Future Songwriting Project Outcomes: Research on Technology Usage and Analysis of Pilots' Recordings

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Abstract. In this report, we describe research performed in the context of the Future Songwriting project (www.futuresongwriting.eu), a two-year European project focusing on creativity and digital tools in music education funded by the Creative Europe Programme of the European Commission. During the project a number of pilots were conducted where school children composed songs with the aid of technology. In this context, we analyze 1) the usage of technology during the Songwriting project pilots and 2) the music materials (i.e. songs) composed by children within specific geographical regions.

Keywords: Songwriting, music technology, technology usage, cross-cultural music making.

1 Introduction

Songs are universal and enduring in humanity. In every society, songs have held an important place in human culture. Research has found that children and adolescents have a vast musical world of songs. A 2009 Harris poll of children between the age of eight and eighteen found that the amount of time they spend listening to music increases with age from about one hour per day for eight- to ten-year-olds to about three hours per day for fifteen- to eighteen-year-olds (Harris, 2013). Almost all this music is in the form of songs. Most of the adolescents in the developed world have access to portable music listening devices (e.g., cell phones, tablets, MP3 players) (Teens, 2014). For many young people, songs are the soundtrack to their lives (Ford, 2010).

Although songwriting has been taught for decades by music therapists (Fickem 1976; Wigram, 2005), it has not been widely included in the school music curriculum (Shehan, 2007). Songwriting can provide a complementary, alternative venue for musical learning for those students who are passionate about music but, for whatever reason, have not access to formal music education.

Nowadays, there is a plethora of music technology for music listening, playing and creation. One of the most useful and widely available musical tools for music creation is the digital audio workstation (DAW) (Bell, 2015). DAWs refers to both hardware (e.g. computers and mobile devices) and software applications (e.g. GarageBand, ProTools). A number of music teachers have developed classroom projects using DAWs (Burns, 2007; Carter, 2013), and because this technology allows multiple users to collaborate in and co-create musical ideas together, DAWs are ideal to engage music students in collaborative work through songwriting recording. Although DAWs can be also used to recreate or remix existing works, many people find them to be powerful tools for creating original music material. DAWs can be used to create, produce, write and edit musical ideas individually or in collaboration with others, in physical and/or online spaces. While most of the technologies used in school composing and arranging activities are often limited to music notation software programs, DAWs offer a space for creative music-making experiences requiring no prerequisite knowledge of music theory or traditional staff notation.

In this report, we analyze the use of technology for collaborative songwriting in the context of the Future Songwriting project (www.futuresongwriting.eu), a two-year European project focusing on creativity and digital tools in music education funded by the Creative Europe Programme of the European Commission. During the project a number of pilots were conducted where school children composed songs with the aid of a DAWs consisting of iPads and GarageBand software. In this context, we analyze the usage of technology and the song compositions resulting from these pilots.

The research reported in this paper is the result of a collaboration between the Future Songwriting project partners, in particular, TEOSTO, University of Cologne, SACEM, UniArts Helsinki, Musical Futures, Artisjus, and Universitat Pompeu Fabra.

2 Technology Usage During the Project's Pilots

2.1 Participants

Recruitment and interaction with schools was conducted by UniArts Helsinki (Finland), University of Cologne (Germany) and SACEM (France), while the actual pilots were conducted by the INTO Team. Data processing and analysis was carried out at the Universitat Pompeu Fabra. Three hundred and six students (108 in Finland, 131 in Germany and 75 in France, mean = 12.8 years old, SD = 3.5) with normal hearing, participated in the project pilots.

2.2 Methods

In order to obtain information about the technology usage by the children taking part in the project pilots a dedicated technology questionnaire was developed for this study. The questionnaire was kept as simple and short as possible to potentiate other activities during the pilots. It consisted of 12 questions with responses in a 7-point scale from 1 (strongly disagree) to 7 (strongly agree), 4 questions about time distribution in the composition process, and one open question about their general experience with the technology. The questionnaire was structured in 4 aspects of the musical composition/technology experience: ease, enjoyment, satisfaction and time distribution (see Figure 1).

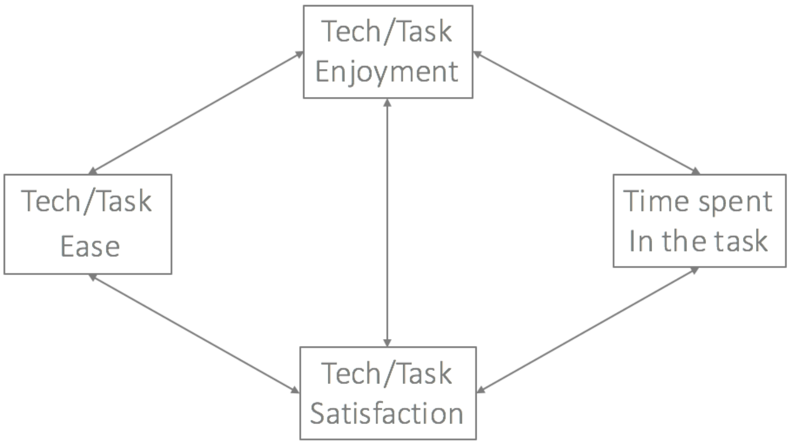

Figure 1. Questionnaire aspects of the musical composition/technology experience.

2.3 Results

2.3.1 Time Distribution

During the song composition process the students were involved in three main tasks: planning the composition where students discussed among themselves what kind of song (i.e. music, music instruments, rhythm, and lyrics) they would like to create; writing the composition lyrics; and performing their composition where they played/singed the song. The resulting time distributions showed that students (perceived to have) dedicated roughly the same amount of time to the tasks of writing the lyrics and performing/recording the song (see Figure 2). However, there were some differences among German, Finish and French students with regards to planning their composition: German students spend more time planning than Finish and French students, and in turn Finish students spent more time planning than French students. This may be due to the age of the different groups. German students were 15-16 year olds, Finish were 12-13 year olds, and French were 11-12 year olds. In fact, there is a very strong correlation between the age of the children and the amount of time they spend planning their composition. This is an interesting fact which can be useful for planning future pilots or sessions.

Figure 2. Time distribution during the pilots: planning (blue), writing lyrics (grey) and singing/playing (orange).

2.3.1 Satisfaction

Students were asked the degree to which they were satisfied about different components of their song compositions on 7-point scales. A repeated measures ANOVA (with item as the independent variable and response as the dependent variable) with a repeated contrast was conducted to determine where significantly different groupings of composition components occurred. Figure 3 shows the mean self-reported satisfaction on the song components. German and Finish students reported the highest satisfaction on the instrumental part of their songs followed by the song as a whole, while French students reported the highest satisfaction on the song as a whole followed by the instrumental part. However, those differences where not found significant among the Finish and French students. Both in Finish and French students there was a significant difference between the satisfaction of the instrumental/whole song and the lyrics/singing. In other words, they were significantly ($p<0.01$ for the Finish students, and $p<0.05$ for the French students) more satisfied with the music than with the singing/lyrics part of their songs. Interestingly, these results highlight the relevance of technology in the creative process since it is precisely on the instrumental part of the songs and the overall result (mixing) which the technology has most impact. The technology used in the pilots was not intended as a tool for creating lyrics, and had a very low influence in the singing/rapping. However, the technology greatly facilitated the creation of the instrumental part of the song, and thus the final composition.

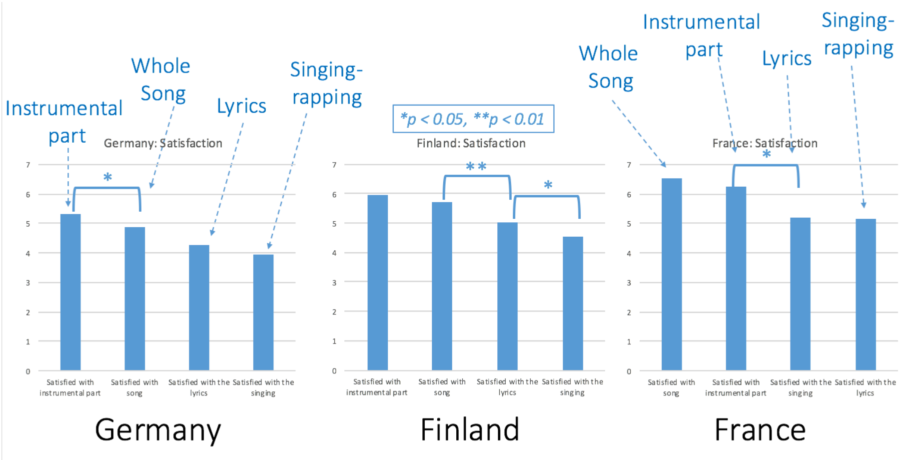

Figure 3. Mean self-reported satisfaction on the song components and significance of the differences.

2.3.2 Correlations

We analyzed the Pearson correlation between the students' responses about the technology ease of use, the technology enjoyment and the overall task satisfaction (see Figure 3). As reasonably expected, results show that there is a very strong correlation between technology ease and technology enjoyment. Interestingly, there is also a correlation between both the technology ease and enjoyment, and the composition process satisfaction. This, is clearly a confirmation that technologies should be as simple as possible in order to be of benefit to the creative process.

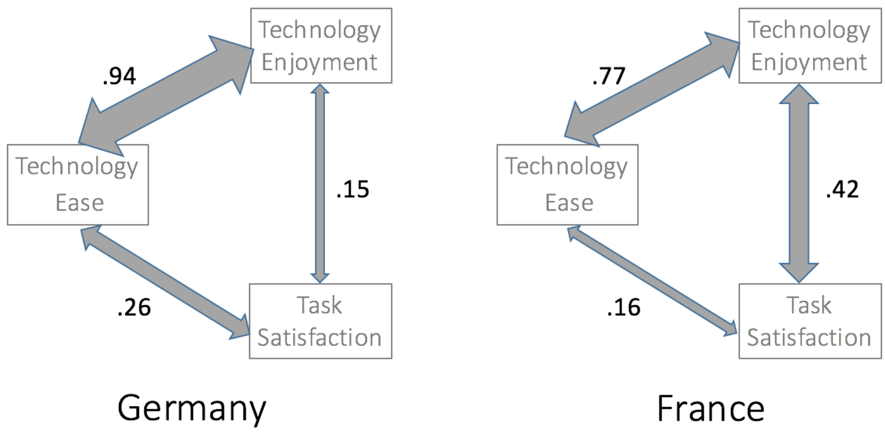

Figure 3. Pearson correlation between the students' responses about the technology ease of use, the technology enjoyment and the overall task satisfaction.

We also analyzed the correlations between different the ease and enjoyment of different technology components involved in the creative process and the song satisfaction (see Figure 4). The most correlated components with the final song satisfaction were the ease of sound editing, the enjoyment of sound editing, and ease of song editing. This highlights the relevance of sound creation and editing, and sound editing in music creation by non-musicians. This are two aspects in which the technology (i.e. GarageBand in the iPad) excels.

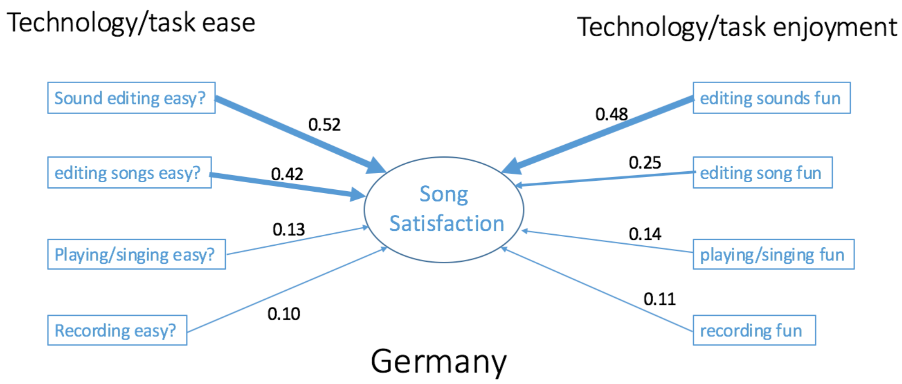

Figure 4. Pearson correlation between the students' responses about the ease and enjoyment of different technology components involved in the creative process and the song satisfaction

3 Analysis of Pilots' Audio Recordings

Music may be characterized by three aspects: sound, behaviour, and concept (Tooby, 1990). Music sound can be defined as a class of auditory signals that are produced by performers. and perceived by listeners, which is composed of melodic, harmonic, rhythmic, timbre, temporal and dynamic components. Music behaviour is associated with activities such as performance, composition, dance, ritual, etc. Music concept has specific functions within any social group (Clayton, 2001; Cross, 2003; 2006; Dissanayake, 2001). The culture concept refers to the set of behaviours, beliefs, social structures, and technologies of a population that are passed down from generation to generation. It includes social conventions related to art, dress, dance, music, religion, etc. It is worth noting that the term culture is not equivalent to 'country' or 'continent'. Moreover, most individuals do not 'belong' to a single culture.

A number of cultural influences can act upon particular individuals, merging and manifesting themselves when performing and composing music. In this paper, we describe a pilot cross-cultural study involving the analysis of music materials composed by children in different geographical regions. The music materials are songwriting compositions produced during school workshops as part of the European Project Future Songwriting in nine schools in Germany and Finland. We are sensitive to the fact that it is impossible to characterize nations as singular cultures and compare them with one another. Instead, the current study attempts to investigate if there are common or distinctive compositional patterns in schools in different geographical regions.

3.1 Methods

The following music features were extracted from the audio recordings using Essentia (Bogdanof, 2013), an audio analysis library for music information retrieval developed by the Music Technology Group, Universitat Pompeu Fabra.

- *Chroma*: This feature is useful for analyzing music whose tuning approximates to the equal-tempered scale. It captures harmonic and melodic characteristics of music, while being robust to changes in timbre and instrumentation.
- *RMSE*: The root-mean-square energy (RMSE) is related to the loudness of the signal. It is useful for getting a rough idea about the loudness of a signal.
- *Spectral centroid*: This feature is a measure used in digital signal processing to characterise a spectrum. It indicates where the center of mass of the spectrum is located. Perceptually, it has a robust connection with the impression of brightness of a sound.
- *Zero crossing rate*: It is the number of times that the signal crosses the zero value in the buffer. It helps differentiating between percussive and pitched sounds. Percussive sounds will have a random ZCR across buffers, where pitched sounds will return a more constant value.
- *Spectral spread*: Indicates how spread the frequency content is across the spectrum. Corresponds with the frequency bandwidth. It can be used to differentiate between noisy (high spectral spread) and pitched sounds (low spectral spread).

- *Spectral rolloff*: It is the frequency below which is contained 99% of the energy of the spectrum. It can be used to approximate the maximum frequency in a signal.
- *Mel-Frequency Cepstral Coefficients* (MFCCs): As humans do not interpret pitch in a linear manner, various scales of frequencies were devised to represent the way humans hear the distances between pitches. The mel scale is one of them.

We applied a wrapper feature selection algorithm to select a subset of the original feature set. The resulting features (chroma, spectral rolloff and MFCCs) were used to train classifiers using machine learning algorithms for distinguishing compositions from different geographical locations.

3.2 Results

The accuracy (i.e. correctly classified instances percentage) obtained by both artificial neural networks (Chauvin, 1995) and decision trees algorithm (Quinlan, 1993) was 70% (baseline = 40%) using stratified 10-fold cross validation evaluation (see Table 1 for details). This result seems to indicate that the reduced number of features considered provide information about the acoustic characteristics of the musical pieces and that machine-learning algorithms are capable of using this information to distinguish the compositions at different geographical locations. It is worth noting that the two Finish Schools are from geographically distant regions with different cultural traditions. Interestingly, the German school compositions are more differentiable from the other two Finish schools than the two Finish schools. Table 2 shows the confusion matrix of the induced classifier obtained by applying the decision trees algorithm.

Table 1. Detailed accuracy by class (Finish School 1 [FS1], Finish School 2 [FS2], German School [GS]) and weighted average (WA)

	TP Rate	FP Rate	Precision	Recall	F-Measure	ROCArea	Class
	0.571	0.154	0.667	0.571	0.615	0.786	FS1
	0.600	0.133	0.600	0.600	0.600	0.873	FS2
	0.875	0.167	0.778	0.875	0.824	0.818	GS
WA	0.700	0.154	0.694	0.700	0.695	0.820	

Table 2. Confusion matrix of the Decision tree classifier

	Finish School 1	Finish School 2	German School
Finish School 1	57.4%	28.4%	14.2%
Finish School 2	40%	60%	0%
German School	0%	12.5%	87.5%

Analysis of the feature set showed that the most informative features for the obtained classifiers were MFCCs, spectral rolloff and chroma. In view of this preliminary results, it is worth exploring other acoustic features for training the classifiers and to include more data in the analysis.

Conclusions

In this report, we have described research performed in the context of the Future Songwriting project. The research used data acquired during the pilots in which school children composed songs with the aid of technology. We analyzed the usage of technology during the pilots, and and the music materials (i.e. songs) composed by children within specific geographical regions.

References

Harris Interactive, “Generation M: Media in the Lives of 8-18 Year-Olds, Appendix C,” Kaiser Family Foundation, January 10, 2013, accessed January 20, 2105, https://kaiserfamilyfoundation.files. wordpress.com/2013/01/8010_appedixc_toplines.pdf.

"Teens Fact Sheet." Pew Research Center's Internet & American Life Project, March 13, 2013, accessed December 8, 2014, http://www.pewinter-net.org/fact-sheets/teens-fact-sheet/.

Charles Ford, "Musical Presence: Toward a New Philosophy of Music," Contemporary Aesthetics 8 (2010), http://hdl.handle.net/2027/spo.7523862.0008.020

Ted Ficken, "The Use of Songwriting in a Psychiatric Setting," Journal of Music Therapy 13, no. 4 (1976): 163–72

Tony Wigram and Felicity Baker, ed. Introduction: Songwriting as Therapy (London: Jessica Kingsley, 2005).

Patricia Shehan Campbell, Claire Connell, and Amy Beegle, "Adolescents' Expressed Meanings of Music in and out of School," Journal of Research in Music Education 55, no. 3 (2007): 220–56;

Bell, Adam Patrick (2015), 'Can we afford these affordances: GarageBand and the double-edged sword of the digital audio workstation', Action, Theory, and Criticism for Music Education, 14:1, pp. 44–65.

Burns, Amy (2006), 'Integrating technology into your elementary music classroom', General Music Today, 20:1, pp. 6–10.

Carter, Bruce (2013), 'Digital natives and composition in the middle school band: From imagination to music', in Michele Kaschub and Janice Smith (eds), Composing Our Future: Preparing Music Educators to Teach Composition, New York: Oxford University Press, pp. 225–37.

Tooby, J., & Cosmides, L. (1990). The past explains the present: Emotional adaptations and the structure of ancestral environments. Ethology and Sociobiology, 11, 375–424.

Clayton, M. (2001). Introduction: towards a theory of musical meaning (in India and elsewhere). British Journal of Ethnomusicology, 10, 1–18.

Cross, I. (2003). Music, cognition, culture and evolution. In I. Peretz & R. J. Zatorre (eds), The cognitive neuroscience of music (pp. 42–56). Oxford: Oxford University Press.

Cross, I. (2006). The origins of music: Some stipulations on theory. Music Perception, 24, 79–82

Dissanayake, E. (2001). Antecedents of the temporal arts in early mother-infant interaction. In N. L. Wallin, B. Merker, & S. Brown (eds), The origins of music (pp. 389–410). Cambridge, MA: MIT Press.

Dmitry Bogdanov, Nicolas Wack, Emilia Gomez , Sankalp Gulati, Perfecto Herrera, Oscar Mayor, Gerard Roma, Justin Salamon, Jose Zapata and Xavier Serra (2013). Essentia: An Audio Analysis Library for Music Information Retrieval, International Society for Music Information Retrieval Conference.

Quinlan R. (1993). C4.5: Programs for Machine Learning. Morgan Kaufmann Publishers, San Mateo, CA.

Chauvin, Y. et al., (1995). Backpropagation: Theory, Architectures and Applications. Lawrence Erlbaum Assoc.