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Profiles, Perceptions, and Practices Related to Customizable Computer-Aided Instruction among Postsecondary Aural Training Instructors

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By Sheila Clagg Cathey and Jay Dorfman

Introduction and Purpose of the Study

With this study, we sought to contribute to the understanding of how postsecondary aural training instructors use CAI. While studies of technology's effectiveness have contributed to the development and legitimacy of aural training CAI, they have largely neglected instructors' approaches to CAI. In addition, it should not be assumed that all instructors who use CAI do so in the same ways; modifications in approaches to CAI may result in vastly varying educational outcomes. The purpose of this study was to determine, based on demographic variables and educational characteristics, the ways in which instructors approach the uses of CAI in their classrooms and curricula. By studying instructors' uses of CAI, the aural training profession can enhance technological practices, and can address current and future needs in the profession among instructors who use CAI.

Because "literally hundreds" of aural training programs are available, we selected a target group from one representative application for the purpose of manageability.[1] To expand the knowledge base in aural training technology integration, this non-experimental quantitative study targeted instructors who use MacGAMUT because this software is representative of customizable instructor options that can be tailored to postsecondary curricula. We recognize that numerous CAI applications exist and play a vital role in postsecondary aural training; our purpose was to examine the functionality of the representative software. Other CAI programs were eliminated because they contain components for sight singing, playing or singing with an accompaniment, improvisation, or composition (e.g., Band-in-a-Box, Hearing Music, Making Music, Playing Music, Practica Musica, SmartMusic); routines for primary- and secondary-school students (e.g., Alfred's Essentials of Music

[1]Deron McGee, "Aural Skills, Pedagogy, and Computer-Assisted Instruction: Past, Present, and Future," *Journal of Music Theory Pedagogy* 14 (2002): 119; Thomas E. Rudolph, *Teaching Music with Technology* (Chicago, IL: GIA, 1996), 71.

Theory); or, have a game-based approach (e.g., Hearing Music). Approaches requiring minimal instructor interaction were also eliminated, including guided-instruction software (e.g., Music Ace) and Internet-based CAI (e.g., Teoria.com).

The software selected for this study was limited to one that encourages instructors' hands-on involvement and emphasizes typical components of dictation skills in postsecondary education (e.g., intervals, scales, chords, melodic dictation, harmonic dictation, and rhythmic dictation).[2] MacGAMUT and Practica Musica are flexible-practice applications that encourage instructors' involvement through extensive options for creating custom content.[3] Practica

[2] As Gary Karpinski notes, "Many courses of study in aural skills begin with 'basic' musical components such as scales, intervals, and chord identification" (*Aural Skills Acquisition: The Development of Listening, Reading, and Performing Skills in College-Level Musicians* (Oxford, England: Oxford University Press, 2000), 19). This theoretical framework—known as objectivism and rooted in behaviorist psychology—is the belief that students must master basic aural elements before integrating them into larger contexts of music and is the most prevalent framework used in teaching dictation. See Ted Buehrer, "An Alternative Pedagogical Paradigm for Aural Skills: An Examination of Constructivist Learning Theory and its Potential for Implementation into Aural Skills Curricula" (PhD diss., Indiana University, 2000), ProQuest (UMI No. 9966041); Sheila Clagg Cathey, "Profiles, Perceptions, and Practices Related to Customizable Computer-Aided Instruction (MacGAMUT) Among Postsecondary Aural-Training Instructors" (DMA diss., Boston University, 2014), ProQuest (UMI No. 3581009); Kate Covington and Charles Lord, "Epistemology and Procedure in Aural Training: In Search of a Unification of Music Cognitive Theory with its Applications," *Music Theory Spectrum* 16/2 (1994): 159–170; Charles Lord, "Harnessing Technology to Open the Minds: Beyond Drill and Practice for Aural Skills," *Journal of Music Theory Pedagogy* 7 (1993): 105–118. Objectivism in aural training dates back to the earliest known textbook on dictation (Michael Traugott Pfeiffer, *Gesangbildungslehre nach Pestalozzischen Grundsätzen: 1* (Zürich, Switzerland: H. G. Nägeli, 1810), as cited in Roy Templeton Will, "The History and Development of Musical Dictation" (MM thesis, Eastman School of Music, 1939)). Constructivism, on the other hand, emphasizes learner interaction and recognizes that knowledge is constructed through learners' experiences. For alternative approaches to objectivism, see Buehrer, "An Alternative Pedagogical Paradigm," 1–231; Kate Covington, "An Alternative Approach to Aural Skills Pedagogy," *Journal of Music Theory Pedagogy* 6 (1992): 5–18; Covington and Lord, "Epistemology and Procedure," 159–170; and Lord, "Harnessing Technology," 105–118.

[3] Flexible-practice CAI "has the express purpose of developing skills, but adds features that allow flexibility of use for both instructors and musicians seeking self-improvement" (David Brian Williams and Peter Richard Webster, *Experiencing Music Technology*, 3rd ed. (Boston, MA: Schirmer Cengage Learning, 2008), 409). The most popular aural-training CAI for postsecondary students is framed around a

Musica was further eliminated because of components that are beyond the scope of this study (e.g., music theory, sight singing, playing or singing with an accompaniment, improvisation, composition).

Research Questions

Several research questions guided data collection for this study:

1. What are the demographic characteristics and educational backgrounds of postsecondary aural training instructors who use CAI as a tool for teaching dictation skills?
2. What are the practices of postsecondary aural training instructors who use CAI as a tool for teaching dictation skills?
3. What influences do demographic and educational characteristics of postsecondary aural training instructors assert on their software usage practices?

Previous Research

While MacGAMUT was used in this study's procedures to investigate instructors' CAI practices, previous researchers who have studied aural training technology have primarily been concerned with the effectiveness of, and students' attitudes

drill-and-practice model (see Buehrer, "An Alternative Pedagogical Paradigm," 1–231; Lord, "Harnessing Technology," 105–118; Williams and Webster, *Experiencing*, 409) or flexible-practice model (see Lord, "Harnessing Technology," 105–118; Williams and Webster, *Experiencing*, 409). Flexible practice (an extension of drill and practice) may be more appealing because it provides instructors with options to customize and evaluate student progress; however, like drill and practice, flexible practice is framed around objectivist theory and becomes a mere extension of the objectivist classroom (Lord, "Harnessing Technology," 105–118). Cathey notes, "Whether drill-and-practice or flexible-practice software, objectivism is the primary reason for creating drills and is the most prevalent framework found in aural-training CAI" ("Profiles, Perceptions, and Practices," 19).

toward technology.[4] All but one aural training study indicated

[4] See Raynold L. Allvin, "Computer-Assisted Music Instruction: A Look at the Potential," *Journal of Research in Music Education* 19, no. 2 (1971): 131–143; Philip Baczewski, "Experience and Evaluation: Ear-training CAI in Action" (paper presented at the meeting of Texas Music Educators Association Convention, San Antonio, TX, 1980); Ann K. Blombach, "OSU's Phoenix Music Project: An Alternative to PLATO and the Micros" (paper presented at the College Music Society Annual Conference, Cincinnati, OH, October 1981); James J. Canelos et al, "Evaluation of Three Types of Instructional Strategy for Learner Acquisition of Intervals," *Journal of Research in Music Education* 28, no. 4 (1980): 243–249; James Caldwell Carlsen, "An Investigation of Programmed Learning in Melodic Dictation by Means of a Teaching Machine using a Branching Technique of Programming" (PhD diss., Northwestern University, 1962), ProQuest (AAT 6301274); James Caldwell Carlsen, "Programed Learning in Melodic Dictation," *Journal of Research in Music Education* 12, no. 2 (1964): 139–148; Fred T. Hofstetter, "GUIDO: An Interactive Computer-Based System for Improvement of Instruction and Research in Ear Training," *Journal of Computer-Based Instruction* 1, no. 4 (1975): 100–106; Fred T. Hofstetter, "Evaluation of a Competency-Based Delivery of Aural Interval Identification," *Journal of Computer-Based Instruction* 27, no. 4 (1979): 201–213; Fred T. Hofstetter, "Applications of the GUIDO System to Aural Skills Research, 1975–1980," *College Music Society* 21, no. 2 (1981): 46–53; Rosemary N. Killam et al, "AMUS: The Computer in Music Instruction" (paper presented at the Texas Music Educators' Association Conference, Fort Worth, TX, February 8, 1979); Wolfgang E. Kuhn, "Computer-Assisted Instruction in Music: Drill and Practice in Dictation," *College Music Symposium* 14 (1974): 89–101; Randall G. Pembrook, "Some Implications of Students' Attitudes Toward a Computer-Based Melodic Dictation Program," *Journal of Research in Music Education* 34, no. 2 (1986): 121–133; Robert W. Placek, "Design and Trial of a Computer-Assisted Lesson in Rhythm," *Journal of Research in Music Education* 22, no. 1 (1974): 13–23; Bernard William Poland, "An Investigation of Some Aural and Notational Elements in Music Theory" (PhD thesis, Ohio State University, 1960), ProQuest (UMI No. 60–2129); Kenneth Harold Smith, "The Effectiveness of Computer-Assisted Instruction on the Development of Rhythm Reading Skills among Middle School Instrumental Students" (PhD thesis, University of Illinois at Urbana-Champaign, 2002), ProQuest (UMI No. 3070051); Kenneth Harold Smith, "The Effect of Computer-Assisted Instruction and Field Independence on the Development of Rhythm Sight-Reading Skills of Middle School Instrumental Students," *International Journal of Music Education* 27, no. 1 (2009): 59–68, doi: 10.1177/0255761408099064; Charles L. Spohn, Jr., "An Exploration in the Use of Recorded Teaching to Develop Aural Comprehension in College Music Classes" (PhD diss., Ohio State University, 1959), ProQuest (AAT 5905941); Charles L. Spohn, Jr., "Programming the Basic Materials of Music for Self-Instructional Development of Aural Skills," *Journal of Research in Music Education* 11 (1963): 91–98; Charles L. Spohn, Jr. and Bernard William Poland, "An Evaluation of Two Methods using Magnetic Tape Recordings for Programed Instruction in the Elemental Materials of Music," National Defense Education Act, Title 7, Project No. 876 (Columbus, OH: The Ohio State University Research Foundation, 1964); Edward A. Tarratus,

that students using technology for dictation drill made significant improvements over students being taught solely with traditional methods of instruction.[5] Because in-class dictation drills may be regarded as a "waste of valuable class time,"[6] aural training technology has provided instructors with the option to spend less time on in-class drills and more time teaching dictation strategies or other areas of musicianship.[7] Although some instructors use CAI as an entire replacement of in-class drill,[8] most use it as an out-of-class practice tool,[9] implying that face-to-face instruction remains central.

Jr. and Charles L. Spohn, Jr., "Cooperative Research in Programed Learning: Taped Interval Discrimination Drills," *Journal of Research in Music Education* 15, no. 3 (1967): 210–214; Jack A. Taylor, "Activities at Florida State University," *Association for the Development of Computer-Based Instructional Systems (ADCIS) News* 12, no. 6 (1980): 58–59; Jack A. Taylor, "The MEDICI Melodic Dictation Computer Program: Its Design, Management, and Effectiveness as Compared to Classroom Melodic Dictation," *Journal of Computer-Based Instruction* 5, nos. 1–2 (1982): 11–21.

[5] Tarratus and Spohn, "Cooperative Research," 210–214.

[6] Michael A. Arenson, "Computer-Based Instruction in Musicianship Training: Some Issues and Answers," *Computers and Humanities* 18 (1984): 157.

[7] CAI may offer instructors more time to demonstrate the relevance of aural skills to music literature and the added benefit of freeing teaching time from redundant and excessive in-class dictation drills. Instructors may use the extra class for dictation games (Deborah Rifkin and Diane Urista, "Developing Aural Skills: It's Not Just a Game," *Journal of Music Theory Pedagogy* 20 (2006): 57–79); whiteboard or blackboard activities (Barbara Liebhaber, "Steps Toward Successful Dictation," *Teaching Music* 8, no. 6 (2001): 32–35); improvisation (Covington, "An Alternative Approach," 5–18; Steve Larson, "Integrated Music Learning and Improvisation: Teaching Musicianship and Theory through 'Menus, Maps, and Models,'" *College Music Symposium* 35 (1995): 76–90; Rifkin and Urista, "Developing," 57–79); composing melodies (Rifkin and Urista, "Developing," 57–79); or alternative approaches to traditional dictation, such as aural identification of timbre, texture, dynamics, range, density, spatial effects, and large-scale structure (Covington and Lord, "Epistemology and Procedure," 159–170; Lord, "Harnessing Technology," 105–118; Steven G. Laitz, "Paths to Musicianship," in *Musicianship in the 21st Century: Issues, Trends and Possibilities*, ed. S. Leong (Sydney, Australia: Australian Music Centre, 2003), 130–150; George Pratt, *Aural Awareness* (Bristol, PA: Open University Press, 1990); Peter Silberman, "Post-Tonal Improvisation in the Aural Skills Classroom," *Music Theory Online* 9, no. 2 (2003); and Diane Urista, "Beyond Words: The Moving Body as a Tool for Musical Understanding," *Music Theory Online* 9, no. 3 (2003).

[8] Cathey, "Profiles, Perceptions, and Practices."

[9] Sheila Clagg Cathey, "Current Practices and Curriculum Needs among Postsecondary Oklahoma Music Theory Instructors" (paper presented at the annual meeting of the Oklahoma Music Theory Round

No known previous researchers have investigated the influence of independent and dependent variables on instructors' uses of aural training CAI. Independent variables investigated in the current study were years of experience in teaching aural skills, years of experience in using the selected software, gender, and highest degree obtained. Dependent variables were importance of monitoring students' software usages, impact of CAI on student learning, impact of instructors' interactions and involvement with the software on student learning, impact of customization on student learning, importance of requiring students to use Mastery Mode, importance of using Practice Mode, importance of using Make My Own Drills, and how often students are required to submit CAI assignments. Spangler's thesis is perhaps the study that comes closest to the present one in terms of aural training CAI use; however, Spangler minimally addressed instructors' interactions and involvement with CAI.[10]

Literature in postsecondary instructors' practices with aural training technology was insufficient; therefore, literature on K-12 instructors' uses of music technology was explored. Previous researchers have suggested that music teachers do not have the same type of training in technology as they do in other areas of music, and thus they feel underprepared to incorporate technology into their teaching.[11] While some extraordinary uses of music technology

Table, Oral Roberts University, Tulsa, OK, October 11, 2013); Cathey, "Profiles, Perceptions, and Practices"; and Randall G. Pembrook and H. Lee Riggins, "Send Help! Aural Skills Instruction in U.S. Colleges and Universities," *Journal of Music Theory Pedagogy* 4, no. 2 (1990): 231–241.

[10]Douglas Raymond Spangler, "Computer-Assisted Instruction in Ear-Training and its Integration into Undergraduate Music Programs during the 1998–1999 Academic Year" (MM thesis, Michigan State University, 1999), ProQuest (UMI No. 1395453).

[11] Jay Dorfman, "Learning Music with Technology: The Influence of Learning Style, Prior Experiences, and Two Learning Conditions on Success with a Music Technology Task" (PhD diss., Northwestern University, 2006), ProQuest (UMI No. 3230095); Dorfman, *Theory and Practice of Technology-Based Music Instruction* (New York, NY: Oxford University Press, 2013); Jason Charles Meltzer, "A Survey to Assess the Technology Literacy of Undergraduate Music Majors at Big-10 Universities: Implications for Undergraduate Courses in Music Education Technology" (PhD thesis, University of Illinois at Urbana-Champaign, 2001), ProQuest (UMI No. 3023143); Grace Ohlenbusch, "A Study of the Use of Technology Applications by Texas Music Educators and the Relevance to Undergraduate Music Education Curriculum" (DMA diss., Shenandoah Conservatory, 2001), ProQuest (UMI No. 3010524); Sam Reese and James Rimington, "Music Technology in Illinois

are being carried out in the K–12 classroom, the reviewed literature indicated that K–12 music teachers use administrative technology more frequently that music technology.[12] These K-12 music teachers, however, ranked music CAI as the most important topic that should be included in professional development opportunities[13] and in the undergraduate music education curriculum.[14] Further, the majority of K-12 music teachers lack formal training in music technology, and are rather self-taught or peer-taught.[15] These findings show a need for music technology training and integration, especially in the various uses of CAI.[16] Aural training instructors, therefore, have an important responsibility in modeling, monitoring, and passing on technical skills related to CAI to the next generation of music educators.

Gender was explored based on a suggested need to investigate gender differences as a variable in achievement with music technology.[17] Gender equivalency in using music technology, as

Public Schools," *Update: Applications of Research in Music Education* 18, no. 2 (2000): 27–32; and Jack A. Taylor and John J. Deal, "The Status of Technology Integration in College Music Methods Courses: A Survey of NASM Colleges and Universities" (paper presented at the annual meeting of the Association for Technology in Music Instruction, Santa Fe, NM, 2003).

[12]In *Theory and Practice*, Dorfman observed creative uses of technology on the K–12 level, such as an elementary school music teacher who assigned in-class iPad projects using GarageBand and SoundSlate (now, replaced by AudioBoard), and high school music teachers assigning students to compose music for movie trailers and creating podcasts with GarageBand.

[13]Reese and Rimington, "Music Technology," 27–32.

[14]Ohlenbusch, "Use of Technology Applications," 1–214.

[15]Reese and Rimington, "Music Technology," 27–32.

[16]For a framework for technology integration, see articles related to *Technological Pedagogical and Content Knowledge* (TPACK), such as Judith Harris, Punya Mishra, and Matthew J. Koehler, "Teachers' Technological Pedagogical Content Knowledge and Learning Activity Types: Curriculum-Based Technology Integration Reframed," *Journal of Research on Technology in Education* 41, no. 4 (2009): 393–416; Matthew J. Koehler and Punya Mishra, "What Happens When Teachers Design Educational Technology? The Development of Technological Pedagogical Content Knowledge," *Journal of Educational Computing Research* 32, no. 2 (2005): 131–152; and Punya Mishra and Matthew J. Koehler, "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge," *Teachers College Record* 108, no. 6 (2006): 1017–1054.

[17]Victoria Armstrong, *Technology and the Gendering of Music Education* (Burlington, VT: Ashgate, 2011); Ann K. Blombach, "The Future of Music

documented in the current study, was found in some studies,[18] while inequalities in respect to gender and music technology were found in others.[19] Earlier literature on gender differences indicated that males used computers[20] and music technology[21] more frequently than females. Recent studies, however, have shown no significant difference in frequency of use or computer self-efficacy.[22]

CAI: Bringing the Pie in the Sky Down to Earth" (paper presented at the New England Conference of Music Theorists Annual Conference, Hartford, CT, April 2001); Jay Dorfman, "Learning Music with Technology"; Jay Dorfman, *Theory and Practice*; Rosemary N. Killam et al, "Research Applications in Music CAI," *College Music Symposium* 21, no. 2 (1981): 37–45; Peter Richard Webster, "Computer-Based Technology and Music Teaching and Learning," in *The New Handbook of Research on Music Teaching and Learning*, ed. R. Colwell and C. Richardson (New York, NY: Oxford University Press, 2002), 416–439; and Peter Richard Webster, "Key Research in Music Technology and Music Teaching and Learning," *Journal of Music, Technology and Education* 4, nos. 2–3 (2011): 115–130, doi: 10.1386/jmte.4.2-3.115_1.

[18] See, for example, Jeffrey E. Bush, "The Effects of a Hypermedia Program, Cognitive Style, and Gender on Middle School Students' Music Achievement," *Contributions to Music Education* 27, no. 1 (2000): 9–26; and Comber et al, "Girls, Boys and Technology in Music Education," *British Journal of Music Education* 10, no. 2 (1993): 123–134.

[19] See, for example, Chris Comber et al, "The Effects of Age, Gender and Computer Experience upon Computer Attitudes," *Educational Research* 39 (1997): 123–133; and Meltzer, "Technology Literacy."

[20] Comber et al, "Age, Gender and Computer Experience," 123–133; Steve M. Dorman, "Technology and the Gender Gap," *The Journal of School Health* 68, no. 4 (1998): 165–166; Meltzer, "Technology Literacy"; and Janet Schofield, *Computers and Classroom Culture* (Cambridge, United Kingdom: Cambridge University Press, 1995).

[21] See, for example, Meltzer, "Technology Literacy," 78–85.

[22] Fannie Johnson Albert, "Computer Learning and Usage by Older Adults" (EdD diss., Texas A&M University at Commerce, 2013), ProQuest (UMI No. 3562480); Constance D. Blanson, "A Non-Experimental Investigation of the Impact of Gender, Academic Skills, and Computer Skills on Online Course Completion Rates" (PhD diss., Capella University, 2013), ProQuest (UMI No. 3557591); Donald Wayne Sorah, Jr., "The Effects of Music Teacher Beliefs, Training, and Resources on Use of Technology" (PhD diss., Florida State University, 2012), ProQuest (UMI No. 519412).

Methodology

Design

We designed a 31-item questionnaire for this non-experimental quantitative study.[23] Ann Blombach—the designer of MacGAMUT—checked the accuracy of software-related details, lending item validity to the instrument.[24] An expert panel of three university faculty advisors, each with significant experience using MacGAMUT and in researching aural skills pedagogy, identified questions that were unclear or ambiguous, and gave suggestions for modifications. The survey was pilot-tested with an anonymous random sample of the target population. Cronbach's Alpha was used to ensure the internal consistency of the instrument and was applied to the results of the pilot test before it was made available to the participants. Results of the pilot test yielded an overall alpha of .973, indicating a very reliable instrument. Because the MacGAMUT database is confidential, Blombach forwarded an email from the researchers with a link to the questionnaire (see Survey Instrument) to all instructors in the database who have registered their software and have deliverable email addresses (N = 1,717). Blombach forwarded two email reminders written by the researchers in two-week increments. The respondents (N = 331) included 53 pre-college instructors who were eliminated from the results, leaving a final sample of 278 anonymous postsecondary respondents.

[23] The survey is available at http://jmtp.ou.edu/journal.

[24] Before an expert panel of advisors examined the questionnaire, the following changes were made based on Blombach's recommendations: we removed the words "allow students to use" (Q15); removed "in a non-graded manner (practice mode)" and "in a graded manner (mastery mode)" because these response options were unrelated to the other response options (Q22); alphabetized textbook choices by author's name to avoid a biased order (Q23); removed "for remedial work" to avoid appearing judgmental toward instructors who use Prep Presets (Q24); added Presets and Libraries for Stefan Kostka and Dorothy Payne's textbook (*Tonal Harmony with an Introduction to Twentieth-Century Music*, 6th ed. New York, NY: McGraw-Hill, 2009) and Joel Phillips, Jane Piper Clendinning, and Elizabeth West Marvin's textbook (*The Musician's Guide to Aural Skills*, New York, NY: W. W. Norton, 2005) (Q24); added "I use my own libraries" and "Other libraries" (Q24); removed "timbre and volume of individual voices" because the default already allows students to use this option (Q29); deleted "identification of what must be notated, including the inner voices" because it was ambiguous (Q29); and added "allowing responses from a MIDI/Virtual Keyboard" (Q29). Neither Blombach nor any other MacGAMUT employee initiated the study, provided funding, or had access to the anonymous raw data.

Sampling Procedures

We used as the population an entire database of instructors who use MacGAMUT. We did not exclude any postsecondary instructors who use MacGAMUT in the United States or other locales.[25] This was an attempt to be more global by attaining a thorough census of these instructors, but it was also beyond our control to stratify the sample because we did not have access to the confidential database of instructors and the database is not grouped according to teaching levels, teaching specialties, institutions, or countries. Out of necessity, a census study was the only viable option for examining the target population. Unlike previous studies that limited data collection to the music theory coordinator, the necessity in using an entire database allowed us to recognize variations in individual pedagogical differences among persons with different academic ranks/positions which may have been overlooked.[26]

Data Analysis

The data analysis for this study examined the relationships between multiple variables; therefore, it extended beyond simple descriptive analysis and also used inferential statistics. Multivariate statistics were chosen to simultaneously analyze whether respondents, grouped using four independent variables, differed on eight dependent variables. Survey results were exported from SurveyMonkey to JMP Pro 9 Statistical Software, a version of SAS, to analyze the data. The level of $p = .05$ was used for all tests of significance; p values less than .05 indicate that a difference between groups was beyond that which could be attributed to chance.

Research Validity

Internal validity is the degree to which a research design rules out explanations for a study's findings other than that the variables involved.[27] The current research violated internal validity with selection threat. As stated in the section on sampling procedures,

[25] Instructors who use MacGAMUT teach at institutions in Australia, Belgium, Brazil, Canada, China, Finland, France, Israel, Italy, Korea, Mexico, Nepal, Netherlands, New Zealand, Norway, Philippines, Slovenia, Sweden, Taiwan, Turkey, United Kingdom, and the United States (Ann Blombach, "MacGAMUT Institutions" (Excel worksheet, 2010)).

[26] See, for example, Pembrook and Riggins, "Send Help!" 231–241.

[27] Robert E. Slavin, *Research Methods in Education: A Practical Guide* (Boston, MA: Allyn and Bacon, 1984).

we did not exclude any potential postsecondary instructors who use MacGAMUT. Steps were taken to reduce additional threats to internal validity. We used an expert panel of advisors and conducted a pilot test with an anonymous, randomly-selected group to ensure content validity of the instrument.

"External validity, or generalization, refers to the degree to which the findings of a study using a particular sample have meaning for other settings or samples."[28] No randomization was used in the current study because an entire target population was invited to participate. A threat to validity was a low response rate (19.28%; N = 331) in comparison to the entire population of instructors with deliverable email addresses who have registered their MacGAMUT software (N = 1,717).[29] Due to the small sample size, low response rate, and lack of randomization, results and conclusions may not be wholly generalizable to the entire target population.

Results

The following results are sequenced according to three distinct sections of the questionnaire: instructors' profiles, perceptions, and practices. Results conclude with an overview of inferential findings.

Instructors' Profiles

Research Question 1 asked, "What are the demographic characteristics and educational backgrounds of postsecondary aural training instructors who use CAI as a tool for teaching dictation skills?" Respondents had between one and 40 years of experience in teaching postsecondary aural skills (mean (M) = 10.84). Years of experience in using the selected software ranged from zero to 23 years (M = 4.72). The majority of instructors identified music theory / aural skills (66.19%) as the primary area of teaching responsibility, followed by applied music (13.67%) as the next highest response. Out of 26 identified primary instruments, piano (33.09%) and voice (12.73%) were most common.[30] The majority (59.85%) of respondents

[28] Slavin, *Research Methods*, 109.

[29] The actual number of current users is unknown because instructors remain in the database until they request to be removed; free upgrades are given; and some servers, email recipients, and anti-virus programs stop all mail from macgamut.com (Ann Blombach, personal communication, March 31, 2011).

[30] Based on the current sample, piano was the most common primary instrument of the respondents. Further evidence for the

indicated that they have obtained a doctorate, indicating a well-educated sample.

The selected software is used among all career age groups. The average age was 43.8, ranging from 22-year-old graduate assistants to a 77-year-old professor emeritus. The most frequent respondents were 30 to 34 years old.[31] Among the entire sample, associate professors (17.98%) and professors (17.62%) were the most common ranks, suggesting the inclusion of veteran professors. Assistant professors (15.11%) were the third most common rank. The sample consisted of a sizeable minority (30.94%) of part-time faculty,[32] comprised of adjunct professors (14.39%), graduate assistants (13.31%),[33] and high school music instructors (3.24%) who teach part-time at the postsecondary level. Table 1 displays gender, highest degree obtained, and academic rank or position of survey participants compared to the population of music theory/aural skills instructors in the College Music Society (CMS) Directory. The targeted sample and the CMS population have similar percentages of assistant professors and professors, yet the percentage of doctoral recipients and rank of "instructor" were significantly different between groups. Among survey respondents, doctoral recipients

prominence of piano is that the second highest primary instrument (voice) trailed behind piano by 20.36%. Moreover, applied music instructors (predominantly piano) comprised the second highest group of respondents, second only to instructors who primarily teach music theory/aural skills. This may imply that piano faculty members are being employed to teach aural training as one of their responsibilities.

[31] The most common rank among 30- to 34-year olds was assistant professor, implying that these instructors may be experiencing excitement over promising new careers, and thus, an eagerness to make a contribution in aural-training pedagogy.

[32] Lecturers (9.71%) and instructors (3.24%) comprised another 12.95% of the sample; however, it is unknown whether these ranks are full- or part-time appointments. If they are part-time appointments, the percentage of part-time faculty for the current sample could be as high as 43.89%.

[33] This is consistent with previous research, in that graduate assistants comprised 16.75% of respondents in Richard B. Nelson's nationwide music theory study ("The College Music Society Music Theory Undergraduate Core Curriculum Survey—2000," *College Music Symposium* 42 (2002): 60–75), and up to 19.5% in Jeffrey L. Gillespie's aural-training sample ("Melodic Dictation Scoring Methods: An Exploratory Study," *Journal of Music Theory Pedagogy* 15 (2001): 50–68). Although an exact number was not provided, Gillespie stated that the "other" category (19.5%) consisted primarily of graduate students.

were significantly higher (p = .048) than CMS, implying that doctoral recipients may be more likely than non-doctoral recipients to use CAI. The rank of instructor was significantly higher (p = .001) in CMS than among survey respondents, which could be a result of nomenclature differences (e.g., adjunct instructor vs. adjunct professor).

	Survey Respondents		CMS Directory	
Demographics	%	*n*	%	*n*
Gender				
Males	54.68%	152	58.88%	1383
Females	44.24%	123	39.89%	937
Unknown Gender	1.08%	3	1.23%	29
Highest Degree				
Doctorate	59.00%	164	45.04%	1058
Master's	34.17%	95	46.32%	1088
Bachelor's	5.03%	14	4.38%	103
H.S. Diploma	0.36%	1	Not an option	N/A
Artist Diploma	Not an option	0	0.30%	7
No Degree Reported	1.44%	4	3.66%	86
Rank or Position				
Adjunct Professor	14.39%	40	10.60%	249
Assistant Professor	15.11%	42	15.28%	359
Associate Professor	17.98%	50	14.43%	339
Professor	17.62%	49	17.45%	410
Visiting Professor	1.08%	3	0.85%	20
Professor Emeritus	0.36%	1	1.96%	46
Lecturer	9.71%	27	7.88%	185
Instructor	3.24%	9	16.60%	390
Graduate Assistant	13.31%	37	Not an option	N/A
H.S. Instructor	3.24%	9	Not an option	N/A
Artist in Residence	None	0	0.34%	8
No Rank Reported	1.08%	3	4.81%	113

Table 1. Survey respondents compared to the CMS directory

Compared to the CMS data (see Table 1), gender was fairly balanced with 10.44% more males than females; this is reflective of the profession, yet more evenly balanced than CMS. Academic rank, however, was conspicuously different. Females were

employed most frequently in temporary positions as graduate assistants (16.26%) and contract positions as adjunct professors (15.45%).[34] Males, on the other hand, overall had more stability, being employed most frequently as associate professors (21.19%) and professors (20.53%). Because 54.92% of females and 63.82% of males had obtained doctorates, highest degree obtained was apparently not the reason for rank differences.

The final demographic item assessed respondents' experience with CAI. As a group, respondents identified 30 aural training software packages they had used, indicating general proficiency in CAI experience. Besides MacGAMUT, the most-used programs were MusicTheory.net (n = 135), Practica Musica (n = 111), Benward and Kolosick's (2010) Ear Training: A Technique for Listening (n = 73), Teoria.com (n = 72), Auralia (n = 63), Horvit, Koozin, and Nelson's Music for Ear Training (n = 50), Music Ace (n = 38), and MiBAC (n = 24). Three of the top CAI (MusicTheory.net, Benward and Kolosick's Ear Training, and Teoria.com) are online sources, perhaps projecting mobile preferences of current traditional-age college students known as digital natives.[35]

Instructors' Perceptions

Instructors were asked about a variety of perceptions to determine their teaching effectiveness, most helpful training or technology support, and several software-related perceptions, such as the importance of demonstrating CAI to students. Perceptions

[34] Further investigation is needed regarding gender and rank. Research on gender and rank has also been requested by the Society for Music Theory's (SMT) Committee on the Status of Women (Brenda Ravenscroft, Robert Zierolf, Sharon Krebs, and Harald Krebs, "Addressing the Gender Imbalance" (Session Report by the Committee on the Status of Women at the Society for Music Theory Annual Conference, Nashville, TN, 2008), retrieved from: http://societymusictheory.org/sites/default/files/Nashville_report.pdf).

[35] According to José A Bowen, digital natives learn in "more mobile, customized, and varied ways" (*Teaching Naked: How Moving Technology out of Your College Classroom will Improve Student Learning* (San Francisco, CA: Jossey-Bass, 2012), xiii). Bowen recommended a six-phase cycle that can be used to extend technology uses beyond the physical classroom as a means to create an interactive postsecondary environment for digital natives. Christopher Jones and Binhui Shao indicated that this generation prefers to receive "information quickly" and has a "low tolerance to lectures" ("The Net Generation and Digital Natives: Implications for Higher Education" (Higher Education Academy, York, June 26, 2011) http://oro.open.ac.uk/30014/, 3).

were also used to identify the impact that the selected software and instructors' interactions with the software have on student learning.

On a six-point Likert-type scale, respondents indicated self-perceived competency in their effectiveness of teaching dictation (M = 4.51; SD = 0.85). Instructors who primarily taught composition or music theory/aural skills had a significantly more positive perception of their teaching effectiveness than instructors in other music fields.[36] Terminal degrees had the most positive impact on self-perceived competency among instructors with 10 to 15 years of teaching experience. Among instructors with one to three years of teaching experience, mean scores were almost identical for instructors with bachelor's, master's, and doctoral degrees. Also among this least experienced group, males reported significantly higher (p = .016) self-perceived competency than females with the same amount of experience; yet, there were more female doctoral recipients than male doctoral recipients in this group. As females gained more experience, their perceived effectiveness increased.[37] Females with 10 to 15 years of experience had higher perceived effectiveness than males with the same amount of experience, and were significantly higher (p = .008) than females with one to three years of experience. The entire group of males, however, reported significantly higher (p = .029) self-perceived competency than the entire group of females. Table 2 summarizes descriptive differences among groups.

[36] Respondents who primarily taught composition had a significantly more positive perception of their effectiveness in teaching dictation than those who primarily taught instrumental ensembles (p = .002), choir (p = .032), and music history (p = .042). Instructors who primarily taught music theory/aural skills were significantly higher than instructors who primarily taught instrumental ensembles (p = .019) and choir (p = .038).

[37] Females with 1 to 3 years of experience had a mean score of 4.00, compared to 4 to 9 years of experience (M = 4.37), 10 to 15 years of experience (M = 4.86), and 16 to 40 years of experience (M = 4.52).

Years Teaching	*n*	*Mean*	*Standard Deviation (SD)*
1-3 years	73	4.26	0.88
Male	36	4.50	0.73
Female	35	4.00	0.97
HS Diploma	1	6.00	- -
Bachelor's	10	4.20	0.91
Master's	34	4.23	0.92
Doctorate	26	4.23	0.81
4-9 years	69	4.44	0.79
Male	40	4.48	0.72
Female	29	4.37	0.90
HS Diploma	- -	- -	- -
Bachelor's	2	4.50	0.70
Master's	30	4.33	0.92
Doctorate	36	4.52	0.69
10-15 years	70	4.77	0.80
Male	37	4.66	0.13
Female	33	4.86	0.13
HS Diploma	- -	- -	- -
Bachelor's	1	- -	- -
Master's	15	4.53	0.99
Doctorate	53	4.86	0.70
16-40 years	61	4.57	0.86
Male	36	4.61	0.93
Female	25	4.52	0.77
HS Diploma	- -	- -	- -
Bachelor's	1	- -	- -
Master's	13	4.46	0.87
Doctorate	47	4.57	0.85

Table 2. Self-perceived effectiveness by years teaching aural skills, gender, and highest degree obtained

Instructors were asked to identify the most helpful training or technology support in using the selected software (see Figure 1). The most common answer was "none," followed by the software's technical support, and "other" answers. Self-exploration of the program was the most common "other" answer. Video tutorials, conference demonstrations, workshops, and professional publications were the least common responses.

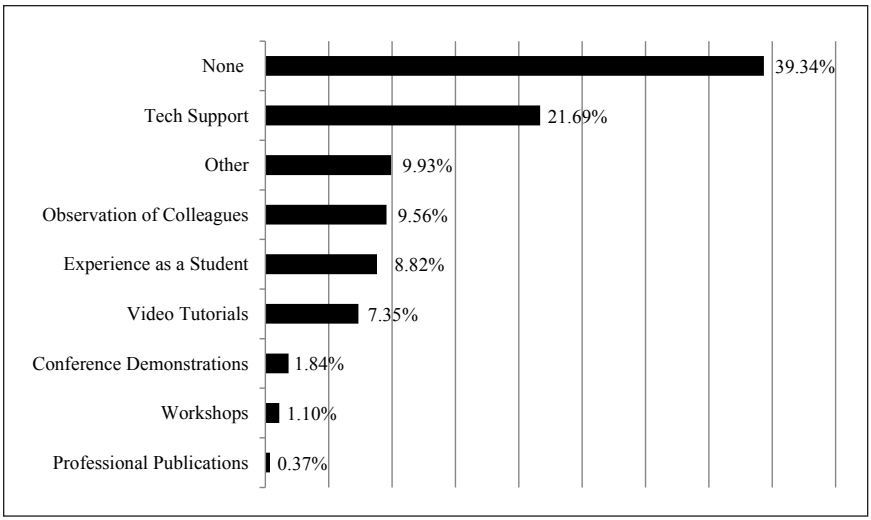

Figure 1. Most helpful training or technology support

Pedagogical techniques used in conjunction with CAI were rated according to their level of importance to respondents (see Figure 2). On a six-point Likert-type scale, checking students' statistics in Mastery Mode and counseling students on effective uses of CAI were the top two responses. Instructors were least likely to check details of the Dates/Times field to see how often and how much time students spend using the selected CAI. For the purposes of this study, monitoring students' work meant that instructors were engaged with students while the software was being used and were providing immediate feedback about how best to use it.

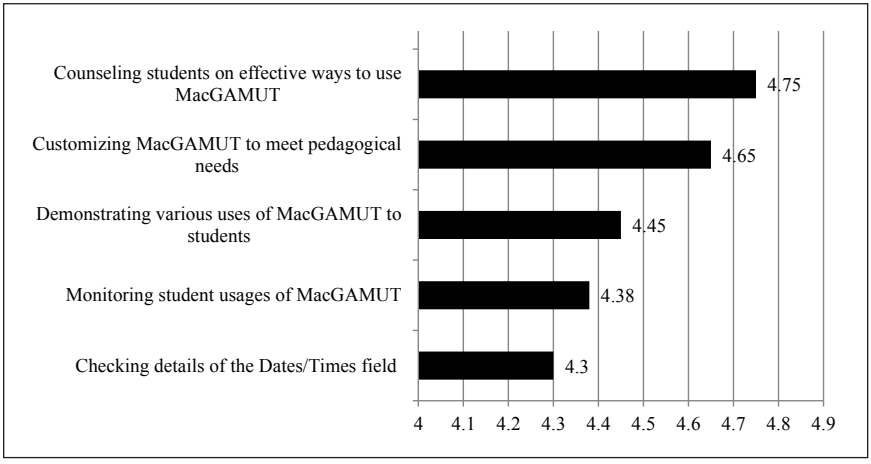

Figure 2. Importance of pedagogical techniques used in conjunction with CAI

On another six-point scale, instructors rated their perceptions of the software's six aural elements for improving aural skills (see Figure 3). Respondents identified MacGAMUT's aural intervals and aural scales as the most effective components for improving aural skills, while harmonic dictation was rated as the least effective.

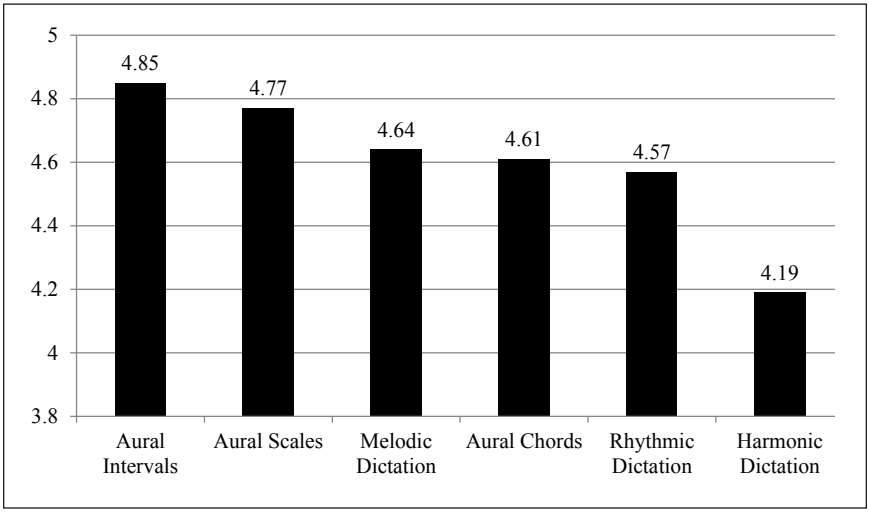

Figure 3. Perceived improvement based on the software's aural components

Instructors also rated their perceptions of technological factors that impact students' dictation skills (see Figure 4). Respondents believe that as instructors, their direct interactions and involvement with the software have the most positive impact on how well students learn dictation skills. Males and females believe with relative equality that the selected software also has a positive impact on student learning. Although CAI with customization features has the potential to provide powerful instructional and learning options that can be tailored to the curriculum and the diverse backgrounds and levels of students, respondents rated customization as the component that has the least positive impact on student learning of dictation skills.

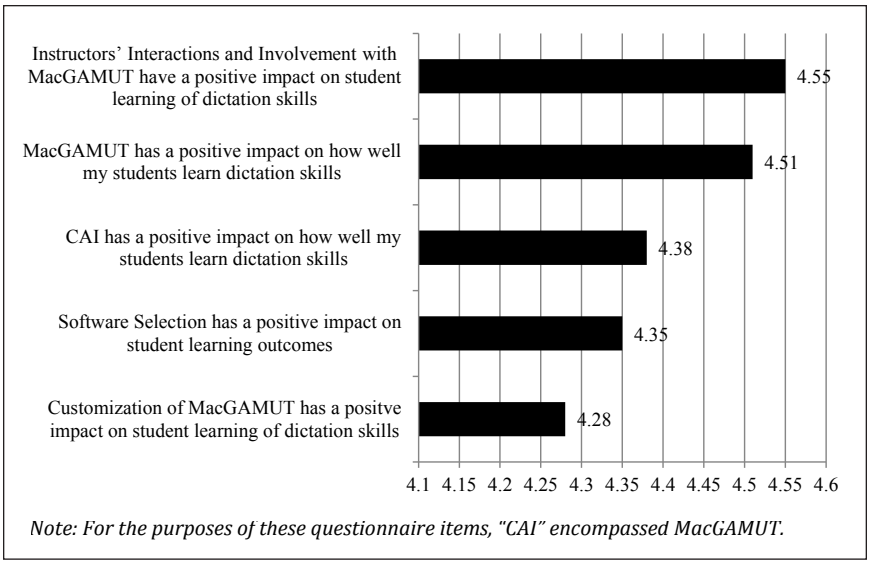

Figure 4. Mean scores for perceived impact of software and instructors' interactions

Instructors' Practices

Research Question 2 asked, "What are the practices of postsecondary aural training instructors who use CAI as a tool for teaching dictation skills?" Practices data included a variety of behaviors, such as current use of the selected software, how instructors use the software, grading of CAI, and how instructors use Presets (default settings), Libraries, and customization features.

The majority (75.91%; n = 208) of respondents were using the selected software at the time of the survey. Out of the instructors who had discontinued using the software, most (59.09%; n = 39) had used it for zero to three years, implying that a lack of experience contributes toward discontinued use. Among all respondents, checking students' statistics in Mastery Mode (M = 4.77; SD = 1.47) yielded the most favorable pedagogical practice measuring hands-on involvement with CAI. Respondents also believe it is important to regularly check students' work using the statistics function (M = 4.14; SD = 1.61), and require students to submit CAI assignments regularly (M = 4.33; SD = 1.44). Further, a strong majority (81.65%; n = 227) reported using MacGAMUT "as a requirement" with their students. Although most instructors require students to regularly submit assignments using Mastery Mode, overall, respondents had a slightly more favorable perception of

Practice Mode (M = 4.66; SD = 1.39) over Mastery Mode (M = 4.56; SD = 1.45).

In this study, CAI assignments from the selected software most frequently contribute 11%-20% of students' overall grades (Figure 5), leaving 80%-90% for other elements such as exams, quizzes, homework, attendance, and participation. The selected software is most often used as a graded supplement to enhance other content, rather than for ungraded practice or extra credit.[38]

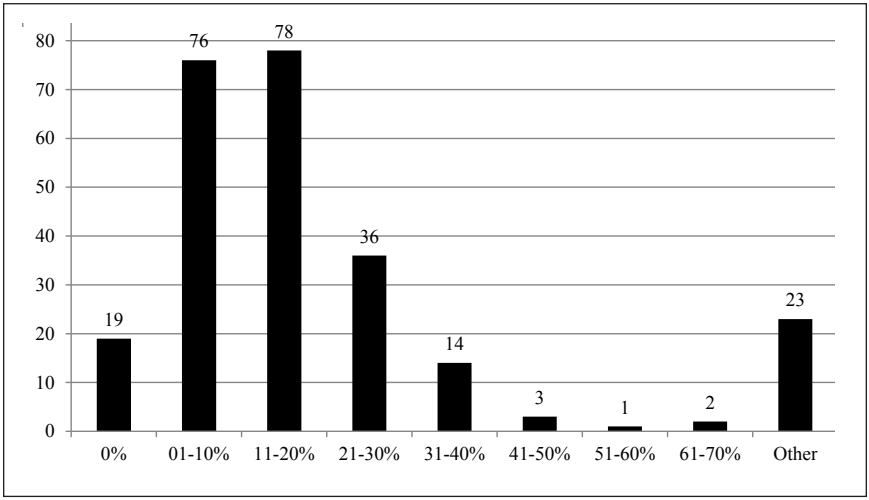

Figure 5. Percentages that CAI contributes to overall grades

As found in Figure 6, the selected software is primarily used as a required, out-of-class practice tool to supplement in-class dictation.[39] It is less often used as an entire replacement of in-class dictation (14.57%), and rarely used as an entire replacement for a traditional course (1.58%).

[38] Spangler, "Computer-Assisted Instruction," found that instructors using MacGAMUT (n = 70) were more likely than instructors using other applications to assign a grade weight for CAI. In Spangler's study, MacGAMUT assignments most frequently contributed 10%–19% (n = 24), 1%–9% (n = 10), and 30%–39% (n = 8) of the students' overall grade. Although the majority (69.57%) in Spangler's study assigned a grade weight, a sizeable minority (30.43%) used MacGAMUT as ungraded practice, extra credit, or "other."

[39] Instructors were asked to select multiple responses.

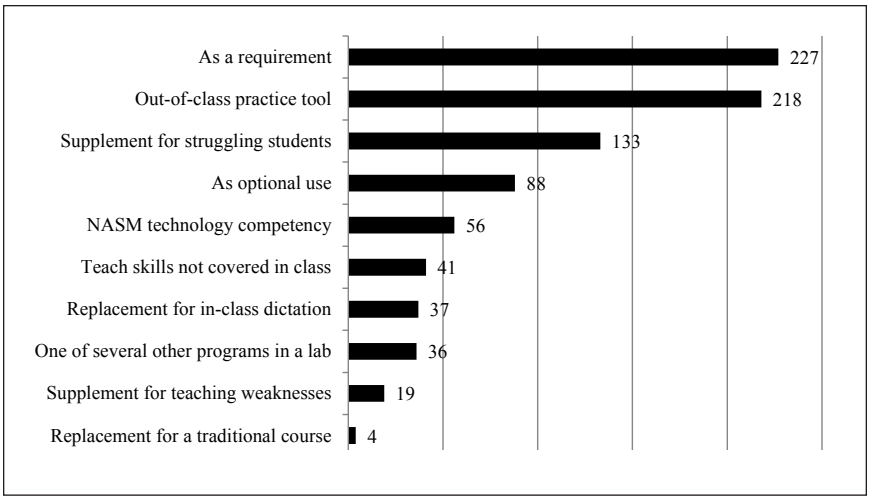

Figure 6. How instructors use CAI with their students

Customization practices indicated that the majority (59.60%) of instructors customizes their uses of the CAI package. Gender was nearly equally matched: 59.09% of females and 60.00% of males customize, implying gender equivalency in technology competency. Instructors with 16 to 40 years of experience in teaching aural skills were the most likely to customize their uses of CAI.

Overall, 79.85% of instructors in this study make CAI Presets easier, rather than harder. They primarily customize Presets to fit the curriculum. In some courses, such as Fundamentals of Music, Presets are made easier, while in other courses, such as Aural Skills IV, Presets are made more difficult. Although instructors have several library files from which to choose, the majority (60.40%) of respondents use the software's Original Presets and Libraries.[40] Although instructors modify libraries, they typically do not create entirely new libraries. Further, the majority (75.58%) of respondents do not create new levels, indicating overall satisfaction with the packaged levels.

Instructors can modify any of the parameter or level settings in the software package in several ways. The most common are increasing the number of hearings before the first answer check (74.48%),

[40]MacGAMUT contains Presets and Libraries for David Damschroder's *Listen and Sing: Lessons in Ear-Training and Sight-Singing* (New York, NY: Schirmer Books, 2005); Phillips, Clendinning, and Marvin's *The Musician's Guide*; Kostka and Payne's *Tonal Harmony;* Much Easier Presets MG6.mgp; Much Harder Presets MG6.mgp; and Prep Presets MG6.mgp. These varieties of Presets imply a need for software designers to have multiple Presets for various levels and backgrounds of students.

allowing students to choose any tempo (71.72%), providing a choice of levels that students are required to complete (66.21%), and re-ordering levels that students are required to complete (64.14%). Because the majority of customizing instructors allow students to have multiple hearings and reduce the tempo, this may imply that the software's Presets are too challenging.

Relationships among Instructors' Characteristics

Research Question 3 sought to determine the influences that demographic and educational characteristics of postsecondary aural training instructors assert on their software usage practices. This question was answered by the use of two multiple analyses of variance (MANOVAs) and Post Hoc ANOVAs. MANOVA 1 was related to instructors' perceptions, while MANOVA 2 was related to instructors' practices. Dependent variables (DVs) for MANOVA 1 were the importance of monitoring students' software usages, the impact of CAI on student learning, the impact of instructors' interactions and involvement with the software on student learning, and the impact of customization on student learning. DVs for MANOVA 2 were the importance of requiring students to use Mastery Mode, the importance of using Practice Mode, the importance of using Make My Own Drills, and how often students are required to submit CAI assignments. Independent variables (IVs) used in both MANOVAs were the years of experience in teaching aural skills, the years of experience in using the selected software, gender, and the highest degree obtained.

The results of MANOVA 1 and MANOVA 2 are shown in Table 3 and Table 4 respectively. These tables show that the years of experience in using the selected software, the years of experience in teaching aural skills, and gender had significant influences on the variability of dependent variables (DVs). The highest degree obtained did not have a significant influence on the variability of DVs in either MANOVA. Although statistical significance was found for the years of experience in teaching aural skills (Table 4), the Post Hoc ANOVA did not reveal any specific interactions with DVs that were contributing to the statistically significant result. Thus, gender and years of experience in using the selected software were the only two IVs that revealed specific interactions with DVs (Table 5).

Identity	Value[a]	*F*	*df*	*p*
Whole Model	0.785	1.69	32	.010*
Years Teaching AS[b]	0.952	0.87	12	.567
Gender	0.055	3.02	4	.018*
Highest Degree	0.946	1.01	12	.434
Years Using Selected Software	0.067	3.65	4	.006*

Note.
[a] The value of each multivariate statistical test in the report
[b] Aural Skills
* = $p < .05$

Table 3. MANOVA 1 results

Identity	Value	*F*	*df*	*p*
Whole Model	0.811	1.58	32	.022*
Years Teaching AS	0.900	2.10	12	.015*
Gender	0.033	1.96	4	.100
Highest Degree	0.965	0.68	12	.764
Years Using Selected Software	0.081	4.78	4	.001*

Note.
* = $p < .05$

Table 4. MANOVA 2 results

Independent Variables	Dependent Variables	*p*
Years of experience in using the selected software	CAI has a positive impact on student learning	< .0001*
	Instructors' interactions with the software	< .0001*
	Customization has a positive impact on student learning	.004*
	Required use of Mastery Mode	.005*
	How often assignments are submitted	.011*
Gender	Monitoring student usages of the software	.017*

Note.
* = $p < .05$

Table 5. Significant Tukey-Kramer HSD Post Hoc ANOVA test results

As shown in Table 5, statistical significance was found for the influence of gender on monitoring student usages of the selected software, in that females were significantly higher ($p = .017$) than males. Monitoring student usages implies that females in the present study are spending time with students, and may be more likely to develop one-on-one relationships with students and to initiate positive instructional strategies. Additional items related to instructors' involvement with students' work were investigated to determine if females and males interact differently in other areas. Females were also significantly higher than males in the importance of counseling students on effective ways to use the software ($p = .006$), checking students' statistics in Mastery Mode ($p = .049$), and how often students' work is checked using the statistics function ($p = .007$).

Years of experience in using the selected software had the most striking influence because it demonstrated a significant relationship in both MANOVAs and had a significant influence on five of the eight DVs (see Table 5). In all five cases, the most experienced software users (four or more years of experience) indicated beliefs that were significantly different from the least experienced software users (zero to three years of experience). The most experienced software users require students to use Mastery Mode and submit CAI assignments, and believe that customization, CAI, and instructors' interactions with the software have a positive impact on students learning dictation skills. The perception that CAI has a positive impact implies that experienced CAI users trust software's ability to provide students with a personal tutor that can facilitate the acquisition of dictation skills. Longevity of using CAI increases instructors' interactions and involvement with CAI, and the perceived value of CAI. Furthermore, longevity of using software also produces seasoned CAI users who maximize the benefits of customizable software in a meaningful way to aid students in the progressive stages of acquiring aural skills. The most experienced software users also represented the largest percentage of customizing instructors.

Although the Post Hoc ANOVA did not reveal any specific interactions with years of experience in teaching aural skills (see Table 4), instructors with 10 to 15 years of teaching experience (Group C) consistently had the lowest mean responses among the other groups of instructors for the importance of requiring students to use Mastery Mode, Practice Mode, Make My Own Drills, and

requiring students to submit CAI assignments.[41] Group C had the most amount of variance from the other groups.[42] The exact reason for their unfavorable outlooks toward the software is unclear. One possible explanation is that Group C had the highest percentage (30.77%) of instructors who have discontinued using the software package. Further, Group C differed from the other groups in that these instructors represented the highest number of doctoral recipients, the highest perceived effectiveness in teaching dictation, and the most confident group of females.

While years of experience in using the selected software had a significant influence on the importance of using Mastery Mode, none of the IVs had a significant influence on the importance of using Practice Mode or Make My Own Drills. This is due to an overall favorable attitude toward Practice Mode (M = 4.66; SD = 1.39), and an overall less favorable attitude toward Make My Own Drills (M = 3.54; SD = 1.53)

Discussion of Results and Implications for Pedagogy

The following discussion serves to address concerns and themes which emerged from the data analysis. It addresses software usage practices, lack of accessible professional development, gender, graduate assistants, years of experience in teaching aural skills, and generalizability.

Software Usage Practices

In this study, aural training software is most often used as a graded requirement, implying that instructors place much confidence in the software's ability to meet out-of-class dictation needs. Although most instructors require students to submit assignments using

[41] Instructors in the sample were divided into four fairly evenly balanced groups: Group A—one to three years (n = 73), Group B—four to nine years (n = 69), Group C—10 to 15 years (n = 70), and Group D—16 to 40 years (n = 61). Mean ages for each group are: 34.4 (Group A), 39.8 (Group B), 46.4 (Group C), and 56.3 (Group D).

[42] Group C had the most amount of variance with Group D (p = .053), which nearly reached statistical significance for the importance of requiring students to use Mastery Mode. Group C also varied with Group B on the importance of using Practice Mode and Make My Own Drills, and with Group A for how often students are required to submit CAI assignments. Additionally, the least experienced group—Group A—indicated a higher average on requiring students to submit CAI assignments than the most experienced group of instructors—Group D.

Mastery Mode, respondents were more favorable toward Practice Mode than Mastery Mode. This may suggest that instructors place more value on the process of practice skills leading up to tested skills. On the other hand, possible negative student attitudes toward Mastery Mode may influence instructor perceptions.

Instructors indicated that their top pedagogical practices with CAI are checking students' statistics, counseling students on effective ways to use software, customizing the software to meet pedagogical needs, and demonstrating the various uses of the software to students. Findings suggest that the instructors who responded to this study use a guided approach rather than an unguided approach when introducing students to CAI. It stands to reason that instructors who use a guided approach in teaching students how to use CAI are less likely to produce students who have resentment or frustration toward CAI. Furthermore, these respondents are probably less likely to discontinue using CAI, though further research is necessary to study this component of the findings.

Lack of Accessible Professional Development

Results from this study suggest that available professional development training regarding the use of CAI is underutilized. Although the targeted software provides technical support and video tutorials, respondents overwhelmingly indicated that they had not used these materials, nor had they sought professional development in the use of the software. Perhaps delivery of training could be facilitated through online resources or networks of users.

A strong percentage (91.37%) of respondents either perceived that their previous student experience in using the software was not helpful in learning to teach with the software, or that they had no student experience, perhaps because some were students prior to the advent of the software program. It appears that many respondents trained themselves how to use CAI during their teaching careers, which raises curricular concerns regarding graduate preparation in technologies associated with aural training pedagogy. Ideally, students preparing to teach aural skills professionally would benefit most from curriculum integration of CAI in their aural training courses and learning how to customize CAI in their music technology courses.

The perceived ease in using CAI is a possible reason for the lack of training. Although respondents reported their own lack of training,

they rated the importance of counseling students on effective ways to use the software as a top priority in pedagogical practices. Further study is needed on accessible professional development training opportunities.

Gender

This study provides implications that males are not technologically superior to females. Males, as a whole, responded significantly higher than females in one area—perceived effectiveness of teaching dictation—yet, this area is unrelated to technology competency or involvement with CAI. Neither male dominance nor gender difference in technology competency was found among instructors who use CAI. Males were not significantly more involved with CAI than females' involvement with CAI, but were significantly lower in several areas. Instructors' interactions with CAI are perhaps most noticeable in customization and checking students' statistics because both require hands-on involvement with CAI. In customization, gender was nearly equally matched, implying gender equivalency in technology competency.

Females in this sample appear to interact differently with their students than male instructors. Significant findings imply that female instructors are more involved with CAI, have a high interest for students' success in the progressive stages of acquiring dictation skills, spend more time with students, and are likely to be instructive and relational in their interactions with students.

Graduate Assistants

Consistent with previous research, graduate assistants are used to teach aural skills courses.[43] Graduate assistantships may provide valuable learning opportunities through observation of faculty members, grading experiences, and student teaching opportunities; however, they may not necessarily allow students to become engrossed in aural training pedagogy and research, pedagogical resources, and learning how to use customizable CAI, among other topics.

The inclusion of graduate assistants may have influenced the overall results of this study. Over one-third (37.84%) of graduate assistants were not currently using the software package at the

[43]Gillespie, "Melodic Dictation," 2001; Nelson, "The College Music Society," 2002

time of the survey, implying sporadic use of CAI, which could have skewed some of the data. Further, over half (52.94%) of graduate assistants do not customize. Many who claimed to customize were most likely answering questions based on how their supervisor customizes.[44] This implies that graduate assistants lack hands-on involvement with CAI and training in using CAI.

Years of Experience in Teaching Aural Skills

Years of experience in teaching aural skills provided additional characteristics of the respondents. Group A (M = 34.4), with one to three years of postsecondary teaching experience, required students to submit CAI assignments more frequently than any other group, possibly to impart any components that they do not feel competent teaching. Group B (M = 39.8), with four to nine years of experience, found Practice Mode and Make My Own Drills more important than any other group, implying an eagerness to explore the software's ungraded modes. Interestingly, the overall sample generally had an unfavorable outlook toward Make My Own Drills. Group C (M = 46.4), with 10 to 15 years of experience, may have the ideal level of experience and confidence. Their mean age places them in the middle of their teaching careers, and this group represented the highest number of doctoral recipients. As stated earlier, this group had the least favorable outlook toward the selected software and had the highest amount of discontinued software users. The most experienced respondents—Group D (M = 56.3), with 16 to 40 years of experience—declined in perceived teaching effectiveness. A longitudinal study would be beneficial to determine software preferences of Groups A and B, understand why Group C consistently had the least positive attitudes, and study teaching effectiveness among Group D. Further research should also address how long it has been since an instructor last used the selected software in teaching.

Years of experience in teaching aural skills also influenced customization practices. In Group A, there were nearly an equal number of customizing and non-customizing instructors. Groups B, C, and D showed a gradual, continual increase in the number of customizing instructors, indicating that years of experience in

[44] When asked about customization of the software's Presets, Libraries, and default changes, common answers provided by graduate assistants included: "Not sure, my supervisor takes care of the presets"; "Not sure—I just grade"; and "I don't know."

teaching aural skills increased the likelihood of customization. Instructors in Group D were the most likely to customize their software uses. Most of these veteran instructors customize and have used the software for four or more years. Group D males rated Practice Mode higher than Group D females, which may suggest that years of experience in teaching aural skills influences males' interest in students' acquisition of dictation skills.

Generalizable Characteristics

Based on current findings, we believe that further research using similar demographic samples may produce comparable results. The following characteristics may be generalizable to samples of instructors who use other aural training software titles. In the current sample, doctoral recipients outnumbered non-doctoral recipients, and the percentage of doctoral recipients was significantly higher when compared to the CMS population of music theory/aural training instructors. It is possible that doctoral recipients are the largest educational group of aural training instructors who use CAI. In the current sample, the majority identified music theory/aural skills as their primary area of teaching responsibility. The current sample, predominantly comprised of four-year college/university instructors (81.48%), had 20.19% more music theory specialists than Anderman's survey of instructors at community colleges.[45] This may also be generalizable to the population of aural training software users. Because the piano is the most accessible instrument for in-class dictation, it seems likely that the piano is the primary instrument of many aural training instructors. In the current sample, piano was the most commonly identified primary instrument. Gender equality in customization practices was found in the current study. Further, females in the current study were more likely than males to monitor student CAI uses, counsel students in effective CAI uses, and check students' statistics. It is also possible that other aspects of CAI use (e.g., how instructors use CAI with their students; most frequently-used components, etc.) are generalizable to users of other software titles. Further research is needed to determine if instructors who use MacGAMUT are more likely to assign a grade weight for CAI work in comparison to instructors who use other software titles. We recommend a replication of this study using other software applications.

[45]Mark Alun Anderman, "Musicianship Instruction in California Community Colleges" (DMA diss., Boston University, 2011) ProQuest (UMI No. 3482464).

Recommendations for Further Research

Harmonic Dictation

It is unclear from the data analysis why the software's harmonic dictation is the least favorable component for improving dictation skills. Future research is needed to identify which settings in harmonic dictation are most frequently changed, reasons for changing default settings, and reasons for lower perceptions of improving dictation skills. Because harmonic dictation is consistently underprepared among incoming college music majors, additional research is needed to investigate whether underdeveloped skills influence instructors' perceptions of CAI's ability to improve these skills.[46] A study employing open-ended responses may provide useful information related to perceived potential problems in the design of various CAI applications, ways of meeting student deficiencies, and other variables related to harmonic dictation. While drill-and-practice and flexible-practice CAI are the most common types of aural training technology, more research is needed in interactive software that appeals to constructivists.

Graduate Training in Technology

Findings from the present study imply a lack of graduate training in technology preparation. The majority of respondents appeared to be self- or peer-taught in using CAI, consistent with previous research.[47] Current graduate assistants exhibited a lack of hands-on involvement with MacGAMUT, training in using CAI, and knowledge of how their supervisor customizes the software. The majority of graduate assistants do not customize, which provides further support for a lack of graduate training in technology. Exploring graduate training in technology is another possible avenue of investigation that is needed.

[46] Carolyn Livingston, "The Role of the Private Instrumental Teacher in Preparing Music Students for College Theory," *American Music Teacher* 31, no. 6 (1982): 14–16; Carolyn Livingston and James Ackman, "Changing Trends in Preparing for College Level Theory," *American Music Teacher* 53 (2003): 26–29.

[47] Reese and Rimington, "Music Technology," 27–32.

Foundational Assumptions Regarding Technology among Digital Natives

Foundational assumptions regarding aural training technology among current traditional-age college students is another beneficial topic to study. Future researchers should investigate digital natives' attitudes toward and preferences of aural training technology for out-of-class practice. Researchers should also explore mobile computing opportunities in aural training, and investigate interactive software options in aural training that encourage creativity beyond a flexible-practice or drill-and-practice model.

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