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Guitar vs. Piano: The Effects of Instrument Sound in Web-Based Ear Training

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Abstract: This study investigated the effects of instrument sound on college music students' achievement in melodic interval discrimination using a Web-based ear training module. A Web-based learning module for pitch discrimination was developed as a training and data collection tool for the study. This repeated measure design study collected participants' achievement scores (pretest, posttest, and follow-up posttest), practice records, users' feedback, and focus-group interviews as data; for subsequent analysis using *t*-test, and analysis of variance. Findings of the study confirmed that: (a) Web-based pitch discrimination training had a very large positive effect on achievement in melodic interval discrimination, and (b) Pitch discrimination using melodic intervals recorded in guitar sound produced a larger positive effect on achievement than intervals in piano sound.

Introduction

Pitch discrimination is important to college music students because higher-level music classes often require the students to have a firm foundation in basic listening skills. The improvement of pitch discrimination skill by way of ear training provides the means for first year college music students to learn the relationships of the musical pitches and to attain good listening skills. Because better listeners make better musicians (Worthington & Szabo, 1995), college music students who possess better listening skills are more likely to succeed as musicians. One integral part of music education and training for college music student is, therefore, to learn to hear (Kraft, 1967). Successful musicians are usually well versed in identifying musical intervals, and are able to identify scores of intervals readily and accurately (Burns & Ward, 1982; Killiam, Lorton, & Schubert, 1975). Students who hope to improve their musical ability should therefore develop their musical pitch discrimination ability to become better listeners.

Technology-Enhanced Music Instruction

Computer-based ear training have had a long history since the mid 1970s, when the Graded Units for Interactive Dictation Operations, or G.U.I.D.O., was first offered via the

PLATO mainframe to provide programmed instruction for the recognition of intervals, melodies, chords harmonies and rhythms for college music students (Hofstetter, 1975; 1978; 1985; Peters & Beiley, 1995). Reports of the positive effects on the early use of Computer-Based Instruction (CBI) for aural skills development eventually lead to the incorporation of CBI into college music theory curriculum (Davis, 2001; Eddins, 1981). Since then, CBI for ear training was regarded not only as a feasible substitute for classroom music instruction (Deihl, 1971; Killam, 1984; Kuhn & Allvin, 1967; Wittlich, 1987), but also a reasonable and effective “tutor” (Taylor, 1980) capable of assisting students’ learning (Kemmis, Atkin, & Wright, 1997).

Despite greater than 90% of music schools claimed to make use of CBI for ear training in their music theory classes, the instructional problem faced by educators was that music students could not effectively practice the ear-training exercises needed to improve their aural skills, which is caused by limited physical and computer-based resources, such as available laboratory time, number of computers for practice, and copies of ear training software (Spangler, 1999). Although appropriately designed educational Websites have been shown to be motivational to students (Arnone & Small, 1999; Loh & Williams, 2002), there was a shortage of pedagogy-based Web-based music instruction (WBMI) as compared to CBI for other subject areas. Lacking good WBMI, it was no wonder that many music educators considered Web access in a music classroom as “wasting time” (Spangler, 1999). The wide gap in the literature on the use and effects of WBMI, particularly at the college level (Coffman, 2000), points to good opportunity for the research and development of innovative WBMI to meet the needs of music instruction.

Research Questions

While current classroom practice is an end result of what work in the classrooms over the years, advances in technology and development of new instructional tools and methods can often help to improve current practices. Pitch discrimination training can benefit from the integration of instructional design and technological advances to improve lesson delivery and classroom instruction.

The piano earned its place in a music classroom because it allows music instructors the liberty to produce a wide range of musical notes and styles. Because the piano was commonly found in a classroom, not only was it being accepted as the instructional tool of choice, but also for ear training. Nevertheless, having the piano as the only instrument for sound production in ear training is of little practical value to players of other instruments, speaking from a pedagogic point of view. Moreover, musical pitches produced by the acoustic piano are often considered impure from a psychoacoustic point of view. The impure sound of a piano note is the result of a group of (two, or three) vibrating strings culminating in a “composite sound” rich in harmonics and overtones. An acoustic guitar with a singly, freely vibrating string, would produce an acoustically purer sound in contrast to the acoustic piano. Psychoacoustics studies informed us that the harmonics and overtones found in composite sounds would often confound a person’s aural perception, whereas an acoustically simpler or purer sound would facilitate higher accuracy in pitch discrimination. Because acoustically less complex sound is easier to discriminate than acoustically complex sound, from a psychoacoustic point of view, should an acoustically purer instrument such as guitar be used in introductory ear training in the music classroom, instead of the acoustic piano that is acoustically more complex?

The first research question is: ***"What are the effects of instrument sounds on achievement in pitch discrimination of melodic intervals?"*** Since environmental and instructional factors have not been shown to play a significant role in the development of aural skills (Heritage, 1986), other factors such as prior musical learning and instrument playing experience has been suggested to significantly affect a person's musical achievement (Sloboda & Davidson, 1996). The second research question is: ***"What are the effects of Web-based pitch discrimination training, in relation to prior music learning and instrument playing experience?"***

Research Materials

An online ear-training module named Mona Listen has been developed for this study with the dual purpose of pitch discrimination training and data collection. Sampled piano and guitar sound of high fidelity were used in this study as sound source to provide a better musical context, and to maximize the pedagogic values of ear training. In comparison, commercial ear training CBI commonly made use of instrument sounds synthesized by computer sound cards, which were lower in fidelity than the sampled instrument sounds used in this study. The training modules required the participants to memorize, recall, and identify melodic intervals in both ascending and descending orders. Specifically, this study investigated the effects of (a) different instrument sound, and (b) Web-based pitch discrimination, on first year college music students' achievement in melodic interval discrimination.

The Study

Permission to collect data from first year music majors at a major research university in the United States was obtained from the Institutional Review Board (IRB) at the host institution prior to the commencement of the study. The training module was subsequently field and pilot tested before actual data collection took place in Fall 2003. A total of 65 first year students completed both pretest and posttest; of which, 62 completed the follow-up posttest also. The follow-up posttest took placed one week after the conclusion of the online data collection, and was meant to measure the post-treatment retention of pitch discrimination skill of the participants in this study.

The test items used in the pretest, posttest and follow-up posttest were all drawn from a total of sixteen carefully counterbalanced items. These items consisted of melodic intervals in two instrument sounds (piano and guitar) in 4 interval classes (P5, P4, M6 and m3) and two play order (ascending and descending). Participants were randomly assigned to one of two counterbalanced groups for pitch discrimination training of melodic intervals at the point of online registration for the study.

Findings

A reliability coefficient of 0.906 attested to the high inter-item correlation among test items, measured using Cronbach alpha (α). Statistically significant differences in this study were generally reported at the a level of 0.05; and the effect sizes of repeated measure studies were reported as partial Eta squared (hp2) values (Thalheimer & Cook, 2002), in which case the values of 0.01, 0.06, and 0.14 represented small, medium and large effect sizes, respectively (Green, Salkind & Akey, 2000).

Research Question I:

Pitch discrimination training using melodic intervals recorded in guitar sound has a larger positive effect [t (65) = 6.418; $p < .001$; $Eta^2 = .392$] *than piano sound* [t (65) = 3.075; $p < .005$; $Eta^2 = .129$] *on achievement of melodic intervals identification. Students trained with melodic intervals recorded in guitar sound attained higher achievement scores than students trained with melodic intervals recorded in piano sound. There was a large interaction effect among different Intervals* [F (9, 49) = 21.154; $p < .001$; $Eta^2 = .795$].

Guitar sound was found to be more superior to piano sound in pitch discrimination training. Pitch discrimination in music classroom had been traditionally provided using the acoustic piano. One reason for this well accepted classroom practice was the versatility of the acoustic piano as an instructional tool for teaching music.

However, the psychoacoustics properties of the acoustic piano would suggest otherwise, and music educators might want to consider using other instrument sounds of *purer* psychoacoustic quality as instructional media for pitch discrimination. Findings in the study indicated that guitar sound is psychoacoustically purer than piano sound, and would therefore be an easier (better?) instructional medium for pitch discrimination training.

Research Question II:

Web-based pitch discrimination training had an overall positive effect [t (65) = 6.269; $p < .001$;
$Eta^2 = .380$] *on first year college music students' achievement in melodic interval identification. Students with prior music training experience learned melodic interval discrimination at a faster rate* [F (1, 63) = 8.555; $p < .005$;
$Eta^2 = .12$] *than students without prior training.*

The results from this study indicated that technology-enhanced pitch discrimination training was indeed effective. There was a significant improvement in first year college music students' achievement in melodic interval discrimination. Music students with prior musical training were found to learn pitch discrimination at a faster rate than students with no prior training. The prior musical training apparently laid a good foundation to provide support and scaffolding for subsequent pitch discrimination training. There was some indication that players of instruments requiring tuning (including voice majors) were able to discriminate musical pitches better than players of instruments that did not required tuning.

Conclusions

Even though WBMI has many advantages over the older CBI, and is a vibrant growing trend in other subjects of study, there is currently a wide gap in the literature on the use and effects of innovative technology and WBMI at the college level. Instructional technology is a field of study that incorporates innovative technology for the purpose of instruction and instructional development. The changes in technology have brought about many authoring tools that are suitable for non-programmer educator-developers (Khan, 1997). The development of WBMI will further prepare the way for other music courses geared towards online certification. The availability of such WBI for music instruction also means that music students will no longer be required to congregate at a music laboratory for "drill-and-practice" exercises in ear training. Because many college students now have easy access to the Internet and Web resources from campuses and dormitories, there will be more opportunity for music students to improve their ear training skill should online ear training become more readily available. These students will eventually be able to access the Web for WBMI at a time and space of their convenience and choosing, beyond the physical constraints of music classrooms and computer laboratories.

This study informed the literature by examining the effects of Web-based ear training for pitch discrimination on college music students' achievement in melodic interval discrimination. Further, the Web-based training module used in this study employed realistic instrument sound to provide not only the musical context for music learning, but also maximize the pedagogic values of ear training for music students aspiring to become professional instrumentalists. The time has come for an update of pitch discrimination training using current available Internet-related technology. More importantly, new research is necessary for the re-evaluation and verification of pedagogic values of current classroom practices. Instructional technologists and music researchers should work in collaboration to improve future music education through technology-enhanced and Web-based music instruction. As music educators seek to improve music pedagogy, researchers of instructional technology can help to innovate by carefully applying instructional design technology principles in technology-enhanced music instruction development. The collaborative research endeavors in WBMI will serve to benefit both academic fields and improve music education, at large.

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