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The Effect of SmartMusic on Student Practice

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The Effect of SmartMusic® on Student Practice

by

Brian Duane Nichols

A Dissertation

Presented in Partial Fulfillment of Requirements for the
Degree of
Doctor in Education
In
Leadership for Learning
(Teacher Leadership)
in the
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THE EFFECT OF SMARTMUSIC® ON STUDENT PRACTICE

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ABSTRACT

The Effect of SmartMusic® on Student Practice

by

Brian Duane Nichols

The purpose of this study was to document the use of SmartMusic Interactive Practice Software and its effect on practice habits and motivation. The 12-week study measured participant practice time using paper practice charts and the online grade book/practice chart in SmartMusic Interactive Practice software. In addition, an 11-question Likert survey was administered pre and poststudy to measure students’ reactions and motivations to practice. Participants (N=38) were randomly assigned to either the SmartMusic group (SM, n=19) or the Contact Control group (CC, n=19). Data from an Independent Samples t test measuring group practice time indicate a significant difference between the mean scores of SM and the CC. Likert survey data were measured using a Wilcoxon Signed rank test and a 2-sample t test and indicate no significant difference in z scores or mean scores, respectively.

Keywords: SmartMusic, music education, instructional technology, interactive practice software, practice
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CHAPTER ONE
INTRODUCTION

Statement of the Problem

Music teachers have long encouraged their students to practice their instruments to improve their performance ability and enjoyment of playing. With such advice as “perfect practice makes perfect” teachers pursue many methods to encourage students to practice such as graded assessments, practice logs, and public praise. However, individual practice is still a concern for music teachers, since many students still remain uncommitted to practice. Interactive music practice software (IMPS) may be a useful tool to motivate students to practice. IMPS allow the student and the computer to interact during individual practice time giving immediate feedback to the student on the accuracy of their performance. This important feature has the potential to increase the quality of student practice by guiding them through the individual work.

Most research has focused on the IMPS assessment module and its impact on student performance accuracy, and the effectiveness of the IMPS as a teaching and learning tool in the classroom (Buck, 2008; Lee, 2007; Ouren, 1997; Sheldon, Reese & Grashel, 1999). However, few investigations have been conducted on the ability of the IMPS to motivate students to practice their instrument on a more consistent basis. Sheldon, et al (1999), investigated the differences in performance quality ratings of undergraduate college students using SmartMusic Interactive Practice Software and they suggested further research into the effectiveness of “SmartMusic on practice and
The Effect of SmartMusic® on Student Practice

Klee (1998) investigated the effect of interactive accompaniment recordings on the learning of solo literature by flute students. He found that students enjoyed using accompaniment tapes and may have been motivated to increase practice time. Further, he suggested future research on the effect of accompaniment tapes and student motivation to practice. Clearly, further investigation is needed into the potential for interactive music practice software to motivate students in the classroom and the practice room.

**Research Questions**

SmartMusic Interactive Practice Software offers numerous teaching and learning tools to aid the music educator and music students. This study focused on the motivational effect of SmartMusic on student practice habits. It examined the following questions:

1) What effect does SmartMusic have on students to increase their instrument practice time as indicated in practice records and SmartMusic records?

2) How do students describe their reactions and motivations toward the use of SmartMusic?

**Purpose of the Research**

The purpose of this study was to document the use of SmartMusic Interactive Practice Software and its effect on practice habits and motivation. One Hundred-Forty Nine 7th and 8th grade band students from a Title 1 suburban middle school in North Georgia were invited to participate in the twelve-week study. Thirty-eight students in
either their second or third year of band instruction accepted the invitation and received parental permission to participate in this study.

**Review of Relevant Terms**

*Extrinsic branching* – Branching controlled by the student where, under certain conditions and at certain times, the student may initiate requests either to skip ahead, to repeat, or to go back to a previous set of exercises (Kuhn & Allvin, 1967).

*Goal* – Object or aim of an action, for example, to attain a specific standard of proficiency, usually within a specified time limit (Locke & Latham, 2002).

*Intonation* - Singing or playing in tune (Oxford Music Online).

*Intrinsic branching* – Branching programmed into a computer allowing a student upon successful completion of one step to proceed to another (Kuhn & Allvin, 1967).

*Notation* - Visual analogue of musical sound, either as a record of sound heard or imagined, or as a set of visual instructions for performers (Grove Music Online, 2011).

*Pitch* - The particular frequency of a sound (e.g. an individual musical note) that fixes its position in the scale (*ibid*).

*Score* - a page, volume, fascicle or other artifact containing a complete copy of a musical work (*ibid*).
CHAPTER TWO

LITERATURE REVIEW

Theoretical Framework

There are a number of issues that must be addressed to fully understand what areas might be affected when using Interactive Music Practice Systems (IMPS). The areas that will be reviewed are practice, goals, computer assisted musical instruction, and assessment and feedback.

Practice

Musical practice has been defined as “the individual study and preparation of music” (Hamann, Lucas, McAllister, & Teachout, 1998). Just as one would practice to improve as an athlete, a writer, or a chef it is important to practice to improve on a musical instrument. This is a necessary endeavor for musicians to “acquire, develop, and maintain” the skills needed for performance (Hallam, 2002). However, many young musicians fail to see the importance of practice once the initial excitement of the new instrument has subsided. Early on, they discover that playing an instrument takes work and students may not be motivated to put in the time necessary to be successful (Lee, 2007). Simply, students may not have developed the intrinsic motivation to practice feeling like they should be playing instead of the excitement of being allowed to play. In a study on the practice habits of beginning band students, McPherson and Davidson (2002) found that children often perceive practice “in the same way as their homework,
in that it was often regarded as a ‘chore’ or even ‘boring’” (p.152). Perhaps, if students have specific practice goals and find the practice time enjoyable they will increase their time, or the quality of it, on their instrument.

IMPS may be useful tools to help create just such an environment. These software packages allow the student and the computer to interact during individual practice time giving immediate feedback to the student on aspects of their performance. This important feature has the potential to increase the quality of student practice by guiding the young musician through the individual practice time. Ciabattari (2004) studied student and teacher perspectives of motivational strategies used to encourage student practice. As suggested by student and director survey results, he found students were more motivated by challenging music; music that was demonstrated, or modeled; and when the music teacher provided feedback on performance. While the IMPS cannot replace the quality feedback and instruction offered by a human teacher, it does provide important modeling, assessment, and feedback during the crucial practice time when a human teacher is not available. However, this does not guide the software to adapt the music as one would see in an intelligent tutoring system. Van Lehn (1988) describes a common characteristic of intelligent tutor systems (ITS) stating, that they “infer a model of the student’s current understanding of the subject matter and use this individualized model to adapt the instruction to the student’s needs” (p. 55). Current IMPS do not meet this definition; nonetheless, the interactive nature of the music practice systems may be a useful tool in helping students enjoy a practice session and result in a desire to increase their practice time.
Goals

When writing on school improvement Schmoker (2003) suggested, specific goals “may be the most significant act” towards increasing student success (p. 23). In fact, research on Goal-Setting Theory found that “specific, difficult goals consistently led to higher performances than urging people to do their best” (Locke & Latham, 2002, p. 706). Motivationally speaking, an assigned goal is more effective when the goal is presented with a purpose (Locke & Latham, 2002). During practice sessions or performances, musicians should seek mastery level work. Simply preparing notes and rhythms is not enough. Ames (1992) studied Achievement Goal Theory and compared performance goals to mastery goals. Performance goals, or ego goals, are centered on one’s ability and self-efficacy. However, mastery, or task goals direct students toward skill development, attempting to understand their work, improvement of competence levels and achievement of a sense of mastery (Ames, 1992). Mastery goals are well suited to guide student practice time as they provide specific tasks to lead the student to improved performance ability. Sandene’s (1997) study on motivation in the music classroom found “moderately positive correlations between students’ classroom task goal perceptions, students’ personal task goals, and internal attributions for success and failure in instrumental music” (p. 176). Conversely, students who sense their teachers as stressing ego goals, such as competitive learning environments, avoid mastery goals in their own work (ibid). Ames’ (1992) work with Achievement Goal Theory found the mastery goal’s central tenets of effort and outcome supports achievement-directed behavior in the long-term. As in any school subject, music teachers want students to develop practice skills that may enhance their performance ability over time. Research into motivation in the music classroom
(Sandene, 1997) and music practice (Smith, 2005) found mastery, or task, goals to be more effective and should be emphasized more than performance, or ego, goals. Other research in musical instrument practice and goal setting has emphasized the importance of setting specific, high, and attainable goals for students (Christensen, 2010; Hruska, 2011). Perhaps, students will enjoy their practice time when using IMPS coupled with task goals aimed at increasing their performance levels.

**Computer Assisted Musical Instruction (CAMI)**

In 1998, Zhu and Chang characterized Computer Assisted Teaching as being interactive, adaptive, learner-controlled, inexhaustible, and unlimited in time, space, and manageability (cited in Lou, Guo, Zhu, Shih, and Dzan, 2011). The computer assisted music instruction (CAMI) provided by IMPS meets five of these six characteristics allowing the student unlimited access to the self-paced, interactive music practice experience. IMPS packages, unlike intelligent tutor software, do not adapt to the learner. However, students can access the music to be studied on their own schedules and control their practice sessions. A private instructor or ensemble director may have a limited amount of time to offer for individual instruction and practice. However, as Allvin (1971) stated, the “computer does have time” (p. 133) to aid the student in learning the coursework.

In their research, Kuhn and Allvin (1967) called for the “development of a reliable device which can extract pitch information directly from each note of a subject’s musical performance and make this pitch information available to a computerized teaching device for evaluation the subject’s performance” (p. 306). They reported on the development of a computer-assisted teaching system being evaluated by Stanford
University. The device was centered on a pitch extraction device that was felt to be more accurate and reliable than a human evaluator. The system individualized instruction thereby allowing students to move at their own pace by way of intrinsic and extrinsic branching. Allvin (1971) further investigated the use of CAMI using IBM’s CourseWriter II software to individualize music instruction in aural-visual instruction, error analysis and notation instruction. In his 1971 study, he stated, “In the next decade computer-assisted instruction will strengthen musical training and raise the level of proficiency in aspiring professional musicians”. CAMI provides an environment for “teaching music composition or editing, music appreciation and musical instruments” (Lou, et al, 2011, p. 46). The accompanying research data indicated students felt “the CAMI enhanced their learning achievement during the course on learning Chinese instruments” (p. 55).

In 1973, Peters used an updated PLATO system (PLATO III) at the University of Illinois to investigate the accuracy of the computer interface in judging student performance of pitch and rhythm patterns presented by the computer. He found that the system and the interface device “could judge student performance of trumpet exercises” (p. 148). In an effort to solve synchronization problems with taped musical accompaniment for instrumental soloists, Dannenberg (1985) conducted research on, and built, computer systems capable of online score following and real-time accompaniment using on-line algorithms. This research continues at Carnegie-Mellon University as Dannenberg and his colleagues continue to refine the system for keyboard performance, vocalists, and ensembles of instrumentalists. According to the Carnegie-Mellon website, “Dannenberg’s patent on computer accompaniment is licensed to MakeMusic!” and was
used to develop SmartMusic software
(http://www.cs.cmu.edu/~music/accomp/index.html).

A study of college-aged instrumental students interaction using IMPS showed that a majority of students found computer assisted musical instruction to be fun making practice time more enjoyable (Sheldon, Reese, & Grashel, 1999). Flanigan (2008) found that students may not practice more, but are more productive in their practice when using IMPS. In a study that reported the impact of a five-year plan to introduce instructional technology into music classrooms in Hong Kong and found the technology supported student motivation and increased the quality of learning (Ho, 2004).

**Assessment and Feedback**

IMPS may provide assistance to the teacher when assessment of a student performance is used as a motivating technique. “If the goal of an assessment is to motivate students to practice an excerpt in an attempt to achieve perfection, SmartMusic can allow them the time they need” (Erwin, 2009, p.18). This allows students to perform their assessments in practice rooms, gives them an opportunity to play their tests away from their peers, and gives the teacher more time to address ensemble concerns. Also, if they are timid when performing in front of the class, students may feel more comfortable playing for the computer. It was also found that “the SmartMusic assessment program fostered an interactive learner-centered paradigm, empowering the student to direct his or her own learning from immediate succinct and unequivocal feedback” (Buck, 2008, p. 64).

Assessment of individual student performance is a time-consuming task for band and orchestra directors. The conductors often have large classes making it difficult to
hear individual students play a musical passage. IMPS may provide assistance to the
teacher when assessing a student performance as students can perform their part for the
computer and have the software evaluate the performance. This also allows students who
are timid when performing in front of the class to feel more comfortable playing for the
computer and provides the teacher more time to address ensemble concerns (Ewers,
2004; Erwin, 2009).

IMPS may provide the individualized guidance and assessment necessary for the
student to demonstrate knowledge of the content (Orman, 1998). The assessment feature
of IMPS provides immediate, summary feedback to students during practice sessions
allowing for progress to be compared to mastery goals. This is important in students’
musical development, as they cannot be expected to master the practice goals without
feedback (Locke & Latham, 2002).

Pitts, Davidson, and McPherson (2000) found many participants in their study of
music practice repeatedly played their exercises, but did not display self-correction
behaviors when teacher correction was not available. The assessment feature in IMPS
provides feedback that may assist the student with their self-correction behavior. Further
research has indicated this feedback may reinforce music performance skills thus
allowing the student to prepare for future classroom assessments (Buck, 2008; Erwin,
2009) and performances (Tseng, 1996).

Selection of Interactive Music Practice Software

Numerous interactive music practice systems, including Essential Elements
Interactive (EEi), Interactive Pyware Assessment System (iPAS), and Interactive Practice
Studio (IPS), are available to aid musicians in their practice. Each of these programs
The Effect of SmartMusic® on Student Practice

provides feedback on the length, accuracy, and placement of notes. They also provide students with an audio recording of the practice session allowing the performer an opportunity to reflect on the performance. SmartMusic Interactive Practice Software not only provides these features; but its latest version, SmartMusic 2013, includes the intelligent accompaniment system capable of following spontaneous tempo changes with solos for many instruments and difficulty levels, an extensive library of jazz and classical band, choral and orchestral titles, band and orchestral method books and jazz improvisational methods. The access to a wide selection of music, the ability to track student practice through an online teacher grade book, and the accessibility to the software were the primary factors leading to the selection of SmartMusic for this study.

SmartMusic was first introduced in 1994 as the hardware-based Vivace Intelligent Accompanist System. Rudolph (2006) reviewed SmartMusic and stated, Vivace “cost several thousand dollars, and owners needed to spend hundreds of dollars more to purchase solo accompaniments” (p. 10). By 1998, Vivace was renamed SmartMusic, no longer required expensive hardware, and “the program became subscription based” (ibid, p. 10). When speaking of SmartMusic; Sheldon, Reese, and Grashel (1999) state, “It is likely that this form of technology-based music instruction will provide a favorable supplement to traditional music instruction, give music students access to high-quality accompaniment, and allow solo literature to endure as a prominent complement in the development of young musicians” (p. 253).

In a study on student practice habits, Pitts et al. (2000) suggested practicing must be enjoyable “if it is to bring musical development and satisfaction” (p. 53). It is speculated that students enjoy practicing with SmartMusic as they perform with ‘live’
musicians and receive immediate feedback on their performance (Tseng, 1996; Ouren, 1997; Snapp, 1997). Sheldon et al. (1999) studied the effects of SmartMusic on musicians’ performance quality and found, “nearly all stated that it was fun to use and it made practicing more enjoyable” (p. 259). Further, they state, practicing with accompaniment “can be regarded as a learning tool” (p. 259). Snapp (1997) interviewed 172 school band directors to determine the effectiveness of the Vivace Intelligent Accompanist System in K-12 band programs and found “strong relationships exist between Vivace use and musical growth” (p. 180). Recently, Gurley (2012) compared the perceptions of 147 students in 6th through 12th grade concerning the effectiveness of SmartMusic as a practice and assessment tool. His results indicate that younger students were more motivated to practice with SmartMusic than the older ones (p. 42).

Almost 20 years ago, Tseng (1996) studied the impact of the Vivace Intelligent Accompaniment System on the practice of 10 college-level flute students. She found 8 out of 10 participants expressed in interviews that “the pieces become more meaningful to them while learning with accompaniments” (p. 120). Additionally, Tseng (1996) found “Vivace helped them learn music faster and better” (p. 120). She found Vivace to not only be “instructional but motivating to play with the accompaniment” (p. 121). Tseng concluded, “all participants in this study found it motivating to play with the accompaniment, especially in the context of a concerto since they hardly had an opportunity to rehearse with a real orchestra” (p. 119). In a similar manner, Buck (2008) studied the effects of SmartMusic’s assessment module on student music performance by presenting teacher-led instruction with and without the software to two separate groups of
high school students. Based on his survey data he reported, “some students found
listening to the recording of their own performance helpful, even motivational” (p. 66).

Research on the motivational effects of SmartMusic on student practice has
produced mixed results. Flanigan (2008) compared the intonation and rhythmic accuracy
of two groups of college brass students. The first group (WSM) used SmartMusic in their
practice time and the second group (NSM) practiced without the use of SmartMusic.
When discussing motivation to practice, Flanigan (2008) reported the WSM group did
not practice longer than the NSM group but did “achieve greater results in the same
amount of time” (p. 102). He saw this an indication that “the software was not a
motivating factor in the amount of participants’ practice”, but viewed the study results as
“giving evidence” that SmartMusic “contributed positively to the quality of practice by
the participants” (p. 102). Based on participant’s survey responses on the use of Vivace in
the K-12 classroom, Snapp (1997) found students “practiced more, accomplished more in
their practice, were better prepared, and were therefore more confident when they
performed” (p. 182). Flanigan (2008) examined the effect of SmartMusic on the
intonation and rhythmic accuracy of 20 college level brass players. In written responses
to use of the software participants were “unanimously positive” about the usefulness of
SmartMusic and “indicated they would voluntarily continue use of SmartMusic” (p. 103).

Lee (2007) reasoned, through the course of his research that, “the group using the
SmartMusic (2006) program would see a significant increase in their performance scores”
(p. 78). Unfortunately, his data did not support his hypothesis. As a result of this, he
suggested that, “perhaps the length of time for the study affected the results in this area”
as the “study was 12 weeks in duration” (p. 78) and suggested that a future study lasting
longer than 12 weeks to test the effect of computer-assisted instruction on performance ability. While Lee (2007) suggested that, “the use of computers for delivery of supplemental teaching material is no more effective in promoting performance achievement than teaching to young instrumentalists with teacher-centered instruction via method books in the traditional manner” (p. 75).

Yet, other studies have found SmartMusic to have a positive impact on student performance. Buck (2008) found that when compared to the teacher-led group, “the pre and posttest mean scores for the SmartMusic assessment group showed larger gains for both etudes on MPS and TSS measures” (p. 57). Indeed, “the data suggests that the SmartMusic assessment program reinforces music performance skills, especially in technically oriented music passages” (p. 63). Tseng (1996) found a positive effect on performance skills stating, the “Vivace system (previous name for SmartMusic) also helped the participants to become steadier in their rhythm and tempo performance” (p. 121).
CHAPTER THREE

METHODOLOGY

Research Questions

SmartMusic Interactive Practice Software offers numerous teaching and learning tools to aid the music educator and music students. This study was focused on the motivational effect of SmartMusic on student practice habits. The study addressed the following questions:

1) What effect does SmartMusic have on students to increase their instrument practice time as indicated in practice records and SmartMusic records?

2) How do students describe their reactions and motivations toward the use of SmartMusic?

Research Design

Permission to conduct the study was granted by the school principal, the school district research office, and the university’s Internal Review Board. Parents of the participants completed the required consent forms (Appendix A) granting permission for students to participate in the study. The study was set in a Title 1 suburban middle school in North Georgia with a school population of one thousand students. The population was diverse, comprised of 2.8% Asian, 42.6% Black, 45.7% Hispanic, 3.3% multiracial, and 5.6% white students, with 85% of the population qualified for free or reduced lunch cost. The band program had approximately 330 students, including one hundred-forty nine 7th
and 8th grade students who were invited to participate in the 12-week study. Of these, 38 students who were in their second or third year of band instruction accepted the invitation and received parental permission to participate in this study. The students represented a wide range of performance abilities from a below average performer to a District Honor Band individual.

This quasi-experimental study incorporated a Control Group Design regarding participant practice time, with a pre/posttest Likert survey to gauge their reaction to the treatment. The Likert survey (Appendix B) was adapted, with permission, from a previous study conducted by Gurley (2012) at Texas Tech University.

Georgia’s music educators association holds yearly large group performance evaluations where bands are evaluated on their performance by a panel of three professional music educators. This study coincided with the band class’ preparation of three instructor selected musical works to be performed for the upcoming state evaluation and additional works to be performed at a spring concert for the school community. All 7th and 8th grade band students were required to submit each of these works in SmartMusic for a class grade, with the goal of achieving a 100% score on each playing test. Students with no at home access to SmartMusic were able to submit their recordings using the computers in one of the six practice rooms in the band room.

Participants were separated into groups based on their musical instrument type. The names of the participants were randomly selected with names drawn from a hat and divided into two groups. The SmartMusic (SM) control group (n = 19) was supplied with a subscription for their home computer and a USB microphone to use for at-home practice. In addition, all participants (N = 38) received a Paper Practice Chart (Appendix
C) to be signed by parents, verifying student practice frequency and length of practice time. They Contact Control (CC) group was asked to refrain from purchasing SmartMusic for home use or using the software at a friend’s house. Six computers were available for student submission of playing tests in the band practice rooms. Limited time was available for students to practice with these computers during and outside of class. However, students did use the computers to submit their playing tests.

MakeMusic, Inc., the developer of SmartMusic, provided 60 subscriptions and 60 microphones for this study through a successful SmartMusic Research Grant (see Appendix D). If the researcher purchased these items the cost would have exceeded $3,700 and the study may not have been possible. SM participants received a subscription and a USB microphone at the beginning of the study. The CC Group participants received a subscription and a USB microphone at the conclusion of the study.

**Role of the Researcher**

The researcher served as the Director of Bands working with an Associate Director teaching the classes of participants who are involved in the study. An effort was made by the researcher and Associate Director to display similar behavior to all students, with no advantage given to students using the program in this study. Consequently, all students were encouraged to practice their instrument daily to prepare for the classroom playing tests and the state evaluation (Appendix E).

**Data Collection and Reliability**

This study included three separate data collection methods to determine the effect of SmartMusic on the participants’ practice. First, participant practice time was measured
using Paper Practice Charts that were verified by participants parents’ signatures. Secondly, before and after the study, participants completed a Likert survey measuring their attitudes and beliefs concerning the use of SmartMusic. Finally, the SmartMusic online Practice Report and Gradebook assisted in measuring participants’ quantity of practice and served to validate the parent-signed practice records. The online Practice Report began tracking practice time each time the student clicked the Start Take button and paused when the song ended only counting the time when the student played with the song. The cumulative practice time is submitted to the SmartMusic Teacher Gradebook (Appendix E). Unfortunately, this feature does not assess the quality of the practice, but it is another data point to assist in evaluating the effect of the software. The software does assess accuracy of notes and rhythms, which may be helpful to students during practice time, but this information was not used for this study, as it did not specifically address quantity of practice time.

Participant data was kept strictly confidential and housed on the servers provided by the SmartMusic software and in a locked file box at the researcher’s home. All data from the paper practice charts and Likert survey will be erased or destroyed within one year after the completion of the study.

Data Analysis

The Paper Practice and SmartMusic Online Practice Reports provided practice durations that were analyzed using an Independent Samples t test in IBM SPSS 19 software. In addition, participant opinion data from the pre/posttest Likert survey was analyzed with the Wilcoxon Signed Rank Test and 2-Sample t-Test using SAS software.
Significance of the Study

While numerous students expressed interest in participating in the study, only a small number returned the required Institutional Review Board paperwork to participate. Unfortunately, this small sample size ($N=38$) may prevent the results of the study from being generalized to the population. However, in a limited sense, the results may provide valuable information to music educators, students and parents as to the effectiveness of SmartMusic to motivate students to practice their instruments more often. In a study of the differences in performance quality ratings of undergraduate college students using SmartMusic, Sheldon, Reese and Grashel (1999) found that “students indicated they were largely motivated by it and that it functioned to make practicing less boring and more fun” (p. 264). Indeed, parents and students may see positive impacts on student practice and performance levels as a result of student practice with SmartMusic.

Limitations

Several limitations emerged throughout the course of this study. A majority of the participants in the study rode the school bus and were unable, due to lack of space for larger instrument cases, to take their instruments on the bus. The inability to take instruments home may have impacted the practice time totals for some students. They were allowed to practice in the band room before and after school, but this was not always possible as busses may be late or students may eat breakfast in the school cafeteria. Students were also allowed time in class to submit their playing tests in SmartMusic. However, with only six computers available and large class sizes in excess of 60 students, their time was limited. Additionally, the practice rooms containing the computers were not soundproof, allowing students in the classroom to hear other students
playing their tests. This may have caused students to feel uncomfortable playing their
tests for SmartMusic during class.

Additionally, a handful of students, as determined by school administration, were
pulled from the band class during the study for remediation in math and language arts to
prepare for the state criterion reference exam.

**Delimitations**

SmartMusic began as the Vivace Intelligent Accompaniment System providing
digital accompaniment to soloists. As the software developed over time, the assessment
features were added to aid students and teachers in evaluating facets of performance.
While accompaniment and assessment are important components of the SmartMusic the
motivational potential of the software has received little study. The gaps in the research,
coupled with the researcher’s interest, led to the decision to focus this study on
motivation and practice.
CHAPTER FOUR

FINDINGS

Data Descriptions

This study documented the effects of SmartMusic Interactive Practice Software on student practice, as well as student attitudes toward practicing with SmartMusic. The research provided quantitative data on student practice times over a twelve-week period and results of pretest and posttest Likert surveys. These data addressed the following research questions:

1) What effect does SmartMusic have on students to increase their instrument practice time as indicated in practice records and SmartMusic records?
2) How do students describe their reactions and motivations toward the use of SmartMusic?

Data Analysis

Research question 1.

Participant practice time was determined using the Practice Chart feature within SmartMusic (Appendix F) and verified using Paper Practice Charts (Appendix B) that were signed by participant’s parents. Practice times from the 12-week study were totaled for each group and analyzed in IBM SPSS 19 software.

While the CC group did not have access to SmartMusic at home they did access the software at school to practice or submit playing tests for class. An Independent
Samples $t$-test comparing the mean scores of the SM and CC practice data from SmartMusic found a significant difference between the two groups ($t(36) = 2.36, p < .05$). The mean of CC was significantly lower than SM ($m = 24.0 & 65.8, sd = 29.41 & 71.08$, respectively). Further, Cohen’s effect size value ($d = 0.77$) suggested a large practical significance. These data appear to indicate the SM students practiced more than the CC Group.

Practice time totals for each group were not identical when comparing the SmartMusic Practice Chart and the parent signed Paper Practice Chart (SM: 1,251 minutes in software vs. 6,347 on paper; CC: 457 minutes in software vs. 3,751 on paper). An Independent Samples $t$-test compared SM and CC mean scores and found no significant difference between the two groups ($t(36) = 1.13, p > .05$). However, it is interesting to note the mean of CC was lower than SM ($m = 197.4 & 334.0, sd = 287.41 & 438.19$, respectively). The data from the SM Charts confirm that students spent more time practicing than CC, with self-reported time of 6,347 minutes for the SM group and 3,751 minutes for the NSM Group. A possible explanation for the difference in SmartMusic Practice Chart and the Paper Practice Chart times may be that students felt a need to inflate Paper Practice Chart times to please the instructors or their parents or they practiced things other than SmartMusic items.

**Research question 2.**

In order to examine reactions and motivations towards the use of SmartMusic, SM and CC participants completed a Likert survey (Appendix B) at the beginning and conclusion of this research study. Individual data were entered into SAS software and analyzed using the Wilcoxon Signed-ranks test and a 2 Sample $t$ test.
Due to the highly skewed distribution of responses on the Likert survey (Appendices G and H) and the small sample size for each group, a Wilcoxon Signed-ranks test was selected to determine any relationship between the pre and poststudy survey results. No significant difference was found in the results ($S = 5.72, Z = 1.45, p > .05$). Prestudy responses were not significantly different from poststudy results for either the SM or CC group. Results would seem to indicate participant reactions during the study did not change over time.

Further, each Likert item was examined for a significant difference between groups and none were found ($p > .05$). A 2-sample $t$-test was selected to compare the mean prestudy scores to the mean poststudy scores for each group. The prestudy mean of the SM group was 43.2 ($sd = 5.11$) compared to a poststudy mean score of 43.9 ($sd = 4.84$). The prestudy mean of the CC group was 43.28 ($sd = 4.53$) and a post-survey mean score of 42.0 ($sd = 5.10$). No significant difference was produced for pre and poststudy for the SM or CC groups, and would seem to confirm participants’ reactions and motivations to SmartMusic did not change over the course of the study.
CHAPTER FIVE

DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

Summary of Study

The purpose of this study was to document the use of SmartMusic Interactive Practice Software and its effect on practice habits and motivation. The diverse school population of approximately 1000 students was comprised of 2.8% Asian, 42.6% Black, 45.7% Hispanic, 3.3% Multiracial, and 5.6% White students, with 85% of the population qualified for free and reduced lunch. The band program was comprised of approximately 330 students. Thirty-eight students in either the second or third year of band instruction accepted the invitation with parental permission to participate in the study. The students represented a wide range of performance ability from a below average performer to a District Honor Band participant. Participants were randomly assigned to either the SmartMusic Control Group (SM) or the No SmartMusic Contact Control Group (CC). Three separate data collection methods served to determine the effect of SmartMusic on the participants’ practice. First, participant practice time was measured using a Paper Practice Chart (Appendix B) that was verified by participant parent signatures. Secondly, before and after the study, participants completed a Likert survey (Appendix C) measuring their attitudes and beliefs concerning the use of SmartMusic. Finally, the SmartMusic online Practice Report and Gradebook (Appendix F) assisted in measuring participants’ quantity of practice with the software. The online Practice Report began tracking practice time each time the student clicked the Start Take button and paused
when the song ended only counting the time when the student played with the song. The cumulative practice time was submitted to the SmartMusic Teacher Gradebook (Appendix F). SmartMusic measures practice time as the time a student actually plays with the software. Indeed, students may have spent more time playing their instrument without the software, which would certainly qualify as time spent in practice.

**Overview of the Problem**

SmartMusic was originally named Vivace and designed for use as accompaniment software for solo performers. As noted, most research has focused on the impact of the IMPS assessment module on student performance accuracy, and the effectiveness of the IMPS as a teaching and learning tool in the classroom (e.g., Buck, 2008; Lee, 2007; Ouren, 1997; Sheldon, et al, 1999). However, few investigations have been conducted on the ability of the IMPS to motivate students to practice their instrument on a more consistent basis. Past research (Klee, 1998; Sheldon, Reese, & Grashel, 1999) suggested further study into the effect of SmartMusic on student practice. This study was guided by these gaps and the researcher’s interest in the motivation of SmartMusic on students in the local classroom. Consequently, the decision was made to focus solely on the practice time information available with and without SmartMusic.

Music teachers have struggled to find ways to encourage their students to practice their instruments on a regular basis. Extrinsic (i.e. practice logs, graded assessments) and intrinsic rewards (i.e. public praise, playing better) may help, but perhaps technology could play a greater role in solving this problem. IMPS allow the student and computer to interact during individual practice time and may motivate the student to increase the amount of time practiced.
The following research questions guided this study:

1) What effect does SmartMusic have on students to increase their instrument practice time as indicated in practice records and SmartMusic records?

2) How do students describe their reactions and motivations toward the use of SmartMusic?

Discussion of Findings

In order to address the first research question practice time data from each participant was gathered through two methods: The SmartMusic Gradebook with online Practice Report and a Paper Practice Chart signed by participants’ parents with self-reported practice times noted by the participants.

While the practice time data from the SmartMusic Practice Chart did not agree with the self-reported Paper Practice Chart data, raw data from both Practice Charts show the SM group practiced more without SmartMusic. Perhaps knowing the SmartMusic software was available at home encouraged the SM group to take their instrument home for practice. Regardless, the results of an Independent Samples t-test comparing the mean scores of the SM and CC groups would seem to indicate students in the SM group practiced significantly more than the CC group. Given the Title 1 status of the school, it is possible home access to the Internet may have been a problem for students. If this is the case, student practice times may have increased if home Internet access was available. Nonetheless, as music educators continue to search for techniques and tools to encourage student practice the results of this study seem to support the notion that the use of interactive music practice software, specifically SmartMusic, may have a positive effect on students and serve to motivate them to increase the quantity of their practice time.
Research question 2 was addressed with the 11-point Likert survey (Appendix B), administered to the participants before and after the study. Data were analyzed using a Wilcoxon Signed-rank test and a 2-sample t-test. The results of both tests would seem to indicate student reactions remained similar over the course of the study. Although past studies using SmartMusic (e.g. Buck, 2008; Flanigan, 2008; & Lee, 2007) have indicated changes in participant attitude using Likert surveys or questionnaires, results of this study do not show a change in participant attitudes. However, home practice records do indicate a significant difference between the SM and CC groups. While data from the Practice Chart would seem to indicate students in the SM group were motivated by the use of the software the mean scores from the Likert survey seem to contradict these results showing little change in student reaction to SmartMusic. Further, the participants’ description of their reactions appeared to disagree with their actual behaviors. While the SM group seemed to imply they were not overly motivated by the software data indicate they practiced more than the CC group.

**Limitations of Findings**

The small sample size of thirty-eight participants may make it difficult to generalize these findings to the population. Nonetheless, the results may provide useful information to parents, students, and music teachers as they strive to find effective methods to motivate and encourage student practice.

**Relationship to Previous Literature**

The purpose of this study was to document the use of SmartMusic Interactive Practice Software and its effect on practice habits and motivation. Past research has
suggested students find practice boring and are unmotivated to put the necessary time in for practice (Lee, 2007; McPherson & Davidson, 2002). It was speculated the use of SmartMusic Interactive Music Practice software might serve to make practice enjoyable and thereby motivate students to practice. Goal Setting Theory suggests the importance of assigning tasks with high attainable goals to encourage students’ best work (Locke & Latham, 2002). Participants in this study were encouraged to do their best work to prepare for concerts and state evaluation performances (Appendix E). Perhaps the key to the effective use of SmartMusic is the setting of high, attainable goals to guide students on their musical journey. The software may serve as a useful tool in the process.

Previous studies have suggested the assessment and feedback modules in SmartMusic may increase student practice quantity and quality by providing timely evaluation and assistance when a teacher is not present (Buck, 2008; Erwin, 2009, Pitts, Davidson, & McPherson, 2000; & Tseng, 1996;). Results from the data in the SmartMusic Gradebook (Appendix F), Paper Practice Chart (Appendix C), and Likert survey (Appendix B) would seem to indicate students in the SM group with home access to SmartMusic were motivated to practice their instruments more than students in the CC group without home access to the software. These findings support results from previous studies including: 1) Sheldon, Reese, and Grashel (1999) who investigated solo performances of college music students with three accompaniment groups and found students using digital accompaniment in Vivace (SmartMusic’s predecessor) enjoyed their practice time. 2) Ouren (1997) studied the use of Vivace accompaniment in middle school students and found they were motivated to spend more time with the technology. 3) Gurley (2012) examined student reactions to the effectiveness of SmartMusic and
reported the use of SmartMusic in the band curriculum was a motivating factor of younger students. 4) Additionally, when studying the impact of information technology on music learning, Ho (2004) discovered 89% of the 543 participants reported they were “motivated to learn with music technology, which they found fun and interesting” (p. 65).

**Implications for Future Research**

The purpose of this study was to document the effect of SmartMusic on student practice. Future research on this subject is encouraged to seek a larger sample size. Perhaps a study with duration longer than twelve weeks may supply a deeper level of data to assess the software’s impact on practice. Additionally, a longer study may avoid in any potential bias due to the novelty of using the software (e.g. Berz & Bowman, 1995). As SmartMusic has received numerous updates since it was introduced as Vivace, future studies on the assessment feature of software may be needed due to a lack of contemporary research on this topic.

It would be interesting to consider the impact of gaming and social media on student practice and SmartMusic. Petkov & Rogers (2011) suggested the use of serious gaming to engage and motivate the technology-minded students in today’s classrooms. Perhaps future research and development may lead to a gaming function within SmartMusic to motivate younger musicians to interact with the software and their instrument.
REFERENCES


doi:10.1080/1461380022000011939


doi:10.1080/14613800050004422


APPENDIX A

Kennesaw State University Assent Form

PARENTAL CONSENT FORM WITH CHILD ASSENT STATEMENT

Title of Research Study: SmartMusic and Student Practice
Researcher's Contact Information: Brian D. Nichols at bnicho20@kennesaw.edu

Your child is being invited to take part in a research study conducted by Brian D. Nichols of Kennesaw State University. Before you decide to allow your child to participate in this study, you should read this form and ask questions if you do not understand.

Description of Project
The purpose of the study is the purpose of the research project will be to document the use of SmartMusic Interactive Practice Software and its effect on the practice habits and motivation to practice of band students.

Explanation of Procedures
Students will:
1. Practice their instrument to prepare for band class and the upcoming Georgia Music Educators Association Large Group Performance Evaluation, and submit playing test on their instrument using SmartMusic Interactive Practice Software. (Six computers are available in the band room for student use.)
2. Submit a parent-signed paper practice chart (used in the band program already) to verify practice time.
3. 30 students will be asked to install a copy of SmartMusic Interactive Practice Software (provided for free) on their home computer to aid in their practice time, log into SmartMusic during any practice session and submit the online Practice Report into the SmartMusic software. 30 additional students will receive a free copy of SmartMusic for their personal use at the end of the study.

Time Required
Students are expected to practice their instrument 20 minutes/6 days a week to prepare for band class and the upcoming Georgia Music Educators Association Large Group Performance Evaluation. This study will not require additional time beyond normal practice expectations.

Risks or Discomforts: None Known
Benefits: Students may benefit from the ability to use SmartMusic at home for any individual practice time. In addition, parents and students may see performance levels increase as a result of practice with this software.

Compensation: Students will receive a one-year subscription to SmartMusic Interactive Practice Software.

Confidentiality: The results of this participation will be confidential. Participant data will be kept strictly confidential and housed on the servers provided by the SmartMusic software. Paper Practice Charts will be kept in a locked file cabinet at the researcher's home.

Use of Online Surveys: None

Inclusion Criteria for Participation: This study will include the members of the 8th grade band at our school. Students are under no pressure to participate in the study and may withdraw at any time.

Parental Consent to Participate

I give my consent for my child, _______________________________________________, to participate in the research project described above. I understand that this participation is voluntary and that I may withdraw my consent at any time without penalty. I also understand that my child may withdraw his/her assent at any time without penalty.
The Effect of SmartMusic® on Student Practice

__________________________________________________
Signature of Parent or Authorized Representative, Date

________________________________________
Signature of Investigator, Date

_____________________________________________________________________________________
PLEASE SIGN BOTH COPIES OF THIS FORM, KEEP ONE AND RETURN THE OTHER TO THE INVESTIGATOR

Research at Kennesaw State University that involves human participants is carried out under the oversight of an Institutional Review Board. Address questions or problems regarding these activities to the Institutional Review Board, Kennesaw State University, 1000 Chastain Road, #0112, Kennesaw, GA 30144-5591, (678) 797-2268.

_____________________________________________________________________________________
Child Assent to Participate

My name is Brian D. Nichols. I am inviting you to be in a research study about SmartMusic and Student Practice. Your parent has given permission for you to be in this study, but you get to make the final choice. It is up to you whether you participate.

If you decide to be in the study, I will ask you to practice your instrument as we prepare for our upcoming concerts, submit a paper Practice Record to indicate how long you practiced, submit your playing tests in SmartMusic30 students will receive SmartMusic to use at home now and the remaining 30 will receive SmartMusic at the end of the study.

You do not have to answer any question you do not want to answer or do anything that you do not want to do. Everything you say and do will be private, and your parents will not be told what you say or do while you are taking part in the study. However, they will see the results of your tests on your report card. When I tell other people what I learned in the study, I will not tell them your name or the name of anyone else who took part in the research study.

If anything in the study worries you or makes you uncomfortable, let me know and you can stop. No one will be upset with you if you change your mind and decide not to participate. You are free to ask questions at any time and you can talk to your parent any time you want. If you want to be in the study, sign or print your name on the line below:

______________________________
Child’s Name and Signature, Date

Check which of the following applies

☐ Child is capable of reading and understanding the assent form and has signed above as documentation of assent to take part in this study.

☐ Child is not capable of reading the assent form, but the information was verbally explained to him/her. The child signed above as documentation of assent to take part in this study.

______________________________
Signature of Person Obtaining Assent, Date
APPENDIX B

SmartMusic Survey

Please write your lunch number here: __________________
Please circle the answer that best matches the way you feel in response to the question.

1. Practicing with the SmartMusic program increases my confidence.
   Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

2. Practicing with the SmartMusic program has helped me to play more accurately.
   Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

3. My practicing using the SmartMusic program is more effective than without it.
   Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

4. Practicing with the SmartMusic program helps me to find mistakes in my playing.
   Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

5. Given a choice, I would rather practice with SmartMusic than without SmartMusic.
   Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

6. Practicing with SmartMusic is frustrating.
   Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

7. I learn music faster when I use SmartMusic.
   Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

8. I am less successful when I practice with SmartMusic.
   Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

9. I am less confident about my playing after using SmartMusic.
   Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree
10. I practice more often when I have the opportunity to use SmartMusic.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

11. SmartMusic makes me want to practice for longer periods of time.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

From “Student perception of the effectiveness of SmartMusic as a practice and assessment tool on middle school and high school band students,” by Rodney Gurley, 2012, (Unpublished Masters Thesis). Texas Tech University, United States-Texas
APPENDIX C

Paper Practice Chart

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APPENDIX D

SmartMusic Research Grant Letter

October 25, 2013

Dear Mr. Brian Nichols,

Congratulations! The MakeMusic Research Grant Committee is pleased to inform you that your grant proposal has been chosen and we are looking forward to the opportunity to partner with you during your research study.

As part of your research you will be awarded 60 one-year SmartMusic student subscriptions and microphones.

Beginning of Grant Responsibilities
Awardees will provide MakeMusic with the following:
- Start and end dates of research

End of Grant Reporting Responsibilities
Awardees will provide MakeMusic with the following:
- A digital copy of any dissertation and/or published work written or substantially prepared during the grant period
- Copies of any surveys or questionnaires used
- A statement of 1,500 words describing the awardees’ dissertation
- MakeMusic has the right to publish the statement
- Awardee is willing to give a brief video interview of their experience

As soon as Beginning of Grant Responsibilities are complete, you will be contacted by your MakeMusic Account Representative to facilitate the subscription code redemption process.

Please feel free to contact me with questions. Once again, congratulations!

Sincerely,

Beth Nahlovsky
Director of Education Sales
952-906-3630
bnahlovsky@makemusic.com
APPENDIX E

Sample Assignment for Students

Assignment Details

Assignment Name: Practice Chart #1

Instructions: Our expectation is the same as always. That you will practice 20 minutes a day 6 days a week. SmartMusic allows me to see when you have completed those minutes with the software.

State Standards Add or Remove

Points Scheduling

Assessment 120
The Quarter 3 grading period starts on 1/14/2014 and ends on 3/13/2014.

Assign on 3/3/2014
Email reminder
Due date 3/28/2014

Assign to students who enroll later
APPENDIX F

SmartMusic Gradebook Screenshot

![SmartMusic Gradebook Screenshot](image-url)
APPENDIX G

Distribution of Likert scale responses – SmartMusic Group

Figure 1. Histograms indicate SmartMusic Group Pre-/Post- responses from Likert survey by question. Questions 6, 8, and 9 were reverse coded for analysis.
The Effect of SmartMusic® on Student Practice

Distribution of Q8Pre

Distribution of Q8Post

Distribution of Q10Pre

Distribution of Q10Post

Distribution of Q11Pre

Distribution of Q11Post
APPENDIX H

Distribution of Likert scale responses – Contact Control Group

Figure 2. Histograms indicate Contact Control Group Pre-/Post- responses from Likert survey by question. Questions 6, 8, and 9 were reverse coded for analysis.
The Effect of SmartMusic® on Student Practice

Distribution of Q3Pre

Distribution of Q3Post

Distribution of Q4Pre

Distribution of Q4Post

Distribution of Q5Pre

Distribution of Q5Post
APPENDIX I

Permissions

To Brian D. Nichols, Ed.S,

MakeMusic Inc. hereby grants you written permission to include screenshots, images, and other graphical representations of MakeMusic and SmartMusic products for the purposes of the completion of the research you have conducted in 2014.

Steven J. Struhar

SmartMusic Product Manager