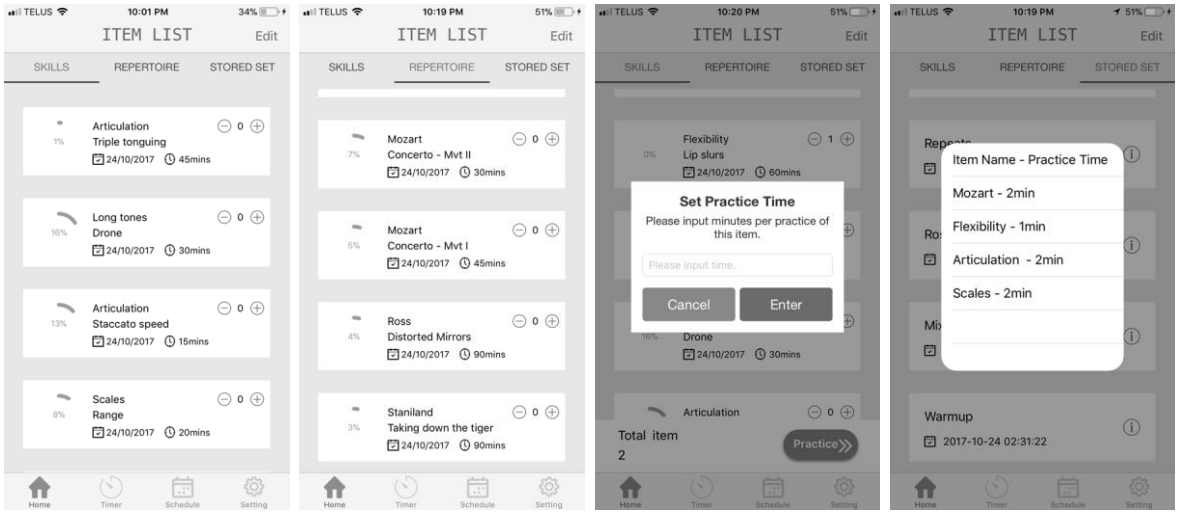
We created a prototype iPhone application with the five main targets:

1. Make it easier to plan practice, track progress towards practice targets, and adjust practice plans. The app must be able to effectively manage interleaved practice but also work well for traditional blocked practice. Flexibility is imperative to the design of the app in order to support individual users in open experimentation around the effectiveness of freely altering their practice routines.
2. Create a user-friendly interface that guides students efficiently through their practice plan. This will avoid the waste of mental energy on logistics, instead prioritizing the increased processing demands of intense practice itself.
3. Enhance the feedback loop between teacher and student, including opportunities to connect outside of lessons, through the capability to share progress recordings, practice assignments, practice plan templates, and practice logs.
4. Provide a framework for students to access the power of "social and participative web technologies" and the "creation of mobile communities of practice" (Figueiredo et al., 2016) through a mobile learning network where users can share ideas, upload and download practice templates, and send recordings to each other.
5. An essential feature of the application is that it is not instrument-specific and can work for all musicians. It is also flexible enough to branch out into other broad areas such as athletics and academics.

4. DESIGN OF THE APP

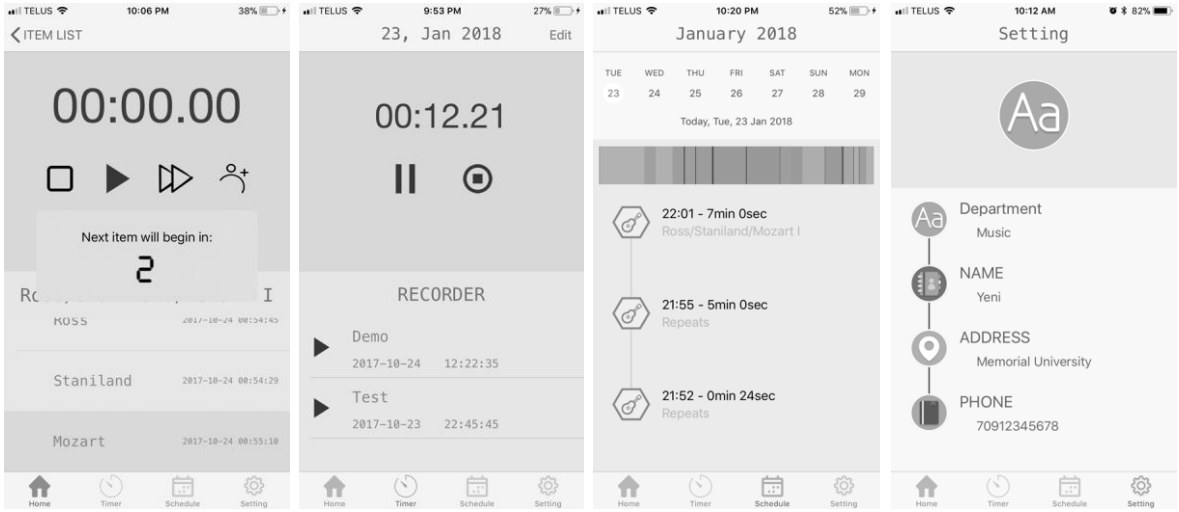
We developed a prototype practice application for the iPhone (iOS 9 or later) using Apple's classic programming language Objective C in Xcode, Apple's integrated development environment. The app has three modules: a calendar for practice scheduling, a timer to log execution of practice plans, and a recorder to track how students improve their skills. These modules plus a Settings module are organized in a typical "tab"-based touch user interface.

- The Home View is where much of the user interaction happens. It provides a venue to view, edit, and execute practice items. The individual practice items can be accessed under the headings “skills” (Figure 1(a)) or “repertoire” (Figure 1(b)), depending on the user perspective at the moment. For example, when teaching trumpet, some of the skills may be tonguing, long tones, articulation, finger speed, etc. Repertoire refers to the pieces of music being studied. The users can edit any item by adding, removing, and modifying descriptions and goal practice times (Figure 1(c)). The practice items can be organized as a “stored set” (Figure 1(d)) to facilitate interleaved practice. The practice program will cycle through the stored set as the user practices (Figure 2(e)), with an option for randomization of the item order. With each practice item, a timer is automatically started to track the time spent, with an option of record- ing the practice with the phone’s built-in microphone. The time for a practiced item is accumulated for the corresponding skill and repertoire item, and can be viewed as a progress graph on the Home View (Figures 1(a) and (b)).



(a) (b) (c) (d)

Figure 1. Application Workflow 1/2



(e) (f) (g) (h)

Figure 2. Application Workflow 2/2

The Timer View (Figure 2(f)) allows the user to freely practice any skill or piece without being associated with any stored set item. The time spent can still be tracked as general practice. The Timer View gives users direct access to the timer, recorder, and also stored recordings.

- The Schedule View (Figure 2(g)) summarizes the planning and execution of the user's practice plan using a calendar-style user interface. It provides a weekly navigation tool at the top of the screen, and displays detailed information about the selected day of that week underneath. Such information is colour-coded for the different skills and pieces in a general progress bar, and then listed with time and text annotation.
- The Settings View module (Figure 2(h)) allows users to edit profile information, control app behaviours, and set permissions to access certain hardware components, such as the microphone and location sensor.

Under the hood of the app, the recording module is built on top of Apple's AVFoundation and AVAudio frameworks. All recorded audio clips are stored after encoding with ADPCM (Adaptive Differential Pulse Code Modulation) to achieve a compression ratio of about 1:4. The recordings, practice templates, and practice logs are managed through SQLite, a lightweight embedded relational database system used commonly in small computer systems, with an FMDB wrapper.

For initial testing, we deployed the app to a number of faculty members and students at School of Music in Fall 2017. We ran an open workshop on the app and obtained valuable feedback from users about improving functionality for the next phase of the app. Incorporating what we already have on our agenda with such feedback, the app can be extended in a few interesting ways with anticipated completion of April 2018.

- We will develop a utility for the creation of practice templates separately with the option for users to load them to the app from the cloud. This utility may be a Web application to allow the creator to work in more space without being limited to the small screens of smart phones. Teachers could help adjust practice routines for students, even between lessons, and users could share ideas with each other. Once a template is loaded to the phone, a user would still be able to customize some of its parameters.
- The users can currently save and playback audio clips as a way to observe their own progression in learning. Next, we will allow users to submit these clips to teachers for evaluation and to enhance possibilities for feedback loop between lessons. The submitted clips will be managed and accessed through a Web utility, which can be integrated with the previous template-creation tool.
- The app will facilitate social interaction amongst students to synergize their learning efforts. With this future module, users can share well-crafted practice templates, plan to practice together, and provide feedback on shared recordings. This can be implemented with a cloud service, or among students them- selves via direct peer-to-peer radio links.
- Once a high volume of practice data is voluntarily loaded to a central server, we can apply artificial intelligence techniques to compare a user's practice performance over time and to compare different users. Such a big-data approach could provide significant information for pedagogical analysis.
- In consultation with various faculty members, we will put an initial library of practice templates available for user download from the cloud. This is to allow users to quickly and easily get started and experiment with the application. As with all templates, these will be adjustable by the user if desired.
- We are creating a more robust user interface, including an option to automatically distribute the allotted weekly practice time across all items based on priority values assigned by the teacher or student.

5. CONCLUSION

The current common pedagogy of applied music instruction is to practice in blocks, similar to other disciplines. However, the theory of contextual interference suggests that frequent alternation of the materials being practiced would yield a better learning outcome, entailing a different way that music could be taught for increased effectiveness. With a smart phone application built as reported in this article, adhering to a prescribed practice template can be easy and rewarding, which otherwise could be mentally stressful and seem extraneous to the subject without the technology. Following the completion upgrades and the creation of the Web functionality in April, we will release the application once again to the university community. There will be a testing and feedback period for the remainder of 2018. The purpose is to obtain proof of concept and guide final upgrades before a targeted open release date in 2019.

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