Seeds of Harmony: Edutainment Project on Music Creativity

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Abstract: This paper reports on the development of "Seeds of Harmony", an online multi-user edutainment platform on music creativity. This project aimed to provide an immersive, interactive and inspirational virtual environment where user can interconnect to creative music.
Keywords: edutainment applications, music creativity, interaction design, interface design, information design, instruction design

Music Creativity

In Hong Kong, music teaching is facing a curriculum reform. Schools are encouraged to involve students in creating music rather than passively listening to music and learning the knowledge about music. There are increasing numbers of schools which possess computers in their music rooms. All these provide a positive environment on developing a technology-based music teaching approach. There are three main categories of technology developed for music education. Applications focused on the interaction and interface design include: music device (Aperghis-Tramoni, 1980), visualization of music (Smith & Williams, 1997), music notepad (Forsberg et al., 1998), interactive environment for object-oriented music composition and sound synthesis (Scaletti & Johnson, 1998), speech interface for building musical score collections (Smiths et al., 2000), Jam-O-Drum interactive music system (Blaine & Perkis, 2000), facial action controlled musical interface (Lyons & Tetsutani, 2001), playing with sounds as playing video games (Desainte-Catherine et al., 2004), music-driven digital violinist (Yin et al., 2004), and karaoke for elementary music education on the internet (Miyashita, 2004). Applications focused on cognitive dimension include: externalization of composer's mental space (Amitani & Hori, 2002). Applications focused on societal dimension include: cooperative visual manipulation of music notation (Bellini et al., 2002), co-presence in distributed virtual music environment (Jung et al., 2000), and collaborative musical edutainment system for children and parents (Oshima et al., 2004). Other applications focused on application of music in other domains: making music in computer science (Roger, 2004), and teaching design patterns using musical composition (Hamer, 2004). This project aimed to develop an online multi-user edutainment platform on music creativity "Seeds of Harmony". Learners can a) learn basic knowledge in creating music, b) observe skills in creating music, c) theorize when creating music, d) experiment with creating music, e) experience creating music, and f) create music in a creative and entertainment-enriched environment.

Design Specification

An online survey for design specification definition of this project (Table 1) was undertaken (magnitude method, scale 0-10). Based on typology of learner (Honey & Mumford, 1982), we studied the rating of different learning modes (Table 2). Over 75% preferred active learning (active experimentation or concrete experience). Correlation analysis showed that experts preferred concrete experience (.153). Based on the three dimensions of learning (Illeris, 2004), and through a number of synectics sessions, we collected 49 types of learning activities which were categorized into 7 qualitative factors (Table 3). We also studied the rating of respective learning activities associated with the 7 qualitative factors (Table 4, 5, 6, 7, 8, 9, and 10). Correlation analysis showed that experts preferred qualities such creative (.143) and encouraging (.140), using instrument (.173) to improvise music, and mechanisms to provide expert feedback (.177). Teachers preferred using gesture (.199) to improvise music, using mark (.163) and compliments (.172) to motivate students.

Table 1: *Profile (multiple selections, 198 respondents)*

Relationship to music	%
Students who study music	24
Teachers who teach music	27
Parents of students who study music	2
Professionals in music	5
Interested in music	51
Others	17

N. B. university: 95%, secondary: 5%, primary: 2%

Table 2: *Mode of learning*

Mode of learning	Rating
Active experimentation (39%)	8.48 ± 1.527
Concrete experience (36%)	8.34 ± 1.594
Reflective observation (11%)	7.92 ± 1.538
Abstract conceptualization (14%)	7.19 ± 1.848

Table 3: *Qualitative factors*

Qualitative factors	Rating
Creative (Table 4)	8.52 ± 1.257
Improvisational (Table 5)	7.88 ± 1.443
Encouraging (Table 6)	7.87 ± 1.528
Entertaining (Table 7)	7.87 ± 1.374
Communicative (Table 8)	7.81 ± 1.382
Referential (Table 9)	7.39 ± 1.490
Assistive (Table 10)	7.38 ± 1.462

Table 4: *Creative*

User create music for	Rating
Movie	7.67 ± 1.78
Story	7.66 ± 1.66
Dance	7.60 ± 1.98
Music notation	7.54 ± 1.94
Game	7.54 ± 1.72
Illustration	7.11 ± 1.76
Poem	6.49 ± 2.04

Table 5: *Improvisational*

Improvise music using	Rating
Instrument	8.05 ± 1.54
Emotion	7.82 ± 1.70
Humming	7.21 ± 1.78
MIDI	7.12 ± 1.78
Gesture	7.03 ± 1.80
Role-play	6.79 ± 1.85
Can music	6.31 ± 2.15

Table 6: *Encouraging*

User receive	Rating
Expert feedback	8.40 ± 1.44
Comments	8.32 ± 1.50
Encouragement	7.99 ± 1.73
Compliments	7.76 ± 1.73
Awards	7.31 ± 1.91
Rankings	6.75 ± 2.06
Marks	6.61 ± 2.10

Table 7: *Entertaining*

User learn via	Rating
Cooperation	7.90 ± 1.45
Music simulation	7.89 ± 1.47
Virtual bands	7.79 ± 1.55
Games	7.55 ± 1.61
Discussions	7.45 ± 1.66
Competitions	7.10 ± 1.78
Role-playing	7.17 ± 1.71

Table 8: *Communicative*

User communicate	Rating
Textually	7.14 ± 1.60
Graphically	7.44 ± 1.47
Audio-visually	8.02 ± 1.36
Gesturally	7.20 ± 1.53
In multi-user mode	7.52 ± 1.52
Synchronously	7.42 ± 1.59
Asynchronously	6.79 ± 1.69

Table 9: *Referential*

User refer to	Rating
Interactive examples	7.90 ± 1.48
Video demonstrations	7.53 ± 1.56
FAQ	7.28 ± 1.60
Hyperlinks	7.13 ± 1.83
Help menu	7.11 ± 1.75
Glossary	6.89 ± 1.90
Model answers	6.79 ± 1.90

Table 10: *Assistive*

User get	Rating
Instant feedback	7.89 ± 1.56
Analysis of strength and weakness	7.82 ± 1.56
Suggestions	7.82 ± 1.50
Tips or hints	7.63 ± 1.67
Progress report	7.43 ± 1.55
Warnings	7.14 ± 1.68
Logs	6.96 ± 1.70

Seeds of Harmony

The system architecture of is developed based on NEURON (Lee et al., 2004; Lee, 2005). With consideration of the abovementioned typology of learners and qualitative factors,

"Seeds of Harmony" is divided into five views, namely learner, supervisor, recipient, administrator, and provider.

Learner View

The learner view is composed of five modules: Muscipula, Sun Flower, Mimosa, Dandelion, and Nepenthes. Learners can input email address as id and play a sequence of music notes as password to login (Fig. 1), receive randomly generated password through forget password page; and view scheduled activities (Fig. 2).

Figure 1: *Login at Seeds of Harmony homepage*

Figure 2: *Learn according to scheduled activities*

Muscipular module: Muscipula supports learning of music theory. Muscipula represents the screen and stage of an interactive classroom where fundamental music theory is delivered. Topics include: a) basics of rhythm and tempo, b) scales, keys and clefs, c) rhythm, d) pitch, e) triads and chords, f) phrases and cadences, g) tempo, dynamics and mood. Learner can choose virtual avatar (Fig. 3) and study music theory through slides and dialogue with virtual tutor (Fig. 4). Muscipula allows supervisors to upload slides and customize dialogue at NEURON which facilitate in customization of content.

Figure 3 (left): *Select avatar at Muscipular home*
Figure 4 (right): *Study theory through slides and dialogue*

Sun Flower module: Sun Flower supports improvisation and visualization of music. In Sun Flower module, the petals of sun flower represent the twelve key signatures of the circle of fifths (Fig. 5). Learner can select the tempo, metronome speed, volume and instrument at the main panel. Key signature selected by learner in the beginning is shown at the bottom-left.

Figure 5: *Select key signature at Sun Flower home*

Figure 6: *Improvise, save music music in private or share folder*

At the improvise panel, learner can improvise music by clicking the keys or by typing the respective notes on the keyboard, go up or down the scale by using the left and right arrow keys respectively. Learners can save music clips in private or share folder (Fig. 6). Visualize panel is composed of 3 functions. Using the colour function (Fig. 7), learner can assign music notes (represented in different colours) to 3D instruments. Corresponding tones assigned on the 3D instrument can be highlighted whenever the respective tone is played back.

Figure 7: *Assign music note to 3D instrument*

Figure 8: *Sculpt 3D instrument in real-time*

Figure 9: *Add behaviour to virtual 3D instrument*

Using the sculpt function (Fig. 8), learner can sculpt 3D instruments in real-time by bending, twisting, tapering, stretching, vertex displacement, and scaling. Using the animate function, learner can animate the 3D instrument by adding behaviours (Fig. 9) such as explode or rotate. The extent of rotation or explosion of 3D instruments is according to the tempo of music clip. Learner can also add virtual conductor to perform replay of music clips.

Figure 10 (left): *Select time signature at Mimosa home*
Figure 11 (right): *Select music clip according to instrument type*

Mimosa module: Mimosa module support music composition. The interval of opening and closing of mimosa represents time signature. Music clips, categorized according to time signature, are represented as rain drops on the mimosa leaves (Fig. 10). Learner can retrieve the music composition of individual music clip by clicking the music instrument encapsulated in the rain drop (Fig. 11). At the compose panel (Fig. 12), learner can interactively change the tempo, the time signature, key signature, revise individual notes and tones, and finally save the music clip for future use.

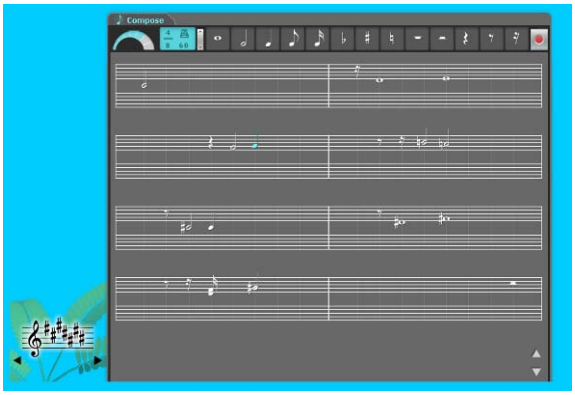


Figure 12: *Revise the composition at Compose panel*

Dandelion module: Dandelion module supports music collaboration. Dandelion seeds represent antennae of rooms created in a multi-user environment (Fig. 13). Learners can create new room and interconnect by activating the new room antenna (Fig. 14). Up to 4 learners can register for each room.

Figure 13 (left): *Retrieve room information at Dandelion home*
Figure 14 (right): *Create new room by registration at antennae*

Learners can communicate through: a) video conferencing, b) private message, c) public message, and d) peer feedback. At the private message panel, learners can send messages to undisclosed recipients. At the public message panel, learners can send message to all learners

in the same room. At the peer feedback panel, learners can give feedback as: a) example/suggestion giver, b) agreer, c) disagreer, or d) questioner. The availability of these communication panels can be selectively controlled by supervisor at NEURON. Learner can select the tempo, metronome speed, volume and instrument at the main panel. Key signature can be selected by learner as shown at the bottom-left. At the improvise panel, learner can improvise music by clicking the keys or by typing the respective notes on the keyboard. Learner can go up or down the scale by using the left and right arrow keys respectively. Learners can then save the music clips in private or share folder to be used later (Fig. 15). At the sequence panel, learners can drag-drop, sequence and combine music clips from different users of the same room using up to four channels (Fig. 16).

Figure 15: *Communicate and improvise music*

Figure 16: *Sequence music clips of room members*

Nepenthes module: Nepenthes module supports distribution of music clips with 3D instrument. Learner can select one music clip and one 3D instrument (Fig. 17), input recipient email address, write message, and send this music clip with instrument as to recipients (Fig. 18).

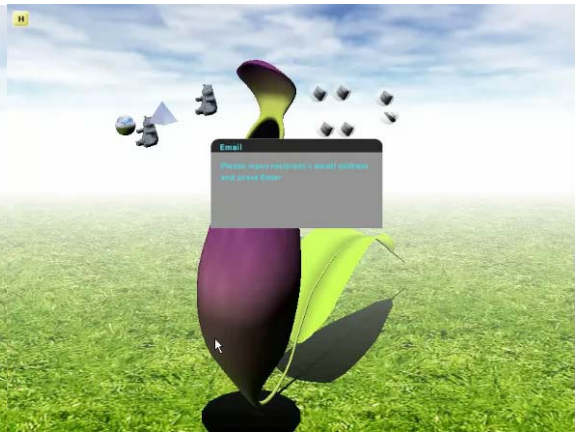


Figure 17 (left): *Select music and 3D instrument at Nepenthes*
Figure 18 (right): *Input recipient email address, and send message*

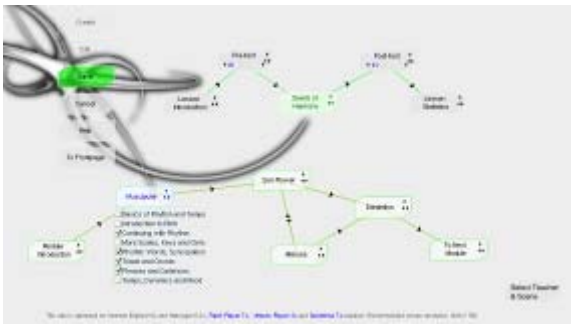
Recipient View

Recipient can access seeds of harmony by clicking a link included in an email sent by learner from Nepenthes module. Recipient can then play back music clip and improvise music using the 3D instrument (Fig. 19).

Figure 19: *Playback music clip sent from nepenthes*

Supervisor View

Supervisor can a) create or edit lessons by loading learning module; b) customize the sequence, the content, and the availability of functions and panels of each of the five modules (Fig. 20); c) edit the dialogue of Muscipula module (Fig. 21), d) name, save, delete, or rename lessons; d) assign learners to rooms of Dandelion module.



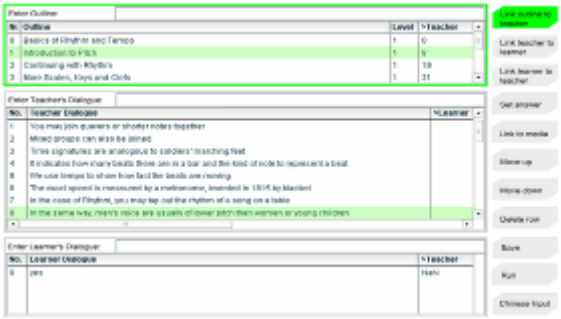


Figure 20 (left): *Configure sequence of learning modules*
Figure 21 (right): *Configure dialogue of Muscipula module*

Administrator & Provider View

Administrators can a) edit login name and passwords, and b) assign lesson to teacher and lesson to learners. Content providers can upload edutainment content and modules.

Usability Testing

Three usability testing workshops were organized. In October 2005, 20 prospective music teachers participated in a workshop (Fig. 22) organized by the Hong Kong Institute of Education (HKIEd). In November 2005, 65 university students, academic staffs, education software developers, and music experts, participated in a workshop (Fig. 23) organized by the Educational Development Centre of The Hong Kong Polytechnic University. In April 2006, 24 primary and secondary teachers participated in a workshop in the Symposium on Technological Innovation organized by the Alliance of Educational Innovation of HKIEd.

Figure 22 (left): *Usability Testing (October 2005)*
Figure 23 (right): *Usability Testing (November 2005)*

Conclusion

"Seeds of Harmony" get students engaged cognitively, physically, and socially. Learners can experience creating music in an innovative and entertainment-enriched environment. "Seeds of Harmony" provide a one-stop platform for trainers, supervisors, learners,

administrators, and providers. Based on a document that specifies the system framework of the "Seeds of Harmony" and the structure of edutainment contents, developers can contribute new edutainment modules through a contribution system. Teachers can then select from this pool of edutainment content for further integration. To ensure scalability with other current e-learning platforms, "Seeds of Harmony" is developed based on SCORM architecture. Based on MIDI standard, "Seeds of Harmony" provides up to 127 types of instruments. Regardless of physical location, time zone, with Internet connection, learners can get interconnected, and create music collaboratively through an online multi-user environment enabled with both asynchronous and synchronous communication. "Seeds of Harmony" promotes interactions among teachers, learners, and experts in an online multi-user environment. Edutainment modules are designed to enable 4Ts of active learning, namely thinking, task-focused, teamwork, and transcendence. Using a combination of five modules, learners can a) learn basic knowledge in creating music, b) observe skills in creating music, c) theorize when creating music, d) experiment with creating music, and e) experience creating music.

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