A DESIGN METHODOLOGY FOR INVESTIGATING DOMAIN-SPECIFIC ASPECTS OF TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE THROUGH THE TEACHING OF MUSIC: THE IMPORTANCE OF AFFECT

Elena Macrides Christofides and Charoula Angeli
University of Cyprus
Cyprus

Abstract

The present study addresses the lack of a theoretical framework for the integration of technology in music teaching and learning, and explores, within the framework of Technological Pedagogical Content Knowledge (TPCK), the importance of affect in instructional design. The study extends the theoretical framework of TPCK to a design framework and proposes a methodology and instructional design guidelines that address both the cognitive and the affective domains of learning. The research has both practical and theoretical significance as it provides teachers with explicit guidance on how to design music lessons based on TPCK principles and examines interactions among content, technology, and affect.

Introduction

Over the past two decades, many studies have emphasized the role of technology in transforming the teaching of composition, listening, and performing in music teaching. However, current teacher practice does not really demonstrate technology's efficacy in facilitating real musical experiences and powerful pedagogical strategies for the subject-matter of music (Bauer, 2014; Savage, 2007, 2010; Webster, 2007). At present, technology is not extensively used in music teaching, and, often, it does not serve the needs and objectives of music education (Swanwick, 2011; Bauer, 2014). Most teachers use technology for viewing music clips from YouTube, multimedia presentations, or, for administrative purposes, such as, creating handouts, making musical scores for rehearsals, and recording students' musical activities (Bauer, 2014). According to several authors, limited technology integration in music instruction may be attributed to teachers' insufficient knowledge in music technology software and their affordances, conceptual bases, principles, and design methodologies for integrating technology in music teaching (Bauer, 2014; Savage, 2007; Webster, 2007).

Recently, Technological Pedagogical Content Knowledge (TPCK), a theoretical framework for guiding technology integration in teaching and learning, has been proposed by educational researchers to remedy for the lack of such theories (Angeli & Valanides, 2005, 2009, 2013, 2015; Mishra & Koehler, 2006; Niess, 2011). This study adopts the TPCK model of Angeli and Valanides (2005, 2009, 2013) in order to examine domain-specific aspects of the model within the field of music education. The authors acknowledge that the emphasis of the research related to TPCK so far has had a focus on the cognitive domain of learning, although, at the same time, they recognize that the affective domain has been severely overlooked. Consequently, the researchers in this study aim to further develop the work reported by Angeli and Valanides (2005, 2009, 2013) by proposing instructional design guidelines that deal with the importance of affect in the learning design and uncover relationships among emotions, musical content, tools, and pedagogy. It is noted that in this study, the terms affect and emotions are used interchangeably.

The contribution of this research has both theoretical and practical significance, because it explores the undetermined relations of cognition and affect in technology-enhanced learning, and, extends the existing TPCK instructional design guidelines with specific design principles that address both the cognitive and the affective domains of learning.

Technological Pedagogical Content Knowledge and Domain-Specific Aspects: The Case of Music Education

About a decade ago, several researchers used Shulman's framework (1986) about Pedagogical Content Knowledge (PCK) as a theoretical basis for developing TPCK - a framework for guiding technology integration in teaching (Angeli, Valanides, & Christodoulou, 2016). There are different models of TPCK proposed in the literature each having a different concentration (i.e., a concentration on practice, instructional design, context, etc.), and theoretical interpretation about the nature and development of TPCK (e.g., Angeli & Valanides, 2005, 2009; Mishra & Koehler, 2006; Niess, 2011).

The model proposed by Angeli and Valanides (2005, 2009, 2013) has a focus on instructional design and consists of five knowledge bases, namely, technology, pedagogy, content, context, and prior knowledge and conceptions of learners. The model views TPCK as a novel body of knowledge derived from the interaction and contribution of the five knowledge bases. The work of Angeli and Valanides (2009) diverges from the work of others in that it links TPCK theory with practice through a set of clear instructional design guidelines for designing technology-enhanced learning. These principles are as follows:

1. Identify content for which technology integration can have an added value, i.e., topics that students have difficulties in grasping or teachers have difficulties in presenting/teaching.
2. Identify representations for transforming the content to be taught or learned into more understandable forms that are not possible to implement without technology.
3. Identify teaching methods that are impossible or difficult to implement with traditional means and without technology.
4. Select appropriate tools with the right set of affordances.
5. Design and develop learner-centered activities for integrating technology in the classroom.

In addition to the above principles, Angeli and Valanides (2013) proposed Technology Mapping as an instructional approach for steering technology integration into the learning design and developing teachers' TPCK. Mapping indicates the method of detecting associations between the affordances of a tool, content, pedagogy, and learners' content-related difficulties during designing lessons with technology (Angeli & Valanides, 2009, 2013; Ioannou & Angeli, 2013).

In order to guide teachers' design processes more effectively, recently, various researchers pointed to the need for understanding domain-specific aspects of TPCK including the role of affect in the design of technology-enhanced teaching (Voogt, Fisser, Pareja Roblin, Tondeur, & van Braak, 2013; Angeli, Valanides & Christodoulou, 2016; Chai, Chin, Koh, & Tan, 2013). This gap may be related to the fact that the general TPCK framework is in essence a cognitive model that does not provide guidance in integrating affect or associating cognition and emotions in technology-enhanced learning. Therefore, the authors herein take on the general TPCK instructional design principles proposed by Angeli and Valanides (2005, 2009) and expand them to incorporate directions concerning the teaching of affect with technology, so as to deal with the requirements of music pedagogy and effectively help music teachers.

Music Pedagogy: Needs, Problems and Difficulties

Most music curricula in the western world require that students become able to compose, perform, and demonstrate musical understanding during listening (Swanwick, 2011; Paynter, 1992). However, student views of school music become increasingly negative, while their enthusiasm, enjoyment, and engagement decreases dramatically as they grow older (Boal-Palheiros & Hargreaves, 2001; Savage 2007; Hallam, 2011).

The fact that music unfolds in time and is abstract causes students to be inattentive during listening and analysis activities, while personal preferences in certain musical styles have also a negative impact on student receptiveness and concentration (Swanwick, 2011; Todd & Mishra, 2013). In addition, students have problems in recognizing, remembering, and comparing musical characteristics, structures and forms, and, in describing and reflecting critically on music (Todd & Mishra, 2013; Dunn, 2008; Tan & Kelly, 2004).

The implementation of creative activities is even more problematic, because most students are not able to read or notate their compositions relying solely on acoustical memory. Thus, they cannot receive substantial feedback or retain, revise, and extend musical ideas during subsequent lessons (Freedman, 2013). Furthermore, students' imaginative and expressive use of musical materials is directly related to their limited musical training (Burnard & Younker, 2004). From the teachers' perspective, composition is regarded as the most challenging. Teachers report problems in designing and teaching creative activities that stimulate both creative thinking and music learning, and acknowledge lack of knowledge in composition and/or pedagogies for managing creativity in music classrooms (Bauer, 2014; Coulson & Burke, 2013; Dogani, 2004).

Apart from the variety of skills required, and, the difficulties in teaching and carrying out music tasks, researchers assert that classroom activities often are not meaningful or related to students' out of school musical endeavors and interests. For this reason, some researchers propose offering activities that resemble the musical experiences students come across in informal settings, including online collaborative music making (Hargreaves, Marshall, & North, 2003; Savage, 2010; Green, 2007). Other researchers argue that enthusiasm and motivation will increase by shifting the emphasis from the development of skills to understanding the role of emotion in music (Hallam, 2011; Dogani, 2004).

Due to the power of music to influence feelings, people listen to music to modify moods or relieve emotions, relate their current emotional state, have a good time, or cheer themselves (Juslin & Sloboda, 2011). Moreover, emotions influence and shape all aspects of music making. Musicians use musical materials and form to express, communicate, and evoke emotions. A true musical experience (including listening, performing and composing), therefore, must not disconnect the understanding of music's cognitive aspects (musical characteristics) from the discovery of its emotional effects and expressive character (affect) (Paynter, 1992; Swanwick, 2011). Instead, it should encourage communication of emotions, feelings, and identity through composing, performing, or interpreting music (Hallam, 2011). In spite of the great significance of affect in music, there is currently a lack of research studies that examine or guide the integration of affect in music activities (Hallam, 2011).

Teaching Music Composition and Listening-and-Analysis with Technology

Online music collaboration sites and associated tools that can be used locally or over a network (i.e., www.cocompose.com, www.kompoz.com, DigitalMusician.net, explodingart.com/jam2jam, etc.) allow young people to manipulate sound, create and upload their own music, or explore and remix music of others. These types of experiences encouraged researchers to suggest that such informal approaches have the potential to transform music education (Brown & Dillon, 2007; Gall & Breeze, 2008). Associated music technologies, including MP3 files, DJ remixing software, loop-based music composition tools that use ready-made pieces of music, and generative algorithms, do not require classical music training and are appealing to young people who use it extensively in their free time (Crow, 2006). However, these approaches were criticized for implicating a very small number of concepts and musical styles, not developing in-depth understanding about structure, form, and musical materials, and for producing long, effortless, mechanized, unimaginative and inexpressive music (Crow, 2006; Swanwick, 2011; Savage, 2007). Thus, some researchers proposed using these technologies at an introductory stage and then moving on to approaches that allow for more creative thinking (Bauer, 2014; Freedman, 2013).

Processes of composition using music notation or sequencing software were investigated in another body of studies (Nilsson & Folkestad, 2005; Breeze, 2011). According to research evidence, due to their instant playback feature, these technologies facilitate the development of musical knowledge and literacy, and enable students who do not understand music notation to fully participate in the creative process. They allow students to create, review, edit, extend, save musical ideas, and, share with others for feedback (Savage, 2010; Wise, Greenwood, & Davis, 2011; Breeze, 2011; Freedman, 2013).

Studies related to the teaching of algorithmic and electroacoustic composition are rare (Brown & Dillon, 2007; Field, 2007). Finally, with reference to listening and analysis activities, there are publications that examine the use of listening guides or propose related teaching strategies (Kerchner, 2013; Dunn, 2008; Gromko & Russel, 2002), but, there is a lack of studies that investigate the teaching of music with animated and interactive listening maps taking into consideration affect.

A Design Methodology for Investigating TPCK Through the Domain of Music: The Importance of Affect

The design methodology proposed herein has been tested and revised extensively in experimental and control secondary education classrooms during the academic year 2015-2016. The term *design methodology* refers to the development of a method or process for designing technology-enhanced learning within the domain of music education. The methodology was the result of a three-cycle design-based research that focused on investigating affect in listening and composition activities, as shown in Figures 1 and 2. The aim of the design-based research was to find a robust methodology for designing technology-enhanced learning within the context of listening and composition activities in music. In developing the design methodology, the authors first invested efforts in understanding the interplay between technology, music, and affect, and, consequently, devised a set of instructional design guidelines to guide systematically the design of learning activities in music taking into consideration affect.

In more detail, as shown in Figure 1, the process begins with a listening excerpt during which students identify emotions expressed or induced without having any visual stimuli. Then, technological tools are used to support visualizations and explorations of the cognitive aspects of music, i.e., concepts and constructs, such as musical instruments, motives, phrases, sections, mode, melodic motion, and dynamics. Musical knowledge is presented through animated and interactive listening maps, and experimentations with musical concepts using notation software. Along with supporting music learning, transformations and experimentations with technology can also promote understanding of moods related to a specific musical element or combinations of elements in different musical contexts. Moreover, they can support relating moods to contrasting or different uses of a musical element. As soon as learning and exploration of musical materials is completed, students are prompted to create a short composition using technology that will convey a mood or a feeling, and, are guided to make decisions about how to use musical elements and structural devices to achieve the desired emotion.

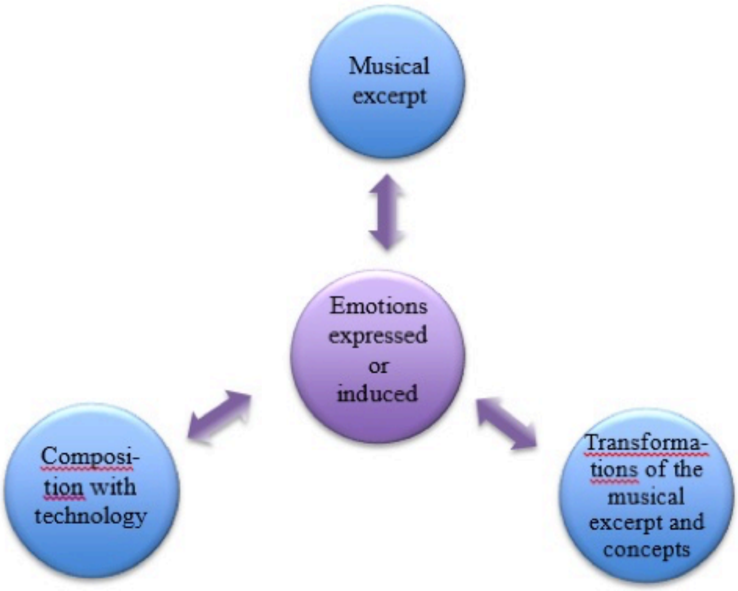

Figure 1. Musical concepts, technological transformations, and emotions.

In the process just described, there are interactions taking place between musical content, emotions, and technology. These interactions are denoted in Figure 2. While transformations of musical content facilitate learning, manipulations of materials with technology influence instant changes in moods or feelings enabling the development of relations among emotional and cognitive aspects of music. Furthermore, technology's resources and affordances, including combinations of sounds, instrument lines, control of materials and constructs, and instant and accurate playback, facilitate the generation of new emotions and ideas during the creative process and help in communicating them more effectively.

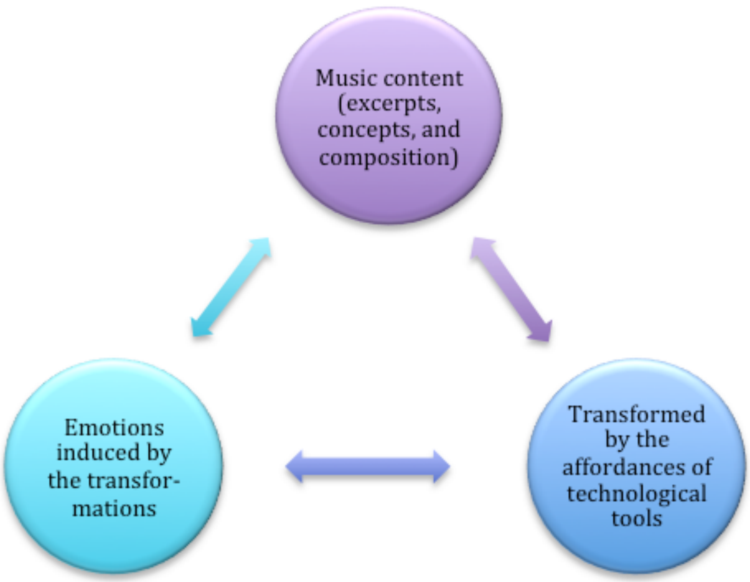

Figure 2. Interactions among musical content, emotions, and technology.

An example is provided for illustrating the preceding discussion. In the example, students experiment with tempo using the notation program MuseScore, and, a file containing a melancholic song in A Minor set at a slow tempo (70bpm). After listening to the slow version of the song, students are guided to open the Play Panel from the Display Menu (see Figures 3 and 4),

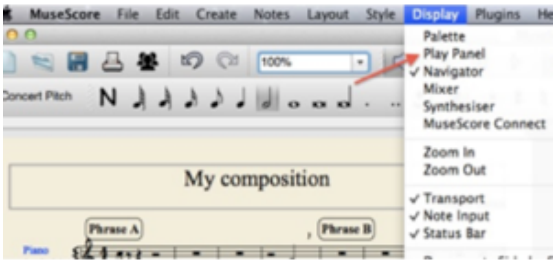

Figure 3. MuseScore: Display Menu.

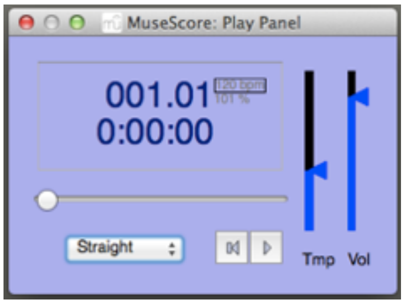

Figure 4. MuseScore: Play Panel.

set the tempo slider at 121bpm, and listen to the song again. While experiencing a happier mood despite the minor mode of the music, students are prompted to write their opinion about how changes in tempo induce different feelings. Similarly, other explorations can be carried out with various elements or combinations of elements using short excerpts in MuseScore. For example, students may explore the emotions elicited by sequentially trying out soft and then loud dynamics on a single melody, and, hence, by repeating the process on a harmonized melody. Exploration may continue by adding a third parameter, i.e., by changing the instrument sounds in the given arrangement.

In learning with technology, two considerations are worth mentioning. First, the affordances of technology can enable students to sidestep their limitations and support practices and uses of musical materials that are very difficult or impossible to realize when composing with real instruments, such as, playing very fast or very slow tempi, or manipulating and transposing motives, changing instrument sounds, and identifying places in the music that sound wrong and revising them. Second, teachers do not need to spend additional time to teach the technical functions of MuseScore. Through the various activities, i.e., presentation of excerpts and concepts, exploration of musical elements, and creative exercises, students gradually become familiar with the program's functionalities as well as the usage of musical materials in relation to affect.

Accordingly, based on the processes described in Figures 1 and 2, the authors herein propose a design methodology consisting of a set of design guidelines that extend the second and third instructional design guidelines proposed by Angeli and Valanides (2009, 2013) (described earlier in the paper), and guide the application of TPCK theory in the teaching of music and affect.

1. Use affect (emotion elicited from a musical excerpt) to motivate students to engage in analysis and exploration of musical excerpts and related concepts.

   1.1. Ask students to identify emotion(s) felt or expressed by the music and write it/them on their handout without having any visual stimuli.

2. Use technology to help visualize, explore, and support understanding of the cognitive aspects of music (structures and elements) according to curricular objectives, such as melodic contour, dynamics, melodic motives, ostinato, phrases, sections, etc.
   2.1. Present an interactive/animated listening map of a *short* musical excerpt.
      2.1.1. Students, working in dyads, explore the animation's resources and complete short questions on their handout. They are also provided with a printed version of the map.
   2.2. Alternatively, play reductions of musical excerpts using a notation software, and/or provide different representations of concepts using the affordances of the software (i.e., piano-roll editor view, mixer, palette).
      2.2.1. Students identify contrasting or different treatment of musical materials and complete very short questions.

3. Use the different transformations that become possible with the affordances of technology to relate cognitive and emotional aspects, i.e., understand how musical elements influence emotion induction (affect).
   3.1. Discuss which musical or structural elements most likely affected the emotions identified earlier (design principle 1), or, how the mood might change if these elements change.
   3.2. Use a notation file that has been prepared before the lesson, and have students (a) experiment with contrasting dimensions of a musical element in order to understand how a change of feeling or mood can be induced, and/or (b) apply the new device or element in a short task using a semi-completed template file so that students can become more familiar with technical, cognitive and affective aspects of a particular concept or combination of two-three concepts (i.e., soft vs loud dynamics, thin vs thicker texture, ascending vs descending melody, conjunct or disjunct melody, etc.).

4. Use a template composition file and provide a handout with restrictions and guiding questions about the treatment of musical characteristics explored in the unit.

5. Prompt students to create musical compositions with emotions in order to express or communicate feelings and mood.

6. Repeat steps 1-5 to teach new concepts, gradually engaging students in more musically and emotionally coherent and technically informed compositions.

Future Directions and Concluding Remarks

In the present study, the authors propose a methodology and a set of instructional design principles addressing both the affective and cognitive domains of learning for guiding technology integration in music teaching and learning. The study attempts to contribute to the further development of TPCK by bridging domain-specific aspects of music education (and more broadly the creative arts), such as, affect, with the affordances of technology in the design process. Furthermore, the contribution of this research has also practical significance as it provides teachers with guidance on learning design. The results of this study can be used as baseline data for future studies aiming at developing theory and methodologies in instructional design and the creative arts. Undoubtedly, including affect in the design process is a complex and mostly unexplored area, and, thus, further investigations toward this direction of research are fully warranted.

References

Angeli, C., & Valanides, N. (2005). Pre-service teachers as ICT designers: An instructional design model based on an expanded view of pedagogical content knowledge. *Journal of Computer-Assisted Learning*, *21*(4), 292-302.

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education, 52*(1), 154-168.

Angeli, C., & Valanides, N. (2013). Technology mapping: An approach for developing technological pedagogical content knowledge. *Journal of Educational Computing Research, 48*(2), 199-221.

Angeli, C., & Valanides, N. (2015). Technological Pedagogical Content Knowledge: Exploring, Developing, and Assessing TPCK. Springer.

Angeli, C., Valanides, N., & Christodoulou, A. (2016). The Theoretical Conceptualization of Technological Pedagogical Content Knowledge. In M. Kennedy, M. Koehler, & P. Mishra (Eds.), *Handbook of Technological Pedagogical Content Knowledge* (2nd edition) (pp. 11-30). NY: Routledge.

Bauer, W. I. (2014). *Music learning today: Digital pedagogy for creating, performing, and responding to music*. Oxford University Press.

Boal-Palheiros, G. M., & Hargreaves, D. J. (2001). Listening to music at home and at school. *British Journal of Music Education, 18*(02), 103-118.

Breeze, N. (2011). Multimodality: An illuminating approach to unraveling the complexities of composing with ICT? *Music Education Research, 13*(4), 389-405.

Brown, A. R., & Dillon, S. (2007). Networked improvisational musical environments: learning through on-line collaborative music making. In J. Finney & P. Burnard (Eds.), *Music Education with Digital Technology* (pp. 96-106). London: Continuum International Publishing Group.

Burnard, P., & Younker, B. A. (2004). Problem-solving and creativity: Insights from students' individual composing pathways. *International Journal of Music Education*, *22*(1), 59-76.

Chai, C. S., Chin, C. K., Koh, J. H. L., & Tan, C. L. (2013). Exploring Singaporean Chinese language teachers' technological pedagogical content knowledge and its relationship to the teachers' pedagogical beliefs. *The Asia-Pacific Education Researcher*, *22*(4), 657-666.

Coulson, A. N., & Burke, B. M. (2013). Creativity in the elementary music classroom: A study of students' perceptions. *International Journal of Music Education,31*(4), 428-441.

Crow, B. (2006). Musical creativity and the new technology. *Music Education Research, 8*(01), 121-130.

Dunn, R. E. (2008). The effect of auditory, visual, or kinesthetic perceptual strengths on music listening. *Contributions to Music Education, 35*, 47-78.
Dogani, K. (2004). Teachers' understanding of composing in the primary classroom. *Music Education Research, 6*(3), 263-279.
Field, A. (2007). New forms of composition, and how to enable them. *Music Education with Digital Technology.* In J. Finney & P. Burnard (Eds.), *Music Education with Digital Technology* (pp. 156-168). London: Continuum International Publishing Group.
Freedman, B. (2013). *Teaching music through composition: A curriculum using technology.* Oxford: Oxford University Press.
Gall, M., & Breeze, N. (2008). Music and eJay: An opportunity for creative collaborations in the classroom. *International Journal of Educational Research, 47*(1), 27-40.
Green, L. (2007). *How popular musicians learn: A way ahead for music education.* Ashgate Publishing, Ltd.
Gromko, J. E., & Russell, C. (2002). Relationships among young children's aural perception, listening condition, and accurate reading of graphic listening maps. *Journal of Research in Music Education, 50*(4), 333-342.
Hallam, S. (2011). Music education: The role of affect. In P. N. Juslin & J. Sloboda (Eds.), *Handbook of Music and Emotion: Theory, Research, Applications* (pp. 791-818). Oxford: Oxford University Press.
Hargreaves, D. J., Marshall, N. A., & North, A. C. (2003). Music education in the twenty-first century: A psychological perspective. *British Journal of Music Education, 20*(2), 147-163.
Ioannou, I., & Angeli, C. (2013). Teaching computer science in secondary education: A Technological Pedagogical Content Knowledge perspective. *In Proceedings of WiPSCE '13, Aarhus, Denmark*. ACM 978-1-4503-2455-7/11/13.
Juslin, P. N., & Sloboda, J. (Eds.). (2011). *Handbook of music and emotion: Theory, research, applications.* Oxford: Oxford University Press.
Kerchner, J. L. (2013). *Music across the senses: Listening, learning, and making meaning.* Oxford: Oxford University Press.
Mishra, P., & Koehler, M. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *The Teachers College Record, 108*(6), 1017-1054.
Niess, M. L. (2011). Investigating TPACK: Knowledge growth in teaching with technology. *Journal of Educational Computing Research, 44*(3), 299-317.
Nilsson, B., & Folkestad, G. (2005). Children's practice of computer-based composition 1. *Music Education Research, 7*(1), 21-37.
Paynter, J. (1992). *Sound & structure.* Cambridge: Cambridge University Press.
Savage, J. (2007). Reconstructing music education through ICT. *Research in Education, 78*(1), 65-77.
Savage, J. (2010). A survey of ICT usage across English secondary schools. *Music Education Research, 12*(1), 89-104.
Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.
Swanwick, K. (2011). *Teaching music musically.* London: Routledge.
Tan, S., & Kelly, M. E. (2004). Graphic representations of short musical compositions. *Psychology of Music, 32*(2), 191-212.

Todd, J. R., & Mishra, J. (2013). Making listening instruction meaningful: A literature review. *Update: Applications of Research in Music Education, 31*(2), 4-10.

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge: A review of the literature. *Journal of Computer Assisted Learning, 29*(2), 109-121.

Webster, P. R. (2007). Computer-based technology and music teaching and learning: 2000–2005. In L. Bresler (Ed.), *International handbook of research in arts education* (Vol.16, pp. 1311-1330). Netherlands: Springer Science & Business Media.

Wise, S., Greenwood, J., & Davis, N. (2011). Teachers' use of digital technology in secondary music education: Illustrations of changing classrooms. *British Journal of Music Education, 28*(02), 117-134.

Author details

Elena Macrides Christofides
elmac@avacom.net

Dr. Charoula Angeli
cangeli@ucy.ac.cy