EDUCATIONAL DEVELOPMENT COUNCIL

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Game-ification Tools in Music Education

Abstract:

The growing trend and success in the implementation of video games for educational purposes is well known. As an outgrowth of this EDC Independent Project grant award, students enrolled in my HU3910 Practicum used game development software to create games that address aspects of music education using "videogame" templates using software resources prepared and created by two WPI undergraduate students this summary. These resources will continue to serve the students of the PI's HU3910 course. The purchase of these digital assets used to create the resources and the employment of two undergraduate students were fully supported by this grant award.

Background:

Using and developing interactive games to enhance learning experiences is a growing trend in academia[1–11]. So-called "Gamification" has been used experimentally and successfully to increase student engagement and learning, and to help facilitate teaching objectives. Gaming development programming environments allow for a convergence of multimedia elements within a single environment. These environments, such as *Unity 3D*[12] and *Construct2*[13], also possess a level of accessibility that allow individuals, such as educators who are non-programmers, to create rich, immersive, interactive systems without the advanced programming skills that would have been required years ago.

Research into the efficacy of such systems to support musicianship stems from prior interactive music projects[14,15] that involved the development and use of software applications designed to support musical creativity by musicians and non-musicians. The use of gaming systems for such applications may be useful to individuals without formal programming experience who have an interest in utilizing multimedia tools to create interactive music systems[16-23].

The development of interactive gaming systems to facilitate music education is currently taught in the PI's HU3910 Practicum. Students in this course approach the concept of developing small interactive games and activities using *Unity 3D* in order to teach concepts of musicianship in an informal manner. The diverse backgrounds of students who participate In the course include programmers, composers, graphic artists, and writers— the necessary talent to develop small games in groups.

The PI has previously created and worked with WPI student teams in the capacity described above. For example, the game *Octoplay* (2015) was created using programming elements similar to the memory, matching game *Simon.* In this manner, the PI and his team modified the gameplay slightly to repurpose it as a melodic pitch-matching game in which a cartoon octopus play a melodic series of pitches, which the user must recreate using the accessible controls of the gaming system.

Figure 1: Octoplay game shows a repurposed memory game as pitch-matching music education game

As the gameplay progresses, the melodies performed by the octopus become more disjunct and faster. Mastery of intervallic aural skills is required to ascend to more advanced levels.

A second example, *Full Scale Attack*, was created using programing elements similar to 2D shooting game *Space Invaders*. In this manner, the PI and his team repurposed the game code and concepts for a shooting game in order to create a music education game in which users learn diatonic music scales by shooting non-scale tones, represented by spaceships with note names, as they fly across the screen. The user is instructed to only allow ships from the designated seven-note scale to pass through.

Figure 2: *Full Scale Attack* game shows a repurposed shooter game as scale-reinforcing music education game

As the gameplay progresses, the scales presented to the user are less-familiar and the sips move more erratically. Mastery of all scalar diatonic collections is required to ascend to more advanced levels.

Octoplay, *Full Scale Attack,* and their implications for music education and informal music learning were recently discussed by the PI at the *College Music Society National Conference* in Indianapolis (2015), and in *Symposium: Music Business and Industry* (Manzo & Manzo, 2015), the peer-reviewed journal of the College Music Society. These games are currently available on the iOS App Store.

As a preliminary activity, the PI asked the HU3910 course from Spring 2015 to create a concept for at least one educational game that could be developed by future HU3910 courses, and match the various game templates and developer assets available on the Unity Asset store that would help them accomplish this. The results, which may be viewed at *http://bit.ly/1HJbwsL*, show more than 20 unique educational game ideas devised by students, and specific links to content they identified that would support this development by providing example game templates, models and artwork, and other developer assets.

Method:

In spring 2016, the PI selected two WPI undergraduate students, one majoring in Mechanical Engineering, and one in Interactive Media and Game Design, currently enrolled in his HU3910 capstone to prepare game templates from existing multimedia game development code, models, and other resources that could be used in future courses to make derivative educational games for music instruction and informal learning for other disciplines. The students worked under the advisement of the PI for ten weeks at ten hours per week beginning in mid-May 2016. The PI worked with the students to identify existing development assets to be purchased and checked in regularly with the students as the continued to develop game templates from these assets.

The team prepared five video game templates that could be modified by others for education purposes as well as a variety of helpful software-based tools that could be helpful for additional student groups. The games described in the *Results* section represent projects by which the undergraduate student team working over the summer modified some existing set of software tools or a development kit, and modified key aspects of the resources in order to generalize them for the purpose of becoming education game templates. For each repurposed project, the team had to consider ways in which the intended purpose of the game could be reworked to provide students in the HU3910, many of whom have little programing knowledge, with a template environment that provided a great level of flexibility in terms of being able to define a new purpose for the kit.

In fall 2016, the PI taught another section HU3910 and provided these game templates to the enrolled mixed-major student groups, and facilitated the creation of two music educational videogames. The games, though not finalized and published by the end of the term, are now hosted on a WPI software repository and will be refined and further developed in future sections of the PI's HU3910 course, which is typically offered in both A and D terms.

Results:

These games represent some of the games created in the PI's HU3910 course, which ran in A term 2016. Using the templates prepared through this project, the students in this course, as well as future students, will have a starting point by which further education games can

be developed for varied informal learning environments and even other core-content subject areas.

Trading Card Game.
One such template that was modified for game-fication purposes was a Trading Card Game software kit purchased from the Unity 3D Asset store. Like other software-based Trading Card Games, like *Hearthstone*, for example, the toolkit provided some basic software-based infrastructure for gameplay. The template team provided the infrastructure to facilitate a system by which the character cards and their attributed could be altered.

Figure 3: *Original image of game development kit*

The HU3910 team used this template to create a game called *Music Quest* by which players informally learn about seminal composers and performers in music history from antiquity to the present. In this game, composers like Bach and Mozart have high skill attributes while performers like Lady Gaga and Madonna have lesser skill attributes but higher showmanship attributes.

Figure 4: *Image of derivative music education game developed from template*

Each card provides a basic overview of the musician whose image it carries and the rationale behind the assigned attribute values. The "venue" by which the trading card game is carried out also plays a role in the gameplay; for example, cards of classical musicians like Brahms and Beethoven who used in a "hip hop club" gameplay environment will be disadvantaged over rap artists like Eminem and Tupac.

Hidden Object Game.

Another game that was developed in the PI's HU3910 course in A term is the *Music Symbol Matching Game*. The original game kit used for this project showed one image amidst a display of many random images and asked the player to find that image and click it in a specified amount of time.

Figure 5: *Original image of game development kit*

The summer template team modified the existing template to allow future students to easily swap the images and the directions of gameplay shown to the user. The students in the PI's A term HU3910 course then used this template to ask users to identify music symbols, musical instruments, and key composers.

Figure 6: *Image of derivative music education game developed from template*

As gameplay progresses, the directions given to the players change such that, initially, they are shown a picture and the name of the symbol or other music image they are to identify, but, as stages progress, the image is not shown leaving the player to identify the music symbol or other image based on its name or another text descriptor, such as "find the symbol that means 'growing louder in volume'".

In addition to these games, the deliverables of this project include a collection of software assets that are publicly housed at the *WPI Media Project Wiki* site (wiki.wpi.edu/vjmedia) for students enrolled in the PI's music courses.

Conclusions:

In the coming months, the PI will be working with students to distribute these games for free on the Internet and on the iOS app store. While the templates will be useful for future derivative educational game projects, and, although it's possible that new student groups will likely build similar games based on the limited number of templates created during this project, the dearth of useful and discipline-specific informal learning games, despite the popularity of the educational game movement, makes this possibility advantageous and not at all a shortcoming of this project. Future WPI students will benefit for years to come just by virtue of the templates that were made and the additional software assets that were purchased during this project.

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