A Cognitive Framework for On-line Music Education
Students' Performance in On-line Listening Activities in a Blended Post-secondary Music Course

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Abstract: This paper describes a cognitive framework for designing on-line listening activities for students in post-secondary music courses. Drawing on music cognition and knowledge acquisition theories, technology-based listening activities were developed as supplemental to classroom-based activities. The study sample consisted of fifty-nine post-secondary students in a World Music course. Before engaging in the listening activities, students completed four pre-activity surveys: 1) general demographics (e.g., program, year in program, gender, age), 2) a music experience survey (non-credit music experience), 3) a self-regulation questionnaire (SRQ) and, 4) a Computer Experience Questionnaire. Students then completed two on-line
t is not easily enacted in the large classroom due to noise and other distractions, and to the lack of time for
students with higher self-regulation scores took significantly less time to complete the on-line listening activities than those with lower self-regulation. However, as predicted by Honing's (2009) music cognition theory, students' levels of music experience were not related to students' efficiency in completing the activities; nor was their computer experience or their levels of self-regulation.

1 CONTEXT AND BACKGROUND

The question that animates this study is how to support students in post-secondary music courses to develop the skills to listen to music and to communicate what they hear. Close listening requires active participation and its practice cannot be taken for granted; neither can an understanding of what one is hearing be assumed to be universal. In this paper, we explore the cognitive processes required to make explicit the musical elements that are understood implicitly and we consider ways of using technologies to support close listening practice. In articulating this question, we are cognizant of the issues facing undergraduate music education: pressures on the amount of time available for face-to-face contact and increasing competition for the inclusion of a wide range of musical styles in order to engage students in their learning. Such issues stem at least in part from the apparent democratization of post-secondary classrooms in which multiple interests, varied cultural backgrounds, and uneven prior experiences with musical materials compete for time and place.

The study of music suffers greatly in the contemporary classroom. In response to the need to incorporate a cross-section of musical styles, genres, and contexts in our institution, we have redesigned the music history curriculum to emphasize core competencies rather than follow traditional models of chronological, narrative, and style-specific curricula. Gone are the days of presenting a survey of 400 years of (only) classical music to first year music majors, and in its place are courses that teach students to listen – to traditional, popular, *and* classical musical works in the context of their creation and performance and as comprehensive exemplars of particular times and places. Close listening, arguably the foundation of all music study, serves as the basis for this redesigned curriculum, and it strives to engage students more deeply in the musical examples themselves, allowing instructors to work with students more meaningfully to develop the skills to communicate what they hear and how they understand its significance. A shift to competency-based learning and the premise of complex cultural contexts has required a reconsideration of what and how we present materials for study in and outside of the classroom.

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The primary challenges in teaching music listening in 21st century post-secondary environments are related to the time and space of student-instructor interaction. Contemporary students, for whom music is largely background to their daily activities – a soundtrack, if you will – first need encouragement to move music to the foreground of their thoughts, then to learn to describe what they are hearing, and finally to develop the critical thinking capacities to imagine cross-cultural meaning. First year classes of 50-250 students are particularly difficult places to focus such individual and experiential listening and discussion: competing sounds and movement in classrooms, lack of familiarity with the diversity of musical styles, and the rigid timetabling of institutional programs result in very little music being played in class and very little time allocated to discussion and feedback. Lecture-style presentation and testing based on the memorization of selected (i.e., pre-programed) musical concepts is therefore the norm. And despite myriad opportunities for listening outside the classroom, few students take advantage of it unless the instructor is involved. With guidance, early stages of close listening such as are considered here assists students in understanding and connecting specialized terminology to music, in comprehending graphic notation and other documentation of cultural matter, and in hearing the complexity of formal structures and the organization of sounds across musical time. Lastly, a general discomfort with expressing subjective responses frequently keeps the majority of students from participating in open discussion. As Long et al (2011) report, increased opportunities for peer-observation and interaction assist students in developing the skills for future involvement in musical activities (696).

Studies in music cognition (Honing, 2009) indicate that individuals possess far greater understanding of what they hear than they believe, suggesting that what is needed in music education is to find appropriate methods to assist students in bringing their innate knowledge to the surface.

In seeking to develop such confidence in students, the challenges of classroom learning must be addressed. Therefore, in this study we propose to resolve some of them by employing educational technologies and a blended delivery format to extend the classroom and invite individual interaction with materials, guiding students into group discussions of ever more complex cultural environments. The problems of insufficient class time to listen to longer musical examples and limited discussion opportunities are met with multiple asynchronous activities; the distractions of classroom sounds and movement are resolved through the potential for direct input of the music through headphones; the challenge of a vast historical and stylistic content is resolved by increasing the quantity and type of materials included in activities; and the enhanced capabilities of technology allow music to be situated alongside other cultural objects, including video and expressions of other art forms, to establish its place within specific cultural contexts. Finally, in our multicultural classrooms, the lack of a common ground of musical experience is increasingly evident; the activities created in the multiple technical and musical contexts emphasized in this study are designed to allow students to move from the personal to the communal, and to come full circle back towards a common understanding of the role of music in their own world.

2 THE COGNITION OF LISTENING

To ensure a solid cognitive foundation for our listening activities, we reviewed the literature on music cognition. Honing (2009) contends that humans possess an inborn ability to hear certain patterns in music such as the meter or beat of the music as well as to distinguish one melody from another (relative pitch).

Starting from infancy, humans experience the music of their own culture and develop their implicit knowledge of it over time, relying on these innate abilities, become adept at distinguishing common patterns and aspects of music that are distinct to their cultural setting. However, Honing asserts that this accumulated knowledge is not accessible to the conscious cognitive system. People are generally unaware they possess these skills and are not able to consciously draw on or report such knowledge. This is referred to as implicit knowledge.

Honing also contends that people with no training in music are not substantially less able to detect these basic elements than those who possess considerable musical expertise. The difference is that this knowledge is explicit in experts, that is, they are aware they possess it, and are able to report such knowledge, allowing them to share their interpretations of the music to which they are listening. Hence, music education for introductory students should provide scaffolded listening opportunities which help them become aware of their implicit knowledge, thereby transferring it to explicit and sharable knowledge.

3 A COGNITIVE FRAMEWORK FOR GUIDED LISTENING

From a theoretical perspective, the need to shift implicit knowledge to explicit knowledge most closely aligns with the concepts described in Karmiloff-Smith's Representational Redescription Model (RR Model) of knowledge acquisition (Karmiloff-Smith, 1992). Through a process she refers to as redescription, implicit knowledge is transformed into explicit knowledge through four phases: Implicit Level (I), Explicit Level One (E1), Explicit Level Two (E2), and Explicit Level Three (E3).

In Implicit Level (I), individuals possess knowledge they have accumulated over time that is not available to their conscious awareness but allows them to respond correctly to external stimuli in their environment. In introductory music courses, this would be evidenced when students are able to answer questions about basic musical elements such as meter (e.g., is this music metric or non-metric?)

The second level, *Explicit Level One (E1),* furthers the process of redescription when the student begins to be able to make comparisons between two pieces of music.

Students are then scaffolded into *Explicit Level Two (E2) through the process of feedback during their listening experience.* Through a sequence of listening to multiple pairs of pieces and being tutored on the terms used to describe the differences they are hearing, students begin to acquire the terminology that will help them discuss the musical nuances they are able to detect.

In Explicit Level Three (E3), the students are conscious of and able to consider multiple forms of the material. They can hear differences in the music, describe these differences with commonly understood terms or diagrams and develop the skills needed to follow musical notation. Finally, students are also able to contextualize this material in a specific cultural space and time. Elements of the music can be tied to the socio-political influences of a specific point in history (A sample statement might be: "The [melody, harmony, rhythm, or timbre] you hear at the beginning of this piece is very typical of [a particular person, place, genre, etc.] and reflects the [music, dance, culture, politics, etc.] of that time.) At E3, verbal interactions with others is critical toward developing a *complex* understanding of how these multiple forms of information fit together.

4 TECHNOLOGIES TO DELIVER THE COGNITIVE FRAMEWORK FOR GUIDED LISTENING

Each of these four phases suggests activities that students must experience to move through each phase. To create our supplemental on-line listening activities, we sought the technologies that could best deliver each set of activities.

We began our guided listening activities at *Implicit Level (I)* using the software *Articulate Storyline* which allows for the creation of interactive presentations with quiz features and audio capacity. Within each slide, students can click, hover over, or drag any object to trigger an action. With *Articulate*, we created multiple auditory presentations of music pairs that allowed students to listen to, respond, and receive new information, listen again, respond, etc. until they were able to detect specific musical elements such as meter and rhythm. This activity gives students practice in drawing on the implicit knowledge they already possess to detect basic elements of the music they hear.

The activity is done independently, and with individual results so students can develop their listening skills without being inhibited by being observed. Students can complete some of the activity and return later to complete the rest. The *Articulate Storyline* interface is visually simple to allow students to attend to the music examples without distractions from a complex visual interface. The features are simple to use and limited in number to encourage the focus to be on the listening rather than the interface itself. Across the two *Articulate* modules, students were presented with increasingly more difficult questions. For incorrect answers, students received feedback and suggestions for listening (e.g., "That is incorrect. Listen again, is there a beat you can tap your finger to?"). The *Articulate* activities represent the first set of on-line listening activities that we developed and targets transitions from Implicit Level (I) to Explicit Level one (E1).

To transition from E1 to E2, opportunities to begin to label and share listening experiences is necessary. To promote this transition, we suggest instructor guided discussion in smaller groups

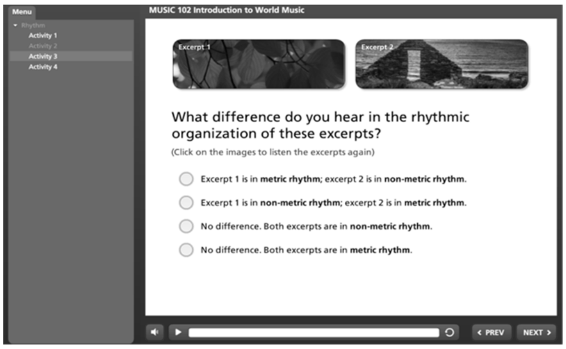

Figure 1: Sample of Articulate activity - identifying musical elements: listen and answer questions on differences in melody, harmony, rhythm, timbre, and texture.

delivered via a conferencing system such as *Elluminate* or *Adobe Connect.* This will allow for students to ask questions and give responses in much smaller groups than in the large classroom without the need for multiple physical break-out spaces.

For the final transition to E3, experiencing multiple forms of information is needed to help students contextualize their listening experience in the cultural and socio-political influences of the time in which the music was composed. To accomplish this last goal, we have developed a virtual world using *OpenSim* with images, videos, audio clips and settings that replicate the space and time we are referencing. Students are represented as avatars in the virtual world and can move through the space while conversing with peers. In the virtual world, students engage in a guided discussion as they view and interact with all of these materials.

5 STUDENT CHARACTERISTICS

Given the diversity of students within introductory music courses, we felt it necessary to explore the potential impact of key student characteristics, including prior music and computer experience and levels of self-regulation.

Recent studies by Demorest et al (2008) and Morrison et al (2013) suggest that prior music training is not a barrier to successful study of unfamiliar music. However, both of these studies explore the enculturation effect – that is, the effect of culture-specific listening and performing on memory, or students' ability to remember unfamiliar music - while Long et al (2011) determine that prior experience is statistically remarkable in students' ability to perform. These studies do not explore the skill of listening for understanding and communicating cultural context as we are attempting here. Rather, with this project, we seek to determine whether music experience impacts a student's ability to listen to any musical style or genre in addition to examining how they listen and respond to its interpretation.

Honing (2009) asserts that levels of prior experience with music training should make little difference to one's ability to listen and comprehend. To determine if Honing's position on music cognition is a viable basis for the design of on-line listening activities, we conducted premeasures on prior music experience for consideration in data analysis.

Boechler, Dragon and Wasniewski (2015) suggest that levels of computer experience can be related to performance levels on a variety of digital tasks and, given that our pedagogical framework is implemented through digital tasks, we also premeasured prior computer experience.

Finally, we premeasured levels of self-regulation because Long, Hallam, Creech, Gaunt and Robertson (2011) assert that, "The cyclic process of self-regulated learning has been identified as a predictor of achievement in musical skill acquisition and musical performance" (p. 683).

6 METHODS

In Fall 2014, we ran a pilot project of just the *Articulate Storyline* activities and the *OpenSim* activities. Our first analysis of this data focused on the students' perceptions of these activities and investigated if prior traits (self-regulation levels) and experiences (prior computer and music experiences) were related to their perceptions of the activities (Boechler, Ingraham, Marin Fernando, Dalen, and deJong, 2015). Students indicated that they enjoyed the activities and that they felt the activities had enhanced their listening and learning experiences.

The current paper describes the analysis of the pilot study log data of the *Articulate Storyline* activities to determine the students' performance (time on task, the number of page revisits and the percentage of correct responses) and whether any of these performance measures were related to their previously mentioned traits and prior experiences.

6.1 Participants and Procedures

Eighty-six post-secondary students took part in the study. Due to incomplete datasets, fifty-nine were included in the final analyses.

Before the listening activities commenced , several pre-measures were collected: 1) General demographics (e.g., program, year in program, gender, age), 2) a music experience survey (non-credit music experience), 3) a self-regulation questionnaire (SRQ) (Brown, Miller, and Lawendowski, 1999), 4) a Computer Experience Questionnaire. (Boechler, Leenaars, and Levner, 2008).

The Music Experience Questionnaire has nine items relating to previous musical training, including specific questions on learning a musical instrument, singing in a choir, taking dance lessons, studying music theory or history, or reading musical notation. For this study, we also ask whether the student had any previous knowledge of the subject of the class, world music. These were all yes or no questions. The Computer Experience Questionnaire is comprised of three measures: 1) the Software Recognition Test (SRT), which is a measure of general exposure to computer applications and digital materials, 2) the Educational Activities Checklist (EAC), and 3) the Recreational Experience Scale (RES). The SRT requires students to check off the software titles they recognize on a checklist of forty titles, twenty of which are actual titles, twenty of which are foils to control for guessing. The EAC asks students to indicate which education-related computer activities students have carried out (e.g., writing html code, using a formula in a spreadsheet, using a library database). The REC asks students to indicate, on a five point likert scale, the range of hours per week they spent playing video games or social networking in Elementary, Junior High, High School and University.

The Self-Regulation Questionnaire has 63 items on a 5 point Likert scale such as, "I usually keep track of my progress toward my goals". Self-regulation is the ability to create a plan, then execute and make adjustments to it in order to reach one's goal.

Students were then asked to complete the on-line listening activities that were supplemental to their face-to-face classroom activities. These activities were on the students' own schedule and were self-paced. They completed two sets of four listening activities, one set about meter and one about rhythm, delivered via *Articulate Storyline* at approximately the mid-point in the semester, that is, beginning in Week 7 of a 13-week course.

As our outcome measures, we collected log data from the *Articulate Storyline* software as the students completed the listening activities. The performance measures were: 1) the overall time on task, 2) the number of page revisits and, 3) score for correct answers. We considered these three dependent variables as indicators of the students' efficiency in completing the tasks. We also wished to determine if any prior traits or experiences the students brought into these activities were related to their efficiciency in completing the tasks. We addressed the following sets of research questions:

Music Ability:

1) Is there a difference in the total time on task as a function of the students' level of prior music experience (High, Low)?
2) Is there a difference in the number of pages revisited as a function of the students' level of prior music experience (High, Low)?
3) Is there a difference in the percentage of correct answers as a function of the students' level of prior music experience (High, Low)?

Computer Experience:

4) Is there a difference in the total time on task as a function of the students' level of prior computer experience (High, Low)?
5) Is there a difference in the number of pages revisited as a function of the students' level of prior computer experience (High, Low)?
6) Is there a difference in the percentage of correct answers as a function of the students' level of prior computer experience (High, Low)?

Self-Regulation

7) Is there a difference in the total time on task as a function of the students' level of Self Regulation (High, Low)?
8) Is there a difference in the number of pages revisited as a function of the students' level of Self Regulation (High, Low)?
9) Is there a difference in the percentage of correct answers as a function of the students' level of Self Regulation (High, Low)?

7 RESULTS

To detect any differences in performance between different levels of each of the independent variables (prior music experience, prior computer experience and the SRQ) , for each dependent variable, (time on task, number of page revisits, number of correct answers) the sample was divided into two groups. Students were categorized as High on each measure if their score was above the mean for that measure.

Students were categorized as Low on each measure if their score was below the mean for that measure. An independent samples T-test was then conducted for each combination of independent and dependent variables.

7.1 Music Experience

Question #1: Is there a difference in the total time on task (minutes) as a function of the students' level of prior music experience (High, Low)? The T-test indicated there was no difference between high and low music experience groups on total task time (High group (n = 37, M = 6.22 , SD = 3.40), and the Low group (n = 22, M = 7.97, SD = 6.60), t(1, 27.77*) = 1.16 , p = .256 (* adjusted df for unequal variances). In other words, students with extensive music abilty did not complete the listening activities any faster than those with little experience.

Question #2: Is there a difference in the number of pages revisited as a function of the students' level of prior music experience (High, Low)? The T-test showed that the differences in the number of revisited pages between the High group (n = 37, M = 3.59, SD = 12.68), and the Low group (n = 22, M = 3.54, SD = 7.73) was not significant, $t(1, 57) = -.016$, $p = .987$.

Question #3: Is there a difference in the score for correct answers as a function of the students' level of prior music experience (High, Low)? No, prior music experience did not help or hinder students in achieving correct answers in the on-line listening activities.(High group (n = 37, M = 154.32, SD = 77.98), and the Low group (n = 22, M = 129.40, SD = 47.55), t(1,57) = -1.35, p = .181.

7.2 Computer Experience

Question #4: Is there a difference in the total time on task as a function of the students' level of prior computer experience (High, Low)? The T-test on group computer experience yielded no significant differences (High group (n = 35, M = 7.07 , SD = 5.30), and the Low group (n = 24, M = 6.58, SD = 4.25), t(1,57) = -.374 , p = .710 . It did not matter if students were proficient or not with computers. Low computer skills were not related to increased time to complete the listening activities.

Question #5: Is there a difference in the number of pages revisited as a function of the students' level of prior computer experience (High, Low)? Level of computer experience did not produce a difference in the number of pages students revisited, (High group (n = 35, M = 1.97, SD = 6.61), and the Low group (n = 24, M = 5.92, SD = 15.23), t(1, 28.99*) = 1.19, p = .242.

Question #6: Is there a difference in the score for correct answers as a function of the students' level of prior computer experience (High, Low)? Again, computer experience did not seem to play a role in students' abilities to answer the questions correctly (High group (n = 35, M = 139.63 , SD = 49.91), and the Low group (n = 24, M = 152.91, SD = 90.35), t(1,57) = .725 , p = .471.

7.3 Self Regulation

Question #7: Is there a difference in the total time on task as a function of the students' level of Self Regulation (High, Low) ? No, no matter the students' level of self-regulation, they did not perform faster or slower. (High group (n = 27, M = 5.96, SD = 3.76), and the Low group (n = 32, M = 7.64, SD = 5.58), t(1,57) = 1.33, p = .190. Self-regulation is the ability to create a plan, then execute and make adjustments to it in order to reach one's goal.

Question #8: Is there a difference in the number of pages revisited as a function of the students' level of Self Regulation (High, Low)? No difference was detected in the number of revisited pages as a result of self-regulation scores, (High group (n = 27, M = 4.85, SD = 15.01), and the Low group (n = 32, M = 2.50, SD = 5.49), t(1, 32.89*) = -.765, p = .450.

Question #9: Is there a difference in the score for correct answers as a function of the students' level of Self Regulation (High, Low)? The T-test was not significant in this case either. (High group (n = 27, M = 149.44, SD = 95.09), and the Low group (n = 32, M = 141.31, SD = 35.41), t(1, 32.07*) = -.420 , p = .677.

8 DISCUSSION

The listening activities described in this paper were a preliminary version of a set of listening activities for music students based on Honing's (2009) concepts of music cognition and Karmiloff-Smith's (1992) Representational Redescription Model (RR Model) of knowledge acquisition.

Honing asserts that novice listeners are almost as good as expert listeners in detecting changes in basic musical elements but simply lack the awareness of their implicit knowledge and the music vocabulary to share their perceptions with others.

Our results support Honing's assertion, in that prior music experience was not related to students' ability to execute the listening tasks. Students with low music experience were not significantly different in the time they took to complete the task nor in the number of page revisits or their scores for correct answers from those students with high music experience. Given that, unlike traditional music courses, we created listening activities that were designed to tap into implicit knowledge and we detected no difference in students with high or low music experience, we suggest that the choice of Honing's cognitive theory as a viable basis for supplemental listening activities is supported.

The Representational Redescription Model provides an implementable framework, through the suggested types of activities, for actually moving learners from Implicit to Explicit and sharable knowledge.

Morrison et al (2013) suggest designing music curricula using "paired same-different discriminations … may be more sensitive to early stages of music learning" (p. 370), however, given the impact of this study on student satisfaction and success, we are proposing classroom adoption of this model for listening-focused music courses, adapted according to the content of the course (popular music, classical music, other culture-specific music and so on) and the specific listening outcome required. Listening for musical structure, comparing melodic variation, etc. are also suited to this method.

9 CONCLUSIONS

Large introductory post-secondary courses often produce challenges to instructors to provide accessible and meaningful experiences for students. In the case of music courses, listening is a critical activity that is not easily enacted in the large classroom due to noise and other distractions, and to the lack of time for repeated listening and discussion of the listening experience.

The diversity of students within these classes is also a concern as prior traits and experiences may influence their ability derive any knowledge from the degrade classroom listening activities.

The series of technology-enhanced listening activities which we have designed are theoretically-derived and do not disadvantage students with lower skills or less experience than other students.

Therefore, our on-line listening activities show promise for alleviating some of the limitations of teaching music, particularly close listening skills, in large post-secondary classrooms.

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