Computer-aided Composition with High School Non-music Students

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ABSTRACT

Interactive music systems can be used to facilitate self-directed composition and performance activities for high school students. In the present study, original software was developed to allow students without formal music training to compose and perform original music while acquiring or strengthening knowledge of musical concepts like harmony, rhythm, and timbre. The resultant data suggest that participants did many of the same things a traditional composer would do while composing which included exploration of multiple diatonic tonal centers, conceptualization of some formal organization of pitch material, paying attention to themes and development in musical time, and experimentation with timbre and harmonic texture.

The participants expressed that they gained some understanding of traditional musical vocabulary such as timbre, tempo, and harmony, by using labeled controls within the software that changed these musical variables in real-time, allowing them to hear the results instantly. The self-directed composition activity did not involve any direct teacher instruction, yet yielded compositions that were both interesting to the students and harmonically sophisticated. Similar systems used with the guidance of a teacher could help facilitate discussion about music concepts as students encounter them in their own compositions.

The data also suggest that students' perceptions about their school music program, in which these participants were not involved, changed for the positive and that they would want to be involved in the school music program if they knew that technology like this were commonly in use.

Keywords

Self-directed learning, computer-assisted composition, interactive music systems, non-music students, performance technology

1. INTRODUCTION

An interactive music system is a technology-assisted environment designed to allow an individual to compose or perform music in real-time in some manner. Systems can be designed to allow users to compose and perform even if users possess no formal understanding of the nature composition and performance. These types of interactive music systems can also become learning environments if a proper educational impetus exists.

The purpose of this research was to explore student perceptions of an interactive software system for music composition and performance. The following research questions were explored:

•Do participants enjoy engaging in activities using an interactive software system for music composition and performance?

•Do participants consider their interaction with the system to be musical?

•What do participants think about during the activity of composition?

•Do participants feel that they learned something about music or enhanced their understanding of musical concepts to some degree during the activity?

•Do the participant's perceptions about the school's music program change after experience with the interactive software system.

2. METHOD

The participants in this study were six high school students from a private school in New Jersey. Participants were randomly selected from a population of male and female 10th through 12th grade students who were not involved in the school's instrumental or general music program. One male student and one female student from each grade were randomly selected for this study. One female participant chose to withdraw from the study. The study continued with five participants.

The study consisted of private sessions between the principal investigator and each of the five participants. The sessions were documented by the principal investigator by using two video cameras, and by taking field notes. Each session began with a video-recorded semi-structured interview between the principal investigator and each participant in which the participant was asked open-ended questions about his/her experiences with music and the school's music program (*See List of Pre-test Interview Questions in Appendix A).*

Following the interview, one hour was allocated to allow the participant to use an interactive software-based music system developed by the principal investigator. *(See Description of Software in Appendix B).* The software aided each participant in real-time composition and performance by mapping four sets of numbers chosen by the participant to the seven notes of a diatonic mode. From four touch screen monitors, the participant then controlled the following musical variables as the sets of pitch material (chosen numbers) were played back in real-time: tonic, mode, tempo, timbre, add diatonic harmony by interval, chord voicings (octave doublings), volume, and rhythmic pattern.

This interactive software activity began with the principal investigator asking the participant to enter some numbers using a computer keyboard. The participants were encouraged to enter some "meaningful" numbers such as their phone number, birth

date, or locker combination. Participants were asked to touch the "Instructions" button on one of the touch screen monitors and read the narrative that opened up. This served to acclimate the participants to the nature of controlling the software through touch and also to provide the following description of the nature of the software:
The software provided the following instructions to the participants:

> *A musical scale has 7 unique notes. The 8th note is a repeat of the first one called "the octave". This software takes a series of numbers and equates them to notes of the scale. For example, the number 5 plays the 5th note of the selected scale. Once you've entered your numbers, control the performance by changing the tempo, the rhythm, and the number of notes that make up each chord.*

The participants were told that the program has numerous controls that manipulate the way that the numbers they entered can be played back or "performed" like a musical composition. The participants were given as much time as they liked to explore the different controls in the program, though it was agreed with the school that the software interaction would be kept under one hour. As the participants used the controls within the software, the composition changed sonically in real-time.

Following the software activity, another 10 minute video-taped semi-structured interview between the principal investigator and each participant was administered in which participants were asked open-ended questions about their experiences with the music software (*See List of Post-test Interview Questions in Appendix C)*.

The study was recorded on two video cameras and transcribed by the principal investigator. Field notes of observed behaviors were also taken by the principal investigator. During the composition activity, one camera was fixed at the participant's face and one camera was fixed on the participant's hands and the control interfaces.

3. RESULTS

Data analysis included transcribing video interviews and field note observations, and observing videoed behaviors by participants while using the software system. After reading through the transcripts, emerging common responses to the pre-/post-test questions were identified. The frequency and use of the software's controls were also identified. This included the amount of time spent on task during the software activity.

Though the study called for participants who were not involved in the school's music program, four of the five participants indicated that they had played a musical instrument.

- Participant 1: self-taught on piano
- Participant 2: started to play flute and recorder in 3rd grade; played piano two years ago and guitar one year ago
- Participant 3: played drums in the school's music program one year ago
- Participant 5: has played piano and flute for more than ten years

None of the participants had ever composed any music and all were unable to articulate their understanding of the concepts of a *melody, harmony, rhythm*, and *timbre* prior to engagement with the interactive music system. Two participants were able to correctly articulate *tempo* during the pre-test interview.

Participants were asked to use numbers of any length that were "meaningful" to them in some way. A few examples such as their locker combination, pet's birthday, or first telephone number were suggested by the principal investigator. Asking the participants to provide "meaningful" numbers, as opposed to random numbers, was an attempt to introduce extra-musical elements, or what Green (2008, p. 87) calls "delineated musical meanings" into the composition. As previously described, the numbers were able to be, and were, manipulated in novel musical ways. This practice is not uncommon, with widely recognized musical cryptograms having been employed by numerous composers including Bach, Brahms, and Shostakovich, who spelled out their name in compositions by mapping letters to pitches (Sams, 2010). However a composer decides upon pitch material, there are musical judgments about tempo, rhythm, harmony, and timbre that need to be reconciled. The software used in this study helped the participants establish the pitch material, while providing them the ability to easily manipulate other musical elements in a variety of ways.

After each of the four allowed sets of pitch material were established, participants did many of the same things a traditional composer would do while composing. All of the participants repeatedly listened to the pitch material as it played back in real-time. All participants made frequent changes to tempo, timbre, rhythms, harmony, volume, and chord voicings. All participants, explored polyphony within each set of pitch material by adding diatonic chord tones (labeled 3rd, 5th, 7th, 9th, 11th, 13th) to the fundamental pitch (labeled root). All participants also played back sets of pitch material simultaneously to achieve a layered result that was at times polyphonic, multitimbral, polyrhythmic, and polytonal. All participants substituted at least one set of their original numbers for different ones, in one case for a single number, at some point during the activity.

Compositional Process

When asked what they were thinking about while they were using the software, four out of five participants described that they developed a specific compositional goal while participating in the activity.

−Participant 1: "...make sure it was in the right key...right everything. I wanted everything to match."

−Participant 2: " I kinda had like this, this kinda like, adventure kinda theme in my head. How to like, like, mix the music like perfectly like one high, one in the middle and then one low is in the background music, kind of, and then one like suspense, kind of."

−Participant 4: "I was just trying to make one simple sound that went altogether."

−Participant 5: "I tried to match a little bit and sometimes I tried, I want to try this one and this one."

Enjoyment

All participants commented that they enjoyed the experience and gave a rating of how fun they felt the activity was on a scale of one to ten:

−Participant 1: "Eight." "I tried to figure out how to match all this. It was pretty fun."

−Participant 2: "Eight or eight and a half because at first I didn't really know how to use the controls, but after a while I got, I got the hang of it."

−Participant 3: "Nine, it could be a ten." "...there's a lot of ways, different ways to do it. You could be doing this for an hour, maybe hours if you're good at it." "It's cool it's creative by just putting in numbers you can make sound from the numbers. And you can also change the tempo, the beat, the timbre, you can change what key you want." "You can change the pattern, by just touching, you can change the pattern of the exact numbers. You can also change the numbers until, say, put random numbers in and just keep doing it until you have the sound that you see fit."
−Researcher: "the numbers you put in, were they random for you?"
−Participant 3: "Some of them were. Like the first time they weren't. Then like towards the end, I just put random words in, random numbers just to see what the sound would be. And some of them I liked that were random."

−Participant 4: "Six or seven. Seven". "It's really cool". "It's easy to make sounds."

−Participant 5: "Ten. It's so awesome. You can try different kinds of instruments and rhythm. I like that."

Musicality

All participants felt that this was a way to be musical:

−Participant 1: "Good, you have to have a good ear. You have to make sure everything's in place."

−Participant 3: "...it's a way to be musical, especially if you don't know like a real instrument--you don't know how to play a real instrument. Like, if you don't actually know how to play a real instrument, I guess this is a good way to, I guess, to learn how sounds, like all the different ways or the different possibilities of sound you can create with just numbers. So."
−Researcher: "Do you feel like you learned some ways?"
−Participant 3: "Mmmhhh [nods yes].
−Researcher: "Do you think you learned anything else?"
−Participant 3: "I learned certain things, say you didn't know what a tempo is, or, say you didn't learn certain things, you can just figure it out on your own. Some things you can just figure out on your own. That, like the chord tones: they change the way it sounds when you click on them. When you click on multiple ones it sounds different. If you click on all of them it might not sound that great."

−Participant 4: "It's just, it's interesting.
−Researcher: "What's interesting about it?"
−Participant 4: "Just how you have an opening to do whatever you want with it. You can change the tempo you do all these other things with it."

Was this Composition?

When asked if this was composition, only one participant alluded to issues of ownership regarding the computer assisted activity:

−Participant 1: "Kind of." "It was part me and part machine."

Participant 4 regarded the activity as being "part of it" [composition] citing that the resulting compositions lacked words and other components of popular music like drums and guitars. All other participants took ownership of what they did as constituting composition and commented about the software as a means of helping them compose:

−Participant 2: "It's helpful. It's very helpful. I learned some things like, that the [looks at computer] what was this called, that the timbre is actually like some of, some ofthe source for some instruments."

−Participant 3: "Yeah, cause that's basically what this is. I guess it gives you the feel of composing music--your own music. Even though you've never heard it, you can actually hear it without actually playing an instrument."

−Participant 5: "Yeah." "It's so easy!"

Participants all responded favorably about the composition they made. Though all noted that they had to do some manipulating of controls in order to get the music to sound the way they liked it.

−Participant 2: "I was really concentrating at first, at first, I was just fooling around and seeing what I could come up with then after a while I said ok let me try this and just messing around with the tempo, speed, and seeing if I could turn it into an actual theme or something so. Yeah it sounded kind of adventurous to me, so I said 'oh, I'll stick with it'."

−Participant 5: "In Korea, there's everything is tests [sic]. So when I was in there, I sometimes, I have to compose some music for tests I didn't like it it's so boring. I can try what it sounds like. [acknowledging software] It's really awesome and. I learned that composing music is not boring. It's funny."

I would like to note that Participant 5 had some difficulty articulating herself in several instances because English is not her first language. As a result, I believe that her statement "composing music is not boring. It's funny" should read "fun" instead of "funny".

Self-directed Learning

The software system itself is a somewhat self-directed approach to composition and the exploration of several aforementioned musical variables manipulated with labeled controls. In fact, no explanation was given for how to use the software other than pointing out the location of on/off button. Only one participant asked particular questions about how to use certain controls once they began to perform/compose. All other participants worked

with the software continuously without speaking and without taking their eyes off of the program. Two participants worked continuously for 20 minutes, two worked continuously for 18 minutes, and one participant was asked to stop by the principal investigator after 1 hour of continuous activity. There were no technical difficulties through each of the sessions.

Use of the software seemed intuitive for all participants who described that the program itself was easy to control. The ease of use in controlling a large number of musical variables with a few accessible controls seemed to have enabled the students to explore aspects of music for which they were largely unfamiliar.

−Participant 1: "It was easy to understand them. You have to make sure of which one--with the right one."
−Researcher: "What's the right one?"
−Participant 1: "I liked to use Harmonic Minor."
−Researcher: "Did you know about harmonic minor before you did this?"
−Participant 1: "No."

Before using the software, all participants said that the reason they were not involved in the school's music program was because they needed to focus on their academic classes. After using the software, participants were asked "If you knew the school's music program had more activities like this one, would you be inclined to join?". All participants answered that they would want to join the program and made no mention of the necessity to focus on academic classes they had previously indicated as their reason for not joining.

−Participant 1: "It would yeah. Because it would help me to--if you want to compose music know, like learn more about music: tempo, what the importance of it. Want to get the right chord, the right note."

−Participant 3: "It would, I guess, put a creative, creative spin on it. It would interest me more. 'Cause it's a different way, you've never really used it like, if you've never actually used it before, or, actually, you tried it this way, and you try and you actually like it, you might be inclined maybe to go, to any place to go, like say cello or bass, that might sound, this might make it sound more interesting. Like the more boring, like to people, the more boring instruments might actually sound fun. People might actually want to join, like say 'Hey, I want to create this type of sound'. So let me just go in here and just create a random sound, and eventually you might come up with something that you like."

Participant 4 said that the use of technology would "lure" him to join the music program, but he would prefer to learn music on a traditional instrument and then approach the technology side.

−Participant 4: "Like say I wanted to learn piano, I'd rather learn piano on a piano and then take it to this where I know what keys do what."

4. DISCUSSION

Participants all expressed that they enjoyed engaging in activities using an interactive software system for music composition and performance. Participants also considered their interaction with the system to be musical and felt that they learned something about music or enhanced their understanding of musical concepts to some degree during the activity.

During the composition activity, four out of five participants described that they developed a specific compositional goal. The fifth participant employed a more "trial and error" approach to composition in which he randomly manipulated different controls until the music sounded a certain way that he liked.

All participants answered that if they knew the school's music program had more activities like this one they would want to join the program and made no mention of the necessity to focus on academic classes they had previously indicated as their reason for not joining.

Research by Edwards (2006) and Williams (2007) suggests that school music programs involve 20% of the school's student population. In the present study, an attempt was made to see if the use of interactive music systems in the classroom would appeal to the participants who belonged to the population of students who are not involved in the school's music program. It is important to note that four out of five of these participants had experience playing an acoustic instrument in some capacity, yet none were a part of the school's music program. Perhaps one reason for 20% student involvement has less to do with lack of interest in a formal music education due to unfamiliarity and more to do with the types of musical activities employed. Perhaps interactive music systems that engage student participation and foster self-directed creativity can provide a mechanism for reaching the other 80%.

According to a study by Strand (2006) detailing the composition methods used in the classroom by music educators, 5.9% of the 339 educators surveyed reported using composition often in the classroom, 39.8% reported using composition "sometimes," 19.5% reported using composition "rarely," 23% reported using composition "very rarely," and 11.5% reported never using composition. The most common reason given for not using composition was that there were too many other learning activities to include composition in the classroom (56.9%). The lack of access to technology was the second most common reason (28.2%). Strand's research suggests that composition may be under-taught in classrooms.

The present study yielded a compositional activity that students were positive about and felt had taught them something about music in the process. The activity utilized technology that involved little setup time and free software. The activity was also self-directed and involved no teacher instruction or facilitation with only minimal operation instructions provided by the software. If the use of similar interactive systems were directed in some capacity by a teacher, such systems could provide a mechanism for self-directed musical learning in which teachers function as facilitators who are able to provide insight and feedback concerning student's compositional activities. In the present study, even without teacher facilitation, participants were able to compose meaningful music, make aesthetic judgments about their composition, change it and hear the change in real-time while exploring aspects of modality, timbre, harmony, and musical time.

This study also raises questions about the software currently used in classroom instruction in both group and individual work. The particular software used in this study, *automata*, was not by any means intended to be a panacea for all musical instruction. Instead, it is a program written with a very concentrated purpose: aid in composition by providing controls to change musical variables and some basic rhythmic examples. However, the coding of the program itself is modular in nature using the open-source EAMIR Software Development Kit (SDK) (Manzo, 2007), so that adaptations of the software could allow the instructor to modify the program to suit their specific instructional objects and emphasize other musical elements like, for example, chord functions. Developing powerful applications for a specific purpose that are related to an instructional objective has become my focus as of late and in this study.

Today, there are software applications for so many things, but to what extent do educators allow music software to dictate how they teach? When one sees an application, an educator might think “what does it do” and “how can I make a lesson out of this", instead of thinking primarily about musical concepts and using technology to facilitate the instruction. In other words, technology may, in fact, dictate the type of instruction used instead of instruction dictating the use of technology.

Common commercial music software menu layouts are designed to be accessible and intuitive, but in doing so, there are bound to be certain biases toward the visibility of what are considered “the more common” features. If the feature that an educator might use to help illustrate the concepts of rhythm or harmony is somewhat buried in the program’s menus, the instructor may feel less inclined to teach those musical concepts right away because there is too much of a learning curve involved in getting to those menus. In essence, there would need to be a sufficient amount of teaching of a software application just to get to the place where the educator can teach what they really want to teach: a musical concept.

For *automata*, the musical variables were clearly labeled and in the foreground because those were the features that I wanted the subjects to use, and, as noted, they did use them. The layout of the controls was intuitive and participants began working with the software immediately. If I wanted the participants to focus on some other musical concept, like, for example chord functions, I could have easily modified the software to accommodate that teaching objective. I would then have a collection of similar applications that all served to illustrate specific musical concepts thus aiding my instructional objectives as an educator.

5. CONCLUSION

In August 2010, Dr. Rick Dammers of Rowan University and I will be conducting a week-long music camp/research project called the Interactive Music Technology Curriculum Project (IMTCP.org) for middle school non-music students that will use a larger collection of similar software applications developed with the EAMIR SDK, each with only a few specific purposes that are related to our instructional objectives in addition to software like *automata* which will be used to provide similar teacher facilitated self-directed composition activities. In this capacity, the instructors will be able to provide insight and feedback concerning student's compositional activities which, as mentioned, was intentionally not permitted in the present study.

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7. APPENDIX

APPENDIX A

List of Pre-test Interview Questions

- Do you play an instrument or sing?
- Why don't you participate in school music?
- How talented does someone need to be to create or perform music
- What does Melody mean to you? Harmony? Rhythm? Timbre? Tempo?

APPENDIX B

Description of Software

Automata is an interactive software system designed to give individuals without any formal music training the opportunity to compose and perform an original piece of music. It was created by V.J. Manzo. The PHP module that allows for a cell-phone to be used to enter numbers was created by Dan Manzo.

A user enters some meaningful numbers such as their phone number, or birth date, or locker combination by using an on-screen number pad. The system gets the numbers and equates each digit (0 – 9) to one of the scale degrees of a user selected musical scale (1-8, 9 = 2, 0 = 3). By default, the software begins in C Major.

The user can then cause the notes to play back in some manner by using the on-screen graphical controls. The user can impose a rhythm and tempo for which these scale degrees are played back sequentially, change the tonic and key, and build tertian harmony from these scale degrees, as well as control the timbres used to synthesize these numbers. Up to four sets of numbers can be loaded and performed simultaneously. For this study, the four sets of numbers were controlled on four small touchscreen USB monitors.

For information on this research project and to download the software used, visit http://www.vjmanzo.com/automata or http://www.eamir.org

APPENDIX C

List of Post-test Interview Questions

- On a scale of 1 - 10, 1 being the least and 10 being the most, how fun was this activity?
- On the same scale, how do you rate this activity as a way to be musical?
- What were you thinking about while you did this?
- Did you feel like you learned anything about music? If so, what?
- Would you want to participate in the school music program if you knew it had more activities like this one? Why?
- In the light of the previous activity, what does Melody mean to you? Harmony? Rhythm? Timbre?