Asia-Pacific Journal for Arts Education

Co-editors:
Dr. Bo Wah LEUNG
Dr. TAM Cheung On
The Hong Kong Institute of Education

http://www.ied.edu.hk/cca/apjae/apjae.htm ISSN 1683-6995

Volume 8 Number 4 December 2010

ICT integration in primary school music education: Experience of pioneering countries and its implications for implementation in Hong Kong

Barry Kwok-yeung LEE
Hong Kong Institute of Education
blee@ied.edu.hk

Abstract

There have been many claims about the benefits that the use of technology can bring to music learning. In fact, examples of successful applications and high levels of motivation associated with computer-based music learning reported in the literature have evidentially substantiated both the feasibility and adaptability of technology applications to music education. This paper describes the experience of Information and Computer Technology (ICT) integration in primary school music education in countries where both pioneering and relatively advanced developments have taken place. A comprehensive study of related literature and curriculum documents has been undertaken, aspects including major software programs development for music education and its pedagogical orientation, hardware configuration and classroom organization, applications of ICT in music teaching and learning, requirements for curriculum, hardware and software, and technology competency requirements and related professional development for music teachers are studied. Findings from the literature reviewed and documents analyzed reveal that ICT can best support constructivist approach to music learning, particularly activities of creative nature such as composing, improvising and creative music making; in addition, resource and related circumstantial factor as well as music teacher's readiness were found to be the most influential factors of successful ICT integration. Coupled with these findings, conclusion and implications for ICT integration in primary music curriculum in Hong Kong are then drawn and discussed.

Introduction

In Hong Kong, since the launching of the five-year strategic plan in IT education in 1998 to promote the use of IT for enhancing teaching and learning in school education, several related research studies had been done (for example, Cheung-Yung & Yip, 2004; Ho, 2004) regarding the implementation of ICT in school music education in Hong Kong. Nevertheless, issues associated with subject integration at the school level have not been fully scrutinized. Thus the main purpose of this paper is, through an extensive review and analysis of related literature and documents in other countries, to provide reference for ICT integration in primary school music teaching and learning in Hong Kong. In the subsequent sections, a study of ICT and music technology integration in music education in countries where both pioneering and relatively advanced developments have taken place (including the United States, the United Kingdom and Australia) will be undertaken, the state of integration in primary schools such as major software programs development for music education and its pedagogical orientation, hardware configuration and classroom organization, applications of ICT in music teaching and learning, requirements for curriculum, hardware and software, and technology competency requirements and related professional development for music teachers, will be discussed.

State of ICT Applications in Music Education

Since the emergence of the personal computer for instructional applications in school education from the late 1970s, music-oriented ICT applications have been employed in music education for more than two decades (Feldstein, 2001; Reninger, 2000; Webster, 2002). As reported in numerous books, journals, periodicals and the Internet websites, technology has been used in a wide variety of music classroom activities in the United States, the United Kingdom and Australia. These activities are *composition* (including arranging - for example, see Carr, 1997; Casey, 2005; Ellis, 1995; Folkestad, Lindstrom & Hargreaves, 1997; Forest,

1995; Reese, 1995, 2001; Roulston, 1995; Hickey, 1997; Langol, 1998; Pierce, 1998; Siegel 2004, *keyboard class* (for example, see Altiere, 1997; Bissell, 1998; Forest, 1995; Renfrow, 1995), *music theory* (including music reading and harmony - for example, see Bustard, 1997; Casey, 2005; Hrycay, 2002; Renfrow, 1995), *musicianship training* (including rhythm training and aural training - for example, see Casey, 2005; Renfrow, 1995), *music appreciation* (including listening and history - for example, see Armstrong, 2004; Haldey, 1996; Roulston, 1995), *accompaniment* (for choral and instrumental activities - for example, see Farnham, 2004; Kersten, 2004; Leong, 2004; Pierce, 1998; Woody & Fredrickson, 2000) etc. There are findings from many research studies that support the contention that "music technology has now emerged as a fully-fledged teaching methodology along side … approaches such as Orff-Schulwerk, Kodály, Dalcroze and other established pedagogies" (Stevens, 1996, p. 185).

Software with pedagogical applications in music education

A review of music technology resource guides such as the *ATMI Technology Directory* (2004) published by the Association for Technology in Music Instruction (US) and the *Music IT Pack* (1997) published by the National Council for Educational Technology (UK) indicated that hundreds of software programs have been developed for music education. As a result of concurrent advancements in hardware, music software programs have evolved from several models ranging from the traditional drill-and-practice type instructional software (for teaching area such as music rudiments and aural skills and characterized by the behaviouristic model of programmed instruction in the late 1970's, e.g. *Practical Theory*—published by Alfred Publishing, *Practica Musica*—published by Ars Nova) to a wide variety of music software applications along the lines of constructivist knowledge building which have been produced in recent years (Reginger, 2000; Webster, 1998, 2002). The traditional drill-and-practice software continues to improve (in terms of audio and visual facilities) and

for the content to function as an effective instructional tool (e.g. *Adventures in Musicland*—published by Electronic Sourceware Systems). Meanwhile, music production software (for scoring, sequencing and digital audio processing, e.g. *Finale*—published by Coda Music), *Cakewalk*—published by Opcode), *Cool Edit*—published by Syntrillium Software Corporation) emerged to streamline the process of composing and music production (Reginger, 2000); music instruction software that was characterized by the constructivist models of learning emerged to provide computer-mediated contexts for students "to construct their understanding of music [and musical knowledge] through their [experience] … expertly guided by teachers" (Webster, 2002, p. 43).

The theoretical and philosophical foundations of constructivism are based on principles of learning from theorists such as Dewey, Vygotsky, Piaget, Bruner and Gardner in the fields of education, educational philosophy and educational psychology. Constructivists perceive learning as the construction of knowledge through experience, and emphasize children's cognitive growth through "exploration, unstructured learning, and problem solving" (Roblyer & Edwards, 2000, p. 62). Therefore, the constructivist approach to learning requires students "to construct knowledge themselves rather than simply receiving it from knowledgeable teachers" (Roblyer & Edwards, 2000, p. 67). Characteristics of constructivist models of teaching and learning include the provision of "resource rich environments", the organization of "problem-oriented activities", the employment of "visual formats" as metaphor, the emphasis of "cooperative/collaborative learning", and the encouragement of "learning through exploration" (Roblyer & Edwards, 2000, p. 67-68).

Webster (2002) points out that technology has been used "in a more constructionist context" (p. 43) in the last decade. According to Webster (1998, 2002), music software supporting the constructivist approach to learning covered categories such as flexible-practice,

guided instruction, games, exploratory, and creativity. In addition, on top of the software programs which engage students directly in learning, accompaniment software, music production software as well as Internet-based information and communication tools also playing a significant supporting role in music teaching and learning.

Hardware configuration and classroom organization

Reginger (2000) has proposed two categories that represent the typical configuration of school computer facilities for music teaching and learning that may be general and music-oriented. General computer laboratories usually contain:

- several computers of one platform (Macintosh or PC)
- CD-ROM and DVD-ROM players
- printer(s)
- headphones
- amplified speakers
- basic software (e.g. music software for drill and practice and for notation) (P. 27)

whereas a music-oriented computer workstation usually includes the following components:

- keyboard or synthesizer
- computer
- CD-ROM and DVD-ROM players
- headphones (or other amplification hardware)
- mixer
- audio control or routing system
- advanced software (e.g. software for sequencing, MIDI notation, and musical accompaniment) (p. 27)

With regard to the patterns of classroom organization, Reese (2001) points out that three types of technology settings can commonly be found in schools.

- One computer with the teacher leading whole-class activities
- One or more computer "centers" at the back or side of the classroom
- Use of a general school computer lab or dedicated music lab with a whole class (p. 46)

When only a single computer workstation is available in classroom, a teacher can use this as a presentation tool—an "electronic blackboard"—by demonstrating music software for

whole class teaching (see, for example, Kassner, 2000; Pierce, 1998; Siegel, 2004). Alternatively, the single computer workstation can be used in a "learning centre approach" where the teacher sets the computer workstation as a learning centre, and students can work on some music software applications independently, in pairs or in small groups. Kassner (2000) points out that "learning centre approach" is ideal for learning about topics such as "timbre, form, harmony, melody, rhythm, notation, music history and style, keyboards, composition, and multicultural awareness" (p. 39). According to Reese (2001), the learning centre approach can be incorporated into class activities in two different ways. In the first approach, the student(s) is(are) taken away (on rotational basis) from normal class activities to work at the centre while the teacher works with the rest of the class (see, for example, Roulston, 1995). In another approach, a computer centre is set up concurrently with other non-computer-based learning centres for small group activities, and all students in a class are organized into small groups to work simultaneously at centres of different learning tasks (see, for example, Casey, 2005). For arrangements in a classroom setting with more than one music workstation being available, one workstation can be used for teacher's presentation while the rest can be set up as learning centres for different computer-based learning tasks. Nevertheless, in teaching practice, both approaches require the teacher to carefully plan the classroom environment, and to work out procedures, schedules and related learning materials.

Obviously, the most favourable setting would be a dedicated music laboratory equipped with hardware of the computer workstation configuration. In such a setting, a whole class of students can work simultaneously on a range of activities such as keyboard literacy, computer-aided instruction, scoring, sequencing, arranging, and multimedia CD-ROM applications, either individually or in pairs, depending on the quantity of computer workstations and the nature of activities (see, for example, Altiere, 1997; Carr, 1997; Forest, 1993, 1995). For the less well-equipped general computer laboratory setting in which MIDI

keyboards are not normally available, students can work in almost the same manner as in a dedicated music laboratory except for activities where keyboards are strictly required (Reninger, 2000).

Applications of ICT in music teaching and learning in primary schools

Early in this paper, examples of ICT applications for school music education at various levels of school education were cited. More specifically, there are quite a number of well-documented cases of technology being employed in music education at the primary level. In the United States, Forest (1993, 1995) reported that technology had been used in a wide variety of ways to teach music to children from pre-kindergarten to 5th grade. Early childhood music learning for pre-kindergarten through 2nd grade was largely supported by computer music games in *Adventures in Musicland* (published by Electronic Courseware Systems). Children explored fundamental music concepts and expanded their musical knowledge through experiencing music in a computer-mediated environment. From 1st grade to 3rd grade, learning of music fundamentals such as sight-singing, music reading skills, pitch identification, keyboard knowledge, ear training was supported by technology-based activities in *Piano Partners Music Learning System* (developed by Margaret Waldmann). In 4th grade, technology had been used to teach music appreciation and notation; from 5th grade, more creative experiences were provided to children with the addition of *Music Time* (published by Passport Design Systems) notation software, activities such as keyboard skills, arrangement of music, composition and ear training were arranged in a keyboard laboratory in conjunction with the *Piano Partners* software package. According to Forest's observations, technology encouraged active learning in music where students were engaged actively in computer-mediated music making and learning.

More importantly, technology can cater for different styles of learning and help students to discover and develop their creative musical talents. Carr (1997) reported that a keyboard laboratory (Korg keyboard lab system) had been used to teach general music to students of 3rd grade and above, and found that technology helped students to "audiate the music they compose" (p. 32). Altiere (1997) used the keyboard laboratory (Yamaha Music in Education system) to teach general music at elementary level, and found that technology helped to reinforce musical concepts. Her teaching was enhanced as technology was found to facilitate instantaneous hands-on experience as well as assessment tasks given to students. Bissell (1998) pointed out that technology integration in elementary music curriculum provides numerous creative opportunities. Through working with keyboard-based software programs such as *MiBAC Music Lessons* (published by MiBAC Music Software, Inc) and *Music Lab* (published by Musicware Inc), lower elementary students may explore basic elements of music such as pitch, tempo, volume, timbre, as well as experiencing improvisation with these music elements, and upper elementary students can explore the extended functions of the software such as the manipulation of a variety of sounds (timbres) and rhythmic styles. Bissell (1998) also pointed out that technology provides a motivating environment and powerful tools with which students may create, record, evaluate and edit their music; through experimentation in various music making activities such as improvising, performing, arranging, and composing, students' creative experiences may be enriched. Pierce (1998) reported that technology was used to create accompaniments for class choral activities and in students' compositional activities in her general music class in elementary school. *EZ Vision* (published by Opcode Systems Inc.) sequencing software was used for students' creative composition in a single computer workstation (with sound module and keyboard) situation. Students (grouped in pairs) worked in rotation following an activity guideline while the rest of the class was having the regular music lesson. Farnham (1998,

2004) used *Musicshop* (published by Opcode Systems Inc.) sequencing software to prepare accompaniments for rehearsals and performance, and observed that technology helped promote the efficiency of rehearsal as well as increasing the quality of performance in his music programme. Casey (2005) demonstrated from her own classroom experiences that "integrating technology into the music curriculum entices students to actively engage in learning" (p. 53). Student-centred computer-based activities in a learning station approach were organized along with her weekly music lessons to reinforce the regular 5th grade curriculum. She used *Music Ace* (published by Harmonic Vision.) for students' practice in note identification, interval training, and pitch matching, and used *Finale Notepad* (published by Coda Music), *Master Trax Pro* (published by Passport Design), *Band-in-a-Box* (published by PG Music Inc.) and *Super Duper Music Looper* (published by Sony Media Software) for students' compositional activities.

In Australia, Roulston (1995) reported that music software applications had been used as part of music class activities. In each upper school (years 4 to 7) music lesson, two students were taken away (on a rotational basis) during their regular music class to engage in computer-based music activities. Students were introduced to notation skills through note-writing/composition activities with *Super Studio Session* (published by Bogas Productions). Students also used CD-ROM titles such as *Musical Instruments* (published by Microsoft Inc.) and *The Orchestra: The Instruments Revealed* (published by Warner New Media) to learn about Western musical instruments through guided activities with worksheets. She concluded that technology applications are "effective means of promoting greater enthusiasm for music" (p. 29), while computer-based compositional activities can provide more capable students with challenging learning experience in music, whereas multi-media music applications might provide less highly motivated students with rewarding learning experiences.

Curriculum, Hardware and Software Requirements, and Implementation Planning Associated with ICT Integration

In 1999, the United States-based Music Educators National Conference (MENC) published *Opportunity-to-Learn Standards for Music Technology* which, as a teacher reference, addressed the implementation of technology in music teaching and learning. This publication outlined technology standards for the elementary school (Grades 1 to 6); the requirements for *Curriculum and Scheduling* are as follows:

1. Use of technology is a regular and integral part of instruction.
2. Teachers employ instructional strategies that appropriately utilize the unique capabilities of technology.
3. Learning experiences in the curriculum include the use of computer-assisted instruction, MIDI sequencing, music notation software, Internet music resources, and electronic musical instruments to help students acquire the knowledge and skills listed in the National Standards for Music Education.
4. Software and hardware selections are made based on the learning goals established for the students.
5. Music classes have the same degree of access to school technology resources, including technology labs, as other classes in the school.
6. Learning profiles (e.g., attendance records and progress reports) for individual students are maintained using databases and other record-keeping technologies.
7. Children with special needs have the same access to technology-based music instruction as other children in the school. Appropriate adaptive devices are available as needed. (Music Educators National Conference, 1999, p.3)

Concerning the provision of hardware, software, teaching materials and classroom space, the suggestions are as follows:

Equipment

Minimal:

1. Every music classroom should contain one multimedia-ready computer that is Internet capable and includes: audio in/out capability, General MIDI sound generation, powered speakers, CD- or DVD-ROM player, and a MIDI keyboard connected to the computer. When a teacher must move between classrooms and schools, a similarly equipped laptop computer is preferred for that teacher.

2. The school computer lab is equipped with dual headphones and MIDI keyboard controllers for use by the students.
3. Students have access to eight digital keyboards (possibly portable units) with standard-size, touch-responsive piano keys.
4. A large-screen video display for class presentation.

Desirable:

1. In addition to the minimal specifications, the classroom teaching station has two to three additional multimedia-ready computers with keyboard controllers (dual headphone capable). Alternatively, there is a digital keyboard lab or dedicated computer music lab with fifteen or more computers configured in a similar way to the workstations recommended in Number 1 above. All equipment includes powered speakers, a computer display projector, and large-capacity removable disk storage.
2. For instrumental instruction, alternative MIDI controllers, such as wind, guitar, string, and drum controllers, are available.
3. Music teachers have the same access to scanners, digital cameras, and other multimedia equipment as teachers in other disciplines.
4. A computer video projector to enhance class presentations in large classrooms.

Materials/Software

Minimal:

1. The software library contains at least six titles of instructional software that reinforces listening, analyzing, reading, and describing music. A plan to purchase three new titles each year is in place, and existing software is upgraded on a regular basis.
2. At least six titles of multimedia software that enables children to create, improvise, compose, and perform music are also available. A plan to purchase three new titles each year is in place, and existing software is upgraded on a regular basis.
3. There is Internet software for supervised access to Web resources.

Desirable:

1. Additional multimedia and software titles are available, and a plan to purchase six new titles in each category each year is in place.
2. The software library contains software for generating music arrangements and accompaniments and libraries of MIDI accompaniment files.
3. There is a basic sequencing/notation package, appropriate to the age level, for recording and printing music.
4. Students have access to basic digital audio editing software for capturing, modifying, and reproducing music.
5. Music teachers have the same access to graphic, multimedia, and Web authoring software as teachers in other disciplines.

Facilities

Minimal:

1. Suitable space is available in the dedicated music classroom for one computer with appropriate power and Internet connections.
2. Students have access to a school computer lab.

Desirable:

1. The school provides music classroom space with appropriate furniture, power, and Internet connections for multiple computer stations.

(Music Educators National Conference, 1999, pp. 3-4)

In the United Kingdom, similar recommendations were made in several different documents. References to curriculum content recommendations regarding the use of ICT in teaching and learning at the school level are set out in the *National Curriculum—Programme of Study for Music* (published in 2000). At Key Stage 1, although the mandated requirement for the use of ICT has not been specified in the National Curriculum for music, opportunities for using ICT within the programme are in fact suggested. At Key Stage 2, a mandated requirement is stipulated in the section concerning the *Breadth of Study*. At this stage, students' knowledge, skills and understanding should be taught through "using ICT to capture, change and combine sounds". More specifically, "Pupils should be taught … how to prepare information for development using ICT, including selecting suitable sources, finding information, classifying it and checking it for accuracy" (National Curriculum Online, 2005).

Regarding the reference for the acquisition of facilities required for ICT integration in the music curriculum, the *Music IT Pack* (published by National Council for Educational Technology—NCET in 1997) and the document *Entitlement to ICT in primary music* (published by British Educational Communication Technology Agency—BECTA in 2003) provide detailed information about and requirements for purchasing the hardware and software for ICT-based teaching and learning. In the *Music IT Pack*, comprehensive guidance on choosing and using the right IT equipment for music classroom is provided. The configuration and specification of major hardware (including equipment for computing,

recording and electronic music) required for different teaching and learning settings are also illustrated, different types of programs (with typical product examples) compatible with teaching and learning are introduced, and finally the criteria for selecting software are suggested. According to the *Music IT Pack*, a typical computer system for general music education applications should basically include components such as:

- multimedia computer
- speakers
- headphones
- microphone
- printer
- modem
- soundcard
- CD-ROM drive (NCET, 1997b, p. 1)

Suggestions have also been made for the acquisition of additional or music-specific peripherals to cater for the needs of particular applications in teaching and learning such as Sequencing and Scoring. Teachers might, depending on the type of classroom activity to be organized and at their discretion, acquire equipment such as:

- MIDI interface and MIDI keyboard (for MIDI sequencing)
- MIDI interface, MIDI keyboard and MIDI sound module (for MIDI sequencing using an external sound source) (NCET, 1997b, p. 7)

In addition, a wide range of ICT applications useful in music education, including the following, are included and suggested in the document *Entitlement to ICT in primary music*.

- computer software and CD-ROMs
- electronic means of communication (e-mail and the Internet)
- equipment for making and replaying sound recordings (e.g. microphones, cassette/minidisc recorders)
- equipment that can alter sounds to give 'special effects' (e.g. add echoes)
- electronic musical instruments (e.g. keyboards) that can produce a range of alternative timbres. (BECTA, 2003, p. 1)

In Australia, references to the utilization of ICT in music teaching and learning at the primary years are specified in the Arts curriculum documents of the individual states and territories which have been developed on the basis of the 1994 national curriculum document on the Arts—*The Arts - Curriculum Profile for Australian Schools* (published by Curriculum

Corporation in 1994). In some states and territories such as Queensland, New South Wales and the Northern Territory for example, only universal statements regarding the integration of ICT in the entire curriculum area of The Arts are made in the curriculum documents (Board of Studies - New South Wales, 2000; Northern Territory Government, 2002; State of Queensland, 2002). In other states and territories, statements associated with ICT integration are set out explicitly; for example, in Australian Capital Territory, the *Arts Curriculum Framework* provides references for using ICT in music teaching and learning. The section describing the scope of The Arts learning area indicates that "electronic equipment (computers, synthesisers and other electronic devices) may be used for extended sound exploration, performance and composition" in music learning in the Upper Primary Years (Australian Capital Territory, 1994, p. 69). In Victoria, the *Curriculum and Standards Framework II* (Victorian Curriculum and Assessment Authority, 2001) outlines references for using ICT in teaching and learning in the primary years. In South Australia, according to the *R–10 Arts Teaching Resource*, no technology applications are specified below year 7 of schooling (State of South Australia, 2004). In Western Australia, references related to the employment of ICT in teaching and learning in the primary years of schooling can be found in the *Outcomes and Standards Framework—The Arts* (Department of Education and Training, Western Australia, 2005, p. 39,41).

Among the curriculum documents regarding ICT integration in music teaching and learning which are available for teacher reference in the countries reviewed, the MENC's *Opportunity-to-Learn Standards for Music Technology* provides the most comprehensive coverage of essential information (including technology standards, requirements for curriculum and scheduling, and sugguestions for the provision of hardware, software, teaching materials and classroom space) with which teachers need to be acquainted. Despite a few explicit indications of ICT applications in teaching and learning being given in some

curriculum documents (for example, in the UK and in some states and territories in Australia), relevant statements in other curriculum documents are merely universal directives or suggested potential opportunities. These can be acted on by teachers at their discretion, taking into consideration the circumstances at the school level such as curriculum aims, class scheduling, resources and other logistic arrangements, in the actual implementation. In curriculum documents where ICT requirements are explicitly stated, it is worth noting that the proposed stages for integration are inclined towards the middle and upper years of primary education (Australian Capital Territory, 1994; National Curriculullm Online, 2005; Victorian Curriculum and Assessment Authority, 2001; Department of Education and Training, Western Australia, 2005). In addition, technology is expected to assume diversified roles such being employed as a musical instrument (e.g. a MIDI keyboard controller attached to a computer to become a digital keyboard instrument), a source of learning experience and a production tool in music teaching and learning.

Technology Competences and Professional Development for Teachers in the Applications of ICT in Music Education

As already discussed, much research has been undertaken regarding ICT applications in music teaching and learning. However comparatively fewer researchers have investigated the issue of professional development for music teachers to enable ICT integration.

In a survey of music teachers in Western Australia, Leong (1995) reported that only 11% of primary teachers indicated that their pre-service teacher education had adequately prepared them to use technology with confidence and competence. About 78% of primary teachers agreed that a compulsory unit on the applications of technology in the classroom should be included in music teacher preparation programme, and “80% of music teachers were interested in attending workshops on the educational applications of music technology” (p. 22). The survey also identified that, although the strength of opinion had not been

specified, one of the reasons for music teachers not using technology in their teaching was due to “lack of expertise, confidence” (p. 24). Leong (1995) concluded that technology must be accommodated in teacher preparation programmes, and that music teachers’ needs for acquiring continuing education in technology must be addressed.

Merrick (1995), in a survey of music teachers in the New South Wales in Australia, reported that less than half (46%) of teachers surveyed were using music technology in class and that 75% of teachers indicated their overall computer knowledge and understanding was within the range from “satisfactory” to “very limited”. Among the teachers surveyed, only 34% of teachers had received training in music technology in their pre-service teacher education programmes, and 61.5% of teachers had received some form of music technology training through in-service programmes. Teachers who had attended in-service music technology training programmes commented that these programmes “failed to provide adequate detail to change the teachers’ operation within the classroom situation” and had not given “adequate time [for teachers] to master the skills and knowledge obtained” (p. 193). They further suggested that these training programmes should demonstrate “how to use the equipment educationally rather than just … the technical operation” (p. 193). In response to these observations, Merrick (1995) proposed that in-service programme of music technology “needs to be graded … not congested with information, … well structured, relevant to classroom needs and non-threatening in nature” (p. 196). In addition, Merrick (1995) suggested that “the study of music technology, both at technical and educational level, needs to become a mandatory part of all pre-service music education courses” (p. 195), and that courses needed “to offer core and elective coverage … [with] focus on particular area of music technology” (p. 195) and develop an understanding of technology-based teaching and learning.

Reese and Rimington (2000), in their study of music technology in Illinois public schools (K-12) in the US, found that, despite a large majority (83%) of music teachers participating in the study who "had some kind of computer training" (p. 31), about 60% of teachers rated their expertise in music technology as "average" or "below average". This might be the reason why the low percentages of teachers using computers during class time were observed and a large number of teachers (94%) indicated their desire for further training. Regarding access to music technology training, survey results revealed that "45% of teachers [were] participating in self-guided learning and 34% [of teachers were] learning from colleagues or friends" (p. 29). Universities and School Districts had provided training to only 25% and 13% of teachers respectively. In addition, major obstacles for music teachers participating in computer training and reported in the survey included "lack of time (67%), lack of school funding (57%), lack of personal funding (46%), and lack of access to training (44%)" (p. 29). Other obstacles included "lack of relevant topics (26%) and poor quality of training (6%)" (p. 29). Obviously, the informal training undertaken by a considerable number of teachers was ineffective and unsuitable. However, Reese and Rimington (2000) concluded that "until structured, organized training becomes generally available, strategies should support teachers in the pursuit of self-guided learning" (p. 31). Given the circumstances reported in the study, the self-guided learning model of professional development might be the most practical and immediate solution to the problems identified.

In a survey regarding the content of pre-service undergraduate elementary music methods courses taught at nine major Midwestern universities in the US, Abril and Frego (2003) discovered that despite the fact that "technology has been in public and higher education for over twenty years, … technology receives the lowest rating as an instructed content area" and has not been incorporated as a substantial portion in these courses. The possible reasons they suggest for this phenomenon might be due to "a pre-existing

technology course, the availability of equipment, [and] the time allowed in the syllabus to include technology" (p. 19).

With regard to the knowledge and skills music teachers required for using music technology in classroom, the Technology Institute for Music Educators (TIME) in the United States published the *Technology Strategies for Music Education* as a guide and reference to national standards for in-service training in music technology. Seven major areas of competency in music technology directly applicable to music instruction were outlined.

1. Electronic musical instruments
2. Midi sequencing
3. Music Notation software
4. Computer-assisted instruction
5. Multimedia and digitized media
6. Internet and telecommunications
7. Information processing, computer systems, and lab management (Rudolph et al, 1997, p. 37)

In addition, the MENC Task Force on Music Technology recommended that technology training for music teachers in elementary school (grades 1 to 6) should include:

Minimal:

1. A planned program of ongoing staff development to provide teachers with training in applying technology in the curriculum is in place. Training is available on a variety of levels to match the varying backgrounds and proficiencies of teachers.
2. To remain up-to-date in the field, all music educators receive at least one staff development day per year for technology training. Training is conducted by those with an awareness of the needs of music educators.
3. Teachers have easy access to email and web services for professional and curriculum development, research, and other communication needs.
4. Teachers are provided with ample time to consult with other colleagues about the use of technology.
5. Technical support and mentoring by those who are knowledgeable about the hardware and software used by music educators is available to music teachers.
6. Teachers are provided with the necessary development time for creating new curriculum materials that make effective use of music technology.

Desirable:

1. A well-planned, long-term program of professional staff-development support is available to all music teachers.

2. Music teachers have ready access to Internet-based professional development opportunities.
3. In lab settings, an appropriate student/teacher ratio is maintained through the use of teacher assistants or aides.

(Music Educators National Conference, 1999, p. 3)

In Australia, Merrick (1998) suggested that the following content areas should be included as part of the Music Technology National Standards for music teachers.

Music Technology

- general knowledge of computers, synthesisers, sound modules, sound cards, and their configuration;
- a knowledge of the different types of instruction that can be employed with computers, i.e. Computer Assisted Instruction, Computer Based Learning, Creativity;
- an awareness of MIDI and its operation;
- an awareness of hard drive recording systems;
- satisfactory knowledge and skills developed through 'hands on' experience with a set of established sequencing, editing, auto-accompaniment and aural software;
- an awareness of Internet access and CD-Roms for resource development and classroom application;
- an awareness of keyboard laboratories and consoles

Classroom Practice

- an awareness of new approaches to classroom practice with technology focus including new learning structures for the teacher and students to use, i.e. cooperative learning, problem solving, facilitating independent learning;
- an awareness of the influence of technology on cognitive and metacognitive processing of learners;
- an awareness of the different structures and settings to use so as to attain educational outcomes of a satisfactory level. (pp. 41-42)

Research findings reported in this section revealed that there had been a widely-held view that music technology should be incorporated as core content in pre-service music teacher preparation programmes. However, despite the fact that music technology had been included in pre-service teacher preparation programmes for some years, music teachers with sufficient confidence in using technology in class teaching were still the minority (Leong, 1995; Merrick, 1998; Reese & Rimington, 2000). In particular, the percentage of technology-competent primary music teachers was even lower (Leong, 1995), and this was suggested as being due to "a perceived incompatibility of technology with elementary general music" (Abril & Frego, 2003, p. 19). These observations reflect the situation that music

technology training currently offered in the pre-service teacher education programme is failing to meet music teacher needs in the classroom; therefore, revision and restructuring of technology training are necessary to ensure music teachers are able to develop sufficiently confidence for fully utilizing technology in classroom settings.

Another important research finding is the demand for in-service training for teachers. Despite many music technology training opportunities for serving teachers being provided, there was still a big demand for in-service training (Leong, 1995; Merrick, 1998; Reese & Rimington, 2000). This phenomenon might be partly due to the evolving technologies—music teachers need to continuously update their knowledge and skills related to music technology. Other possible reasons might be connected with the inadequate training received and the inaccessibility of technology training opportunities. Other major issues identified relating to the provision of in-service training that need to be addressed include the course content (particularly the orientation of training) and the means of provision (mode of delivery). Regarding the content of technology training, Merrick (1998) suggested that technology training for music teachers should, in addition to the training for technical and practical proficiency, also develop an understanding of technology integration in teaching and learning. As for the mode of delivery of in-service technology training for music teachers, training can be in wide variety of formats ranging from self-instruction to formal courses of higher learning including peer instruction, distance learning, training provided by music technology vendors, summer courses and postgraduate courses (Reninger, 2000). The provision of in-service training should be based on both the training resources available to music teachers and the preferred training style of music teachers.

Discussion

Although some music teachers might still consider technology as gimmickry, it has in fact provided music teachers with new approaches to teaching music, and a host of technological alternatives are available to broaden curriculum activities and enrich the musical experience of students. As alluded to previously, from the perspective of classroom music teaching and learning, a number of classroom teaching practices can be facilitated and enhanced by the integration of technology, and the most effective of all applications appears to be creative activities. Technology represents a new approach to creativity in music for children, with the computer-mediated platform making possible certain creative experiences that are less likely to be provided in traditional approaches. For instance, evaluations of students' performance as cited in the application examples reported that composing or arranging activities with sequencing or similar software not only facilitated the execution of activities, but also provided a more authentic experience that resembles that of a real composer or arranger (Webster, 1998, 2002). The capacity of these software programs to allow users to record, edit and print music is in itself a significant motivating factor in creativity. In fact, the actuality that students are able to assume the role of professional practitioner—i.e. composer/arranger—is in fact giving them learning experiences that are both unique and authentic.

Technology can also effectively support the teaching and learning of music reading, listening, rhythm and aural training through the employment of general musicianship software. Furthermore, technology applications directly involved with teaching and learning, production tools (such applications as sequencing, scoring, digital audio processing, and accompaniment), a wealth of music CD-ROMs, web browsing and communication tools are playing a prominent supporting role in classroom music. With the help of these technology tools, music lessons can be more adequately prepared and presented. For example, MIDI-

assisted accompaniment applications can enrich choral activities and facilitate other class activities that require accompaniment.

Despite the indisputable impact of ICT in music education, it is worth noting that not a single advocator of technology in the literature has asserted that technology-based methods will replace traditional pedagogies, but rather that they have the potential to enrich existing pedagogies. For example, Altiere (1997) indicated that, while using technology to enhance her teaching, such aspects as recorder playing, Orff instrumental performance, and singing were still to be taught in class. Reninger (2000) points out that "technology will be there to assist students and teachers, but the most essential component of the music classroom of the future will be, as it has always been, the music teacher who guides students in their journey to understand music" (p. 31). From this perspective, music classrooms will probably not change greatly as singing and music making with class instruments will still be the main focus. However technology used to support these classroom activities will be modernized drastically and speedily, just like the replacement of the phonograph player by digital audio players (such as compact-disc player, Mini-disc player and MP3 player), or the replacement of VCR by the DVD video recorder. Technological innovation is part of an on-going renewal of pedagogies and music technology may be viewed as simply one of the latest classroom tools to optimize teaching and learning.

Conclusion and Implications for integration in Hong Kong

As cited in the literature related to the application of ICT in music education, many teachers have already incorporated technology into music teaching and learning with considerable success. Through a range of music software programs, ICT can support a wide variety of music activities in the primary music classroom and broaden the extent of students' learning experiences. More importantly, ICT integration extends the limits of conventional

delivery systems and activates changes in pedagogical approaches in music teaching and learning from being teacher-centred to more student-centred. Music software programs have evolved to better support the constructivist approach to music learning by providing students with a technology-mediated environment in which students can acquire their knowledge and understanding through unique and more authentic musical experiences. In particular, activities of a creative nature such as composing, improvising and creative music making, and other individualized activities can be usefully employed.

The audit of music curricular documents of the selected countries revealed that technology has become an essential and indispensable element in the music curriculum and is expected to assume multiple roles in teaching and learning. However, even though the requirements for ICT integration are mandated in the curricula, the implementation at school level is, to a large extent, dependent upon the resources available (including human resources), the physical teaching environment and the related logistic support. In fact, models of integration at the class level identified in the literature are basically resource-oriented, and the main determinant of the integration model included multiple factors such as hardware, software, classroom space and class scheduling. In addition, experience and exemplary cases from the selected countries illustrated that the scope of ICT integration is directly connected with the resources and other circumstantial factors.

In Hong Kong, accompanying the implementation of the region-wide IT in education policy, a comprehensive review of the primary music curriculum was carried out, and a new *Music Curriculum Guide* was published in 2003 and implemented from 2006 respectively. In this latest *Music Curriculum Guide*, IT elements have been incorporated, and explicit requirements for using IT in teaching and students' learning were specified. Information provided included proposals for IT-based activities, particulars of hardware and other related

resources, and instructional arrangements for typical teaching situations in primary schools. When compared with the technology standards and related curriculum requirements recommended for primary schools in countries which are relatively advanced in educational development such as the US and UK, recommendations made by the Education Bureau of Hong Kong (EDB) regarding primary school's acquisition of IT equipment and music program's entitlement to access-shared IT facilities for music teaching and learning are practically comparable at least to the minimum standards recommended in countries mentioned above.

Nevertheless, despite the fact that the resource and curriculum requirements were clearly specified, the implementation of curriculum contents of the new music curriculum are not mandatory but merely suggestions, primary schools in Hong Kong have been given high flexibility to allocate resource according to their genuine needs in relation to school-based curriculum development. In consequence, if music coordinators have little or no inclination to integrate ICT into their music programs to any great extent, most schools will at best adhere to the recommendations to allocate the minimal ICT and related resource for music teaching (Lee, 2006 & 2008).

Given resources and the related circumstantial factors have profound influence on ICT integration in teaching and learning, these two issues must be duly attended to and addressed by the school management of individual schools when realizing ICT integration. Besides, while allowing autonomy to schools in the curriculum implementation, the EDB might still need to consider issuing some mandatory administrative directives to assure appropriate and reasonable resources allocation and logistic arrangements so that ICT integration in music teaching and learning at the school level can actually be substantiated.

Furthermore, on the one hand, the realisation of ICT integration in music teaching and learning is fundamentally dependent on the resources and other circumstantial factors. On the other hand, music teachers' IT competency is equally important. As reported in the literature, lack of expertise and confidence was identified as one of the main reasons for music teachers not using ICT in teaching. In addition, the course content and the format of in-service and pre-service technology training that music teachers had attended were unable to address the actual needs of considerable number of teachers and to provide them with sufficient confidence in using technology in their teaching. These observations suggested that whether music teachers will employ ICT in their teaching or not is dependent largely on their technology competency which is directly connected with training. Given the significance of the teacher's role in ICT integration, issues related to music teachers' technology competence and the professional development for music teachers has emerged as another important factor linked with the successful ICT integration in music education.

In Hong Kong, from a pragmatic perspective, the provision of IT training for music teachers by the EDB as a whole was practically adequate in terms of quantity and content (Lee, 2006 & 2010). Nevertheless, it is still the responsibility of the EDB to maintain a continuous provision of sufficient amount of both level- and content-appropriate training places for music teachers to ensure that frontline practitioners are adequately equipped with the most up-to-date knowledge and skills required for ICT integration.

About the Author

Dr. Barry Kwok-yeung Lee, is currently Senior Teaching Fellow in the Department of Early Childhood Education at the Hong Kong Institute of Education. Dr. Lee earned his PhD in ICT in Music Education from Deakin University, an MA(Mus) from Hong Kong Baptist University, an MEd from Chinese University of Hong Kong, a BPhil(Ed) from University of Birmingham, and a PGCert(Computing) from City University of Hong Kong. His main research areas include ICT/music technology in music education; music education for young children; and technology education in early childhood education.

Dr. Lee has been enthusiastic in the development of school band music education in the past

two decades. He was band director of a number of primary and secondary schools in Hong Kong, Chairman of the Hong Kong Band Directors Association (HKBDA), Deputy President of the Asia & Pacific Band Directors Association (APBDA), Honary Director of the Beijing Band Association, and Secretary-General of the Hong Kong Association for Music Educators (HAME). At present, Dr. Lee is the Hon. Treasurer of the Hong Kong Association for Music Educators.

References

Abril, C. R., & Frego, R. J. D. (2003). The Examination of Curriculum Content in Undergraduate Elementary Methods Courses. *Contributions to Music Education, 30* (1), 9-22.

Altiere, L. (1997). Technology-Rich Teaching. *Teaching Music*, *4*(2), 30-32.

Armstrong, M. (2004). Using the Web to Teach Middle School General Music. *Teaching Music*, *11*(3), 24-28.

Association for Technology in Music Instruction. (2004). *ATMI Technology Directory*. Retrieved July 4, 2004, from http://atmionline.org/ATMI/index_dir_search.htm

Australian Capital Territory. (1994). *The Arts Curriculum Framework*. Canberra: Department of Education and Training, Author.

BECTA. (2003). Entitlement to ICT in primary music. In *BECTA—ICT Advice*. Retrieved July 4, 2004, from http://www.ictadvice.org.uk/downloads/entitlement_doc/entitle_music_prim.doc

Bissell, P. M. (1998). Tune in to technology. *Music Educators Journal*, *85*(2), 36-41.

Board of Studies - New South Wales. (2000). *Creative Arts K-6 Syllabus.* Sydney: Author.

Bustard, J. (1997). Technology-Rich Teaching. *Teaching Music*, *4*(2), 30-32.

Carr, E. (1997). Technology-Rich Teaching. *Teaching Music*, *4*(2), 30-32.

Casey, A. C. (2005). A Learning-Center Solution for Using Technology in Elementary Music. *Teaching Music*, *12*(4), 50-52.

Cheung-Yung, W. Y. J., & Yip, L. C. R. (2004). The Implementation of Information Technology Policy in Hong Kong School Music Teaching and Learning. In D. Forrest (Ed.), *The Puerto Papers* (pp. 30-41). Nedlands, Western Australia: International Society for Music Education.

Department of Education and Training, Western Australia (2005). *Outcomes and Standards Framework – The Arts*. Perth: Author.

Education and Manpower Bureau, Hong Kong. (2003). *Music Curriculum Guide (Primary 1 – Secondary 3)*. Hong Kong: Author.

Ellis, P. (1995). Designing Sound: Developing Computer Support for Creativity in Music Education. *Research Studies in Music Education*, *5*, 11-23.

Farnham, A. (1998). Leading Class Activities. *Technology-Based Music Instruction - University of Illinois at Urbana-Champaign, Examples in General Music*. Retrieved April 24, 1998, from http://camil40.music.uiuc.edu/tbmi/examples/general/teachers/farnham/leading/leading.htm

Farnham, A. (2004). Technology in Music Classroom. *MusicStaff.COM, Teacher Lounge – Music Technology.* Retrieved February 22, 2004, from http://www.musicstaff.com/lounge/article13.asp

Feldstein, S. (2001). Music Education and Techonology: Past, Present and Future. *Teaching Music*, *9*(3), 26-30.

Folkestad, G., Lindstrom, B., & Hargreaves, D. J. (1997). Young People's Music in the Digital Age A study of computer based creative music making. *Research Studies in Music Education*, *9*, 1-12.
Forest, J. (1995). Music technology helps students succeed. *Music Educators Journal*, *81*(5), 35-40.
Haldey, O. (1996). Technology and Education: Teaching Music of the World. *Australian Journal of Music Education*, *1*, 23-27.
Hickey, M. (1997). The Computer as a Tool in Creative Music Making. *Research Studies in Music Education*, *8*, 56-70.
Ho, W. C. (2004). Use of information technology and music learning in the search for quality education. *British Journal of Educational Technology*, *35*(1), 57-67.
Hrycay, K. (2002). Bytes for Your Music Room. *Canadian Music Educator*, *43*(3), 33-34.
Kassner, K. (2000). One computer can deliver whole-class instruction. *Music Educators Journal*, *86*(6), 34-40.
Kersten, F. (2004). Using MIDI Accompaniments for Music Learning at School and at Home. *Music Educators Journal*, *90*(4), 44-49.
Langol, S. (1998). A Groove Tools for School. *Music & Computers*, *4*(3), 73-74.
Lemansky, J. (1992). The Traditional Rebel. *The Computing Teacher*, *20*(4), 28-29.
Lee, B. K. (2006). The Application of Information Technology into Primary School Music Education in Hong Kong—A Contextual Analysis. In M. Moore & B. W. Leung (Eds.), *School Music and Teacher Education, A Global Perspective in the New Century* (pp. 122-134). Hong Kong: International Society for Music Education.
Lee, B. K. (2008). *Implementation of ICTs in primary music education in Hong Kong.* Unpublished doctoral thesis, Deakin University.
Lee, B. K. (2010). ICT integration in Primary School Music Education in Hong Kong－Professional Development for Music Teacher: A Contextual Analysis. *Proceedings of ICER 2010 International Conference on Education Research: Learning Community for Sustainable Development* (pp. 121-127). Khon Kaen, Thailand.
Leong, S. (1995). Music Technology Competency and Effective Teacher Preparation. *Australian Journal of Music Education*, *1*, 21-25.
Leong, T. N. (2004). Using Technology as a Vehicle to Enhance Musical Performance. *Canadian Music Educator*, *46*(1), 30-33.
Merrick, B. (1995). The Use of Music Technology in the N.S.W. High School Teacher Perspectives and Curriculum Directions. *Honing the Craft: Improving the Quality of Music Education—Proceedings of the 10th National Conference of the Australian Society for Music Education* (pp. 192-197). Hobart,Tasimania: Artemis Publishing.
Merrick, B. (1998). Music Technology in the New Millennium: Issue for Consideration in Tertiary Training Programs. *Music Education Research & Development for a New Millennium—Proceedings of the XX Conference of the Australian Association for Research in Music Education (AARME)* (pp, 34-43). Sydney: AARME.
Music Educators National Conference. (1999). *Opportunity-to-learn standards for music technology*. Reston, VA, Author.
National Curriculum Online. (2005). *National Curriculum for England—Program of Study for Music.* Retrieved May 27, 2005, from http://www.nc.uk.net/webdav/servlet/XRM?Page/@id=6004&Subject/@id=3871&Session/@id=D_AwbAtOWSMoAsiYrg8HdR
NCET. (1997a). *The Music IT Pack, National Council for Educational Technology.* Coventry: Author.
NCET. (1997b). Guide 2—A computer system for the music classroom. *The Music IT Pack, National Council for Educational Technology.* Coventry, Author.

Northern Territory Government. (2002). *Northern Territory Curriculum Framework*, Department of Employment, Education and Training. Darwin: Author.
Pierce, B. D. (1998). Creativity in the Music Curriculum. *Music & Computers*, *4*(2), 71-72.
Reese, S. (1995). MIDI-assisted Composing in Your Classroom. *Music Educators Journal*, *81*(4), 37-40.
Reese, S. (2001). Tools for thinking in sound. *Music Educators Journal*, *88*(1), 42-46,53.
Reese, S., & Rimington, J. (2000). Music Technology in Illinois Public Schools. *Update: Applications of Research in Music Education*, *18*(2), 27-32.
Renfrow, K. (1995). Keyboard for kids. *American Music Teacher*, *45*(3), 44-45.
Reninger, R. D. (2000). Music Education in a Digital World. *Teaching Music*, *8*(1), 24-31.
Roblyer, M. D., & Edwards, J. (2000). *Integrating education technology in teaching.* New Jersey: Prentice-Hall.
Roulston, K. J. (1995). One Computer – 700 Students: A Suggestion for Use of Computer Technology in the Primary School. *Australian Journal of Music Education*, *1*, 27-30.
Rudolph, T. (Ed.) (1997). *Technology strategies for music education.* Wyncote, Pa.: Technology Institute for Music Educators.
Siegel, J. (2004). How One Class with One Computer Composed Music. *Teaching Music*, *11*(5), 44-48.
State of Queensland. (2002). *The Arts Years 1 to 10 Syllabus, Queensland School Curriculum Council*. Queensland: Author.
Stevens, R. S. (1996). The Performing Arts. In P. C. Clarkson & R. Toomey (Eds.), *Computers Across the Secondary Curriculum: A Review of Research* (pp. 183-207). Melbourne: Deakin University Press.
Victorian Curriculum and Assessment Authority. (2001). *The Curriculum and Standards Framework II Online.* Retrieved June 22, 2005, from http://csf.vcaa.vic.edu.au/ar/ksar.htm
Webster, P. (1998). Young Children and Music Technology. *Research Studies in Music Education*, *11*, 61-76.
Webster, P. (2002). Historical Perspectives on Technology and Music. *Music Educators Journal*, *89*(1), 38-44.
Woody, R. H., & Fredrickson, J. M. (2000). A partnership project: Integrating computer technology and Orff-Schulwerk. *General Music Today*, *13*(2), 8-11.

Asia-Pacific Journal for Arts Education

Prof. Robert WALKER	University of New South Wales	Australia
Prof. Peter WEBSTER	Northwestern University	USA
Prof. Jacqueline WIGGINS	Oakland University	USA
Prof. Jiaxing XIE	China Conservatory of Music	China