Arts Education Policy Review

ISSN: 1063-2913 (Print) 1940-4395 (Online) Journal homepage: http://www.tandfonline.com/loi/vaep20

Music Plus Music Integration: A model for music education policy reform that reflects the evolution and success of arts integration practices in 21st century American public schools

Lawrence Scripp & Josh Gilbert

To cite this article: Lawrence Scripp & Josh Gilbert (2016) Music Plus Music Integration: A model for music education policy reform that reflects the evolution and success of arts integration practices in 21st century American public schools, Arts Education Policy Review, 117:4, 186-202

To link to this article: http://dx.doi.org/10.1080/10632913.2016.1211923

Published online: 26 Sep 2016.

ARTS EDUCATION POLICY REVIEW
2016, VOL. 117, NO. 4, 186–202
http://dx.doi.org/10.1080/10632913.2016.1211923

Routledge
Taylor & Francis Group

Music Plus Music Integration: A model for music education policy reform that reflects the evolution and success of arts integration practices in 21st century American public schools

Lawrence Scripp[a,b] and Josh Gilbert[a,b]

[a]New England Conservatory, Boston, Massachusetts, USA; [b]Center for Music and the Arts in Education, Boston, Massachusetts, USA

ABSTRACT

This article explores the special case of integrative teaching and learning in music as a model for 21st century music education policy reform based on the principles that have evolved out of arts integration research and practices over the past century and informed by the recent rising tide of evidence of music's impact on brain capacity and cognitive skill development. Rather than taking sides in a contentious and unproductive debate between the value of music education for its own sake versus support for music integration as a means for enhancing learning in other disciplines, the authors believe that the Music Plus Music Integration (M+MI) framework now resolves this false dilemma that has limited the evolution of music education school policy over the past two decades. Examples of curricular frameworks, teaching practices, and research findings from several research-based Music and Arts Plus Arts Integration initiatives in elementary and middle schools make clear the ways in which the underlying principle of *differentiation and synthesis* serves as an effective strategy for optimizing learning in artistic and academic domains and also benefits the entire 21st century school community in and through the study of music.

KEYWORDS

Academic achievement; arts in education; brain development; music and arts integration; music education

After almost a century of emergent examples of arts integration teaching practices (Burnaford, Brown, Doherty, & McLaughlin, 2007, p. 1), today school administrators and both arts and classroom educators increasingly subscribe to the view that discipline-specific teaching and learning can be optimized through arts and arts integration practices. A growing consensus has evolved that various kinds of arts integration teaching and professional development programs are positively linked to improved student learning (Burnaford et al., 2007; Deasy, 2002; Catterall, Chapleau, & Iwanaga, 1999; Catterall & Waldorf, 1999; Gardiner, 2000) and innovative teaching practices (Burnaford, Aprill, & Weiss, 2001; Burnaford et al., 2007; Rabkin & Redmond, 2004). Consequently, arts integration has been acknowledged widely as a highly effective tool for school improvement (Mishook & Kornhaber, 2006; Noblit, Corbett, Wilson, & McKinney, 2009).

However, despite the reported successes of arts integration programs in schools, its philosophy and practices are met with fierce resistance from music educators who:

1. Have adopted the "purist " perspective that music should only be taught for its own sake;
2. Do not see the merit of teaching music in collaboration with classroom teachers (or teaching artists) not officially qualified to teach music;
3. Remain skeptical of the claims of arts integration advocates that music can or should be used as a means for learning transfer across discipline boundaries;
4. Cannot imagine overworked and beleaguered music teachers taking the time to dilute their teaching of music in order to serve learning in other subject areas (Freyberger, 1985; Gee, 2003).

The authors contend that these points of resistance are the consequence of a false dilemma. In the Music Plus Music Integration (M+MI) framework, music learning serves *both* "for its own sake" *and* "as a means of enhancing learning in other disciplines." Advocates for this type of integration recommend a framework for music education innovation that features authentic, comprehensive, and interdisciplinary approaches to teaching and assessing musical literacy skills. This approach stresses an integration with math and language that is dependent on discipline-specific learning as part of a continuum of arts, academic, and social learning

CONTACT Lawrence Scripp larry.scripp@necmusic.edu New England Conservatory, 290 Huntington Avenue, Boston, MA 02115, USA.
Color versions of one or more of the figures in the article can be accessed online at www.tandfonline.com/vaep.

(Barrett, McCoy, & Veblen, 1997; Myers & Scripp, 2007; Scripp, 2002; Scripp, 2007; Scripp & Paradis, 2014; Scripp & Reider, 2007; Scripp & Subotnik, 2003; Scripp, Ulibarri, & Flax, 2013; Scripp, Ulibarri, Southerland, Gilbert, & Sienkeiwicz, 2014).

What is music's essential contribution to 21st century schools?

Challenges are growing for music educators at a time when schools are increasingly held accountable for academic performance in the context of standardized tests and new national standards. While music education remains the most prevalent form of arts education in American schools (United States Census Bureau 2010[1]), and remains the primary focus of research on the impact of arts learning on brain capacity and cognitive development (Hodges & O'Connell, 2005), music specialists in public schools are limited by not having enough time or resources to (a) provide ongoing intensive music instruction for students, (b) document or assesses individual student music learning outcomes, or (c) take on professional development or leadership roles outside of narrowly focused performance ensemble rehearsal or classroom general music instruction.

Because no rigorous certification requirements or policies at present exist for hiring music teachers as highly qualified "music integration specialists," the field is open to ad hoc standards of music integration. Therefore, music teachers who cling to the "essentialist" or "purist" position that music should only be taught for its own sake remain reluctant to take responsibility for teaching and learning outside of narrowly defined standards for musical performance training. Furthermore, with the newly formulated National Coalition for Core Arts Standards (NCCAS[2]) in place, music educators are challenged to create far more highly diversified programs that are accountable to "artistic literacy process" standards for formulating and assessing student work in most public schools, without any additional time allotted for instruction required to meet the new standards. However, whereas *music* teachers continue to distance themselves from research suggesting the positive extra-musical effects of music because they do not want to be accountable for school academic performance, *classroom* teachers today are more likely than ever to welcome music into their classroom, believing that music integration substantially improves teaching, student engagement, and overall school performance. Therefore, there is a growing need for 21st century music teachers trained to provide more diverse forms of musical instruction, to contribute to a school-wide music-infused interdisciplinary curriculum, and to provide professional development for teachers to take responsibility for authentic arts integration projects and lessons design to enhance both music and academic student learning (Burnaford et al., 2007; Mishook & Kornhaber, 2006).

Bringing music and arts integration organizations together: The Music-in-Education National Consortium's Learning Laboratory School research project

Anticipating the complexities of advancing music's essential role in 21st century education, the Music-in-Education National Consortium (MIENC[3]) founding members first met in 2000 to discuss the challenge of adapting the principles and best practices of arts integration in order to create and evaluate a network of school-based M+MI programs. For the next 8 years, the consortium attracted major funding[4] to conduct collaborative field research for the purposes of exploring the challenges of resolving the false dilemma of pitting music instruction "for its own sake" against music instruction "for the sake of learning in other disciplines." The MIENC adopted two complementary perspectives in its mission to put music at the core of the public school curriculum: (a) the value of authentic and comprehensive study of music for its own sake and (b) the contribution of music and musical concepts, skills, and processes to teaching and learning in other areas, including academic subjects, other art forms, and social–emotional development (Bamberger, 2000; Scripp, 2000a).

In order to establish consensus on the mission and goals of its national laboratory school network, the MIENC formulated ten guiding principles (see Table 1) for employing and evaluating innovative Music-in-Education practices (including those that were eventually deemed M+MI programs) as a strategy for arts learning–based school reform partnerships. The consortium members believe that music has never achieved its full potential as a core element of school curriculum because of a lack of understanding of how music instruction and music integration practices together benefit whole-school performance. Citing best practices and evidence from MIENC research, several themes have surfaced that can now be considered the building blocks for future policies for music and arts integration practices. Results reported at the conclusion of the project (Scripp, Keppel, & Wong, 2010) articulated the importance of establishing a new consensus regarding (a) indicators of high quality music integration teaching and learning practices, (b) professional development standards for classroom, music specialists, and music teaching artists, (c) strategies for meeting the new challenges of shared leadership and collaborative practice, and (d) the employment of

Table 1. The Ten Guiding Principles developed by the MIENC Leadership Council that directed the development of higher education, arts organization, and school partnerships participating in the MIENC's Learning Laboratory School Network Project (2001–2008) (condensed from Scripp, 2003a, p. 5)

- **Principle 1**: *Re-forming Educational Practice*
  Optimize the capacity of all children to learn by rethinking the essential role of music-in-education.
- **Principle 2**: *Site-Based Change*
  In order to be effective, music-in-education must be understood in the context of a particular school's evolution.
- **Principle 3**: *Differentiation and Synthesis*
  A genuine and comprehensive music program assumes its full educational power through the tension between music as a distinct subject area and as part of a curriculum integrated with other subject areas.
- **Principle 4**: *School and Its Community*
  Music-in-education changes the culture of a school by invoking the school and its community as agents of change.
- **Principle 5**: *Diverse Strategies for Teaching and Learning*
  Diverse strategies for implementation of music-in-education practices are a way to improve the music and music-integrated teaching and learning throughout the school.
- **Principle 6**: *Musicians' Role in Society*
  Teaching experiences and mentorships are essential to developing musicians as artists, teacher, scholars, and citizens, and critical to his/her success as a practitioner and a contributor to society.
- **Principle 7**: *Equity and High Expectations*
  The compelling nature of music creates opportunities for teachers to provide equitable access to learning while sustaining high expectations for all students.
- **Principle 8**: *Reflective Practice*
  Teachers and musicians build their capacities as practitioners through scholarship of teaching that involves documenting, analyzing, and sharing both their own work and evidence of student learning.
- **Principle 9**: *Participation in Professional Community*
  The creation and expansion of professional networks generate discourse, share practices, develop new inquiry, and further research as an ongoing extension of the music-in-education process.
- **Principle 10**: *Diverse Assessment Strategies*
  Commitment to developing, documenting, and disseminating multiple assessment strategies of music-in-education programs to illuminate the complexity and scope of teaching and learning processes, redefine ideas of program quality, and address various audiences and purpose through new technologies.

both formal M+MI teaching frameworks and rigorous music literacy skills assessments across the school curriculum.

Music Plus Music Integration as a strategic priority for 21st century arts-based school reform[5]

By adopting these 10 principles, MIENC members believe that:

> choosing music as a strategic priority for arts-based school reform does not imply music is a preeminent form of arts learning, but rather that music can serve as an effective entry point for the eventual incorporation of multiple art forms into a school's academic professional development, curriculum, and assessment practices. (Myers & Scripp, 2007, p. 382)

MIENC laboratory schools that effectively incorporated authentic, comprehensive, and interdisciplinary music programs as a strategic component of arts-based school reform found that effective music integration units depended on adherence to standards-based music learning outcomes and on rigorous standards of music-integrated instruction, documentation, and assessment practices. Thus, high standards of authentic music and arts integration practices must focus first on teaching music *musically*, in order to foster the kind of creative, cognitive, and sociopersonal skills that students will need to discover and express meaning as they build deeper conceptual understanding of the authentic interdisciplinary connections that occur in high-quality music integration teaching and learning.

The principle of "differentiation and synthesis" as the foundation for Music Plus Music Integration prototype programs

For MIENC members, the generative principle of "differentiation and synthesis" in teaching and learning served as a primary guideline for understanding how "a genuine, comprehensive, and interdisciplinary music program assumes its full power in education through the dynamic tension between music as a distinct, authentic subject area, and as part of a rich curriculum integrated with other subject areas" (Scripp, 2003a, p. 5).

As depicted in the "Differentiation and Synthesis" Matrix (Figure 1), categorically different policy implications exist for music education programs depending on their focus. The top-left quadrant, for example, represents a school policy without any music or music integration in the school curriculum. In this deprived circumstance, only those students with a *family* policy of providing music education outside of the school will benefit from music education. This policy of omission, whether intentional or not, can only be construed as regarding music as *unessential* to the education of the 21st century child.

The top-right and the bottom-left quadrants depict music and music integration as two competing aspects of the music-in-education curriculum (respectively) that may be implemented at relatively lower or higher levels of intensity. The mutually exclusive levels of these two types of programs occur when school communities segregate the focus of their music programs by type and intensity, such that the music program either (a) provides a sequential education in music for all children, while ignoring its contribution to learning across the curriculum or (b) provides strong emphasis on music integration to the point of ignoring the need for a significant music instruction for all children. In addition, the authors contend that conventional music education policies currently only support low-intensity levels of sequential music

	Music Instruction "For Its Own Sake" NOT Provided (as a separate subject or domain)	Music Explicitly Taught And Assessed "For Its Own Sake" (as a separate subject or domain)
Music Integration "For The Sake Of Learning Across The Curriculum" NOT Provided (as a method for connecting learning one subject or domain to another)	Schools that do not provide authentic music instruction or music integration across the curriculum to all of their students by policy regard music as an unessential element of 21st Century education.	Baseline Level Music Instruction: Optional music instruction by music specialists averaging 90 minutes a week (current conventional policy in U.S Elementary schools). High Level Music Instruction: Required classes for all children in comprehensive music curriculum and required home practice totaling 6-8 hours a week (typical policy for those families and schools who support high intensity music education).
Music Integration Explicitly Taught and Assessed "For The Sake Of Learning Across The Curriculum" (as a method for connecting learning one subject or domain to another)	Baseline Level Music Integration Program: At least one thematic or interdisciplinary project per year taking at least 5 days of instructional time. High Level Music Integration Program: Required participation in long-term music integration units. At least one music integration unit per week, 20 weeks a year.	Baseline Level Music PLUS Music Integration: A combination of minimal standards of music instruction and superficial music integration programs. High Level Music PLUS Music Integration: A combination of high quality music instruction and substantial music integration programs that meet high standards of authenticity and comprehensiveness within or across disciplines.

Figure 1. Music Education "Differentiation and Synthesis" Policy Matrix: A four-way matrix designed to map the focus, scope, and intensity of music and music integration programs from the viewpoint of differentiation (music studied as a separate discipline) and synthesis (music as interdisciplinary cognition) and the combination of both in Music PLUS Music Integration programs (adapted from Scripp, 2003a).

instruction (i.e., 90 or less minutes of instruction per week), thereby severely limiting the potential for any child to receive a meaningful or equitable education.

From the MIENC perspective, music educators and policymakers must make clear that only when music *and* music integration programs are taught at high levels of design and high intensity implementation can they succeed on their own terms. That is, sequential music instruction succeeds only when sufficient time (i.e., 6–8 hours a week) is allotted for instruction, guided practice, and ensemble experiences that include a wide range of musical literacy skills (Scripp, Ulibarri, & Flax, 2013). Music integration without attention to significant musical skill development will succeed only as a relatively superficial way to explore curricular connections, even under the best of circumstances.

The bottom-right quadrant of the matrix, therefore, illustrates a clear and powerful synthesis that preserves music in the curriculum as a separate discipline learned by virtue of its own language and literature. This subject area remains inextricably linked to symbol systems, concepts, and cognitive and meta-cognitive skills in other areas of the curriculum, including other forms of arts learning, aesthetic experience, and social–emotional development. This "dynamic tension" between music as a distinct, authentic subject area and as an inextricable component of learning in other subject areas is best represented by the philosophy and practice of Music Plus

Music Integration. M+MI programs in the consortium succeeded when music was taught by fully qualified music specialists, in conjunction with teaching artists and classroom teachers, all focused respectively on its integration with other areas of the curriculum. To ensure music's contribution to cognitive development across the curriculum, high-level M+MI practices required the guidance of classroom generalists, teaching artists, and music specialists willing to see "teaching for learning transfer" as an optimization of both music and music-integrated teaching and learning (Scripp, 2002).

In sum, the principle of "differentiation and synthesis" makes clear music's essential contribution to 21st century education, both by establishing its integrity as a separate domain and by demonstrating the validity by which its concepts and processes can be studied in relation to other disciplines. The dynamic tension of "differentiation and synthesis" helps students to understand these connections through a guided process of interactive interdisciplinary experience, inquiry investigation, and reflection (Hope, 2000, 2003). From this viewpoint, for example, rhythm in music is understood more deeply and authentically by building knowledge of the principles of proportion in both visual art or mathematics, just as the principles of mathematical ratios or visual design are understood more deeply through experiencing musical rhythm and form. Similarly, the grasp of musical notation requires an acknowledgment of its explicit connection to mathematical coordinate systems, as the conception of temporal and spatial coordinates will benefit greatly from analysis of melodic patterns in music.

With the principle of "differentiation and synthesis" in mind as the basis for 21st century music education policy, music learning flourishes upon its integration with other subject areas and becomes an optimal condition for ensuring that all students learn fundamental concepts and processes shared between music and other domains. Likewise, a comprehensive understanding of music itself depends on awareness of fundamental concepts and processes that are shared with other subject areas. As a result of this mutually reinforcing method of integrative teaching and learning, M+MI policies put music at the core of the 21st century curriculum, thereby establishing a strategy for education policy reform.

From the viewpoint that Music Plus Music Integration can provide a blueprint for the evolution of music education policy, the MIENC member organizations believe that a commitment to high-intensity M+MI practices will require support from public education stakeholders well informed about (a) the neurological underpinnings of music and its impact on the brain, (b) research that demonstrates the connection between expanded brain capacities triggered by musical training and cognitive skill development, and (c) field examples of innovative teaching and learning practices that demonstrate the practical application and benefits of M+MI as a strategy for optimizing performance and a culture of equity in K–8 schools.

A chain of evidence: Music learning and its link to brain development, cognition, and, by extension, music learning connections across disciplines

Studies published over the past 15 years constitute a chain of interconnected evidence that explains the way every child's engagement with musical experience and training expands brain capacity for cognitive development and for learning in other disciplines. When research studies are organized from the viewpoint of music as a discrete discipline, inextricably defined by its synthesis with other forms of learning, the six links in this chain of evidence make the case for M+MI as the basis for the optimization of music teaching and learning, confirming its essential contribution to 21st century general education by way of its integration with other subject areas:

Link 1: The human brain is predisposed to musical development.

Link 2: Musical experience, unlike anything else, engages the entire brain.

Link 3: Musical training changes the structure, function, and growth of the brain.

Link 4: Musical training builds brain capacity directly related to cognitive functions that underlie mental processing in various domains.

Link 5: Musical training is highly associated with learning outcomes in other disciplines.

Link 6: School-based M+MI programs demonstrate an increasingly strong association between teacher professional development, arts learning, academic achievement, and positive school culture over time.

In the following pages, the six links are described with specific reference to accumulating evidence that music skill development optimizes learning across disciplines in ways that argue for Music Plus Music Integration—and by extension Arts Plus Arts Integration—program development as an essential contribution to 21st century music and arts education policy.

Link 1: Evidence that the human brain is predisposed to musical development

> Music isn't something we as a species do by choice—it is ingrained in our auditory, cognitive, and motor functions, and is implicit in the way we construct our sonic landscape. (Ball, 2010, p. 5)

In its essence, music is a fundamental component of normal human development available to all children. Musical response, perception, emotion, and skill development, as described in *The Music Instinct* by Philip Ball (2010), for example, provide a vivid description of the scientific discoveries of a universal neurological predisposition for music that allows virtually everyone to respond to music in regardless of culture or environment.

This baseline predisposition is bolstered by evidence from ultrasound images of fetal tissue demonstrating that "there is a selective response to familiar songs even before birth" (Mannes, 2011, p. 46) and that—if parents provide active music participation starting between six and twelve months of age—children will invariably learn scale structure, showing that musical experience plays a pivotal role in early brain development (Mannes, 2011, p. 47). Some researchers now theorize that all humans have the inborn capacity for "perfect pitch" (long-term pitch memory, as indicated by the ability to identify discrete musical pitches), although we are likely to lose it if we do not speak a tonal language such as Mandarin (Levitin, 2006). Furthermore, research on the myths and misconceptions of innate talent for music show that the ability to develop significant musical expertise through deep practice, as in any complex domain, appears to be the birthright of all children (Coyle, 2009; Scripp, Ulibarri, & Flax, 2013; Shenk, 2011).

Link 2: Evidence that musical experience, unlike anything else, engages the entire brain

> Researchers used to think that there was a kind of music center in the brain. Today they realize that the whole brain is a music center. Indeed, music probably uses more areas of the brain than any other function. (Mannes, 2011, p. 33)

By virtue of its expression and experience, music stands alone as the most comprehensive form of engaging the brain. By illuminating the comprehensive impact of complex music activities on brain functions, educators and parents can see the sheer extent to which music engages centers of the brain associated with cognitive functions involved in processing language, math, emotion, and aesthetic response. Neuroscientist Robert Zatorre argues emphatically that, "there isn't a cognitive function that doesn't somehow pertain to music. People have realized that music really does serve as a gateway into understanding human cognition" (Mannes, 2011, p. 33). From Ball's (2010) perspective, "no other stimulus comparably engages all aspects of our mental apparatus, and compels them to speak with one another: left to right hemisphere, logic to emotion" (p. 241). Neuroscientist Larry Parsons adds a great deal of detail to this claim by testing for brain responses to a large spectrum of musical phenomena: meter, tempo, harmony, rhythm, and melodic patterns, and finds that responses to each feature of music involves different parts of our brains as we perceive and process music (Mannes, 2011, pp. 31–32).

Link 3: Evidence that musical training changes the structure, function, and growth of the brain

> Just as physical exercise changes the shape of the body, so too it seems that musical training alters the brain. (Ball, 2010, p. 248)

Strong evidence exists that early and ongoing music training significantly and permanently impacts all children's brain development. Researchers argue that virtually every moment of productive musical experience and practice will incrementally change the way the brain grows and functions. For example, researchers who measure music's impact on brain activity and growth report that the auditory cortex of professional musicians contains 130% more gray matter, 102% more activity in their auditory cortex than in non-musicians, and amateur musicians have 37% more activity in their brains on average than those who did not play an instrument (Mannes, 2011, pp. 73–74). These are impressive figures, because increases in brain growth in the auditory processing areas can be causally linked with levels of musical training.

Differences in brain capacities between musicians and non-musicians go beyond the expected areas of auditory processing in the brain. Zatorre found that the frontal regions (which process higher-order thinking) have dense connections with auditory regions and are important in linking sounds with motor and hand actions. He and others have also measured the unusual density and growth of the corpus callosum—where brain tissues connect the two hemispheres—in musicians. Additionally, the corpus callosum is particularly enlarged in the brains of instrumentalists who started musical training at an early age. In a longitudinal study comparing children who learned to play musical instruments to those who did not, the corpus callosum and the motor regions demonstrated changes in the instrumental group that were not evident in the non-instrumental group. Brain measurement data analysis, therefore, provides a causal mechanism for differences between the groups seen in previous studies (Mannes, 2011, pp. 74–75).

Detailed evidence from neurological studies increasingly reveals that brain growth and function underlie cognitive development, and that music has a profound effect on both. Over the past decade, researchers have found that:

- MRI data of keyboard players revealed "significant volumetric differences" in several areas and evidence of plasticity as a result of intensive motor training (Gärtner et al., 2013).
- Early musical training "modifies functional brain structure… and connectivity, especially callosal transfer, motor control/coordination and auditory processing" (Proverbio, Manfreid, Zani, & Adorni, 2013).
- Music-making activities can induce brain plasticity to overcome neurological impairments (Wan & Schlaug, 2013).
- Neural changes accompanying musical training during childhood are retained in adulthood (Skoe & Kraus, 2012).
- "Structural brain changes occur after only 15 months of musical training in early childhood, which were correlated with improvements in musically relevant motor and auditory skills" suggesting that "structural brain differences in adult experts … are likely due to training-induced brain plasticity" (Hyde et al., 2009).
- Early and continuous musical training impacts the growth of the cerebellum, the size of the corpus callosum, and the density of gray matter cells (Hutchinson, Lee, Gaab, & Schlaug, 2003; Lee, Chen, & Schlaug, 2003).

Link 4: Evidence that musical training builds brain capacity directly related to cognitive functions that underlie mental processing in other domains

> Patel believes that there is an overlap in the cognitive processing of language and music—that music and language syntax share neural networks. He argues that despite their many obvious differences in form and function, music and language share deep neural connections. (Mannes, 2011, p. 92–93)

Music's impact on brain development can be linked to emergent cognitive skills functionally associated with many other areas of mental processing. This fascinating array of cognitive capacities include such disparate phenomena as neural timing, increased activity in the executive function regions, brain plasticity, changes in brain activation, such as lateralization that incorporates or coordinates through new regions or pathways of the brain, creation of shared neural networks that support diverse, formerly isolated, brain functions, activation of neurons that fire similarly for externalized and internalized behaviors, and the secretion of glial cells (white matter) that stabilizes and optimizes the acquisition of complex skills (Coyle, 2009). Thus, in a growing web of interconnections, musical training optimizes neurological and cognitive capacities in ways that can eventually enhance learning in other domains:

- Musical expertise uniquely taps and refines a variety of brain networks, including auditory and general cognitive functions (Moreno & Bidelman, 2013).
- Even after only 20 days of training, children in the music group "demonstrated enhanced performance on verbal intelligence tasks that were positively correlated with changes in functional brain plasticity during an executive-function task, demonstrating that transfer of a high-level cognitive skill is possible in early childhood" (Moreno et al., 2011).
- Musical training "affects oscillatory networks in the brain associated with executive functions, and superior executive functioning could enhance learning and performance in many cognitive domains" (Trainor, Shahin, & Roberts, 2009).
- "The neurophysiological mechanisms underlying syntax processing in music and language are developed earlier, and more strongly, in children with musical training" (Jentschke & Koelsch, 2009).
- Music instruction "confers consistent benefits for spatio-temporal reasoning skills" (Črnčec, Wilson, & Prior, 2006).

Link 5: Evidence that musical training is highly associated with learning outcomes in other disciplines

With very strong evidence in place of music's impact on brain development and its link to general cognitive skills, we can finally extend the range of evidence to address music's link to cognitive skills that are also closely related to the foundational skills underlying academic performance.

For instance, Mannes (2011) describes,

> Jentschke compared EEG brain responses to items in a language test administered to children with musical training to those with no music training. He found that the choirboys—those with musical training—performed much better on processing linguistic syntax. That is, their brains reacted more strongly to the incorrect sentences … [and] used a larger number of neurons for this task. (p. 83)

If these kinds of studies can be replicated and findings prove significant, educators possibly could benefit from such "cross-pollination" of music and language skills to help children who are delayed in their language

development, and, perhaps, even help those with language-processing disabilities (Mannes, 2011, pp. 83–84). Aligned with the goals of supporting music for its own sake and for the sake of learning in other domains, Jentschke's studies carry significance beyond science to general education: it is as important that children learn to sing or to play a musical instrument as it is for teachers and parents to become aware of the contribution of music toward training cognitive processes applicable to other areas of learning (Mannes, 2011, p. 84).

- Musical training can provide an effective developmental, educational strategy for all children, including those with language learning impairments (Tierney & Kraus, 2013).
- Instrumental music training may enhance auditory discrimination, fine motor skills, vocabulary, and nonverbal reasoning (Forgeard, Winner, Norton, & Schlaug, 2008).
- Children in the music groups demonstrated an increase in IQ (Schellenberg, 2004).
- Students who report consistent high levels of involvement in instrumental music over the middle and high school years show significantly higher levels of mathematics proficiency by grade 12. This observation holds both generally and also for low SES students as a subgroup. (Catterall et al., 1999)

Therefore, it appears that enhanced brain capacities resulting from intensive musical study clearly can be linked to positive academic performance.

Link 6: Evidence that school-based M+MI programs demonstrate an increasingly strong association between teacher professional development, arts learning, academic achievement, and positive school culture over time

Thus far, an argument has been made for M+MI as a much-needed new direction for music education policy based on the challenge of resolving a philosophical false dilemma that pits an 'essentialist' view against an 'instrumental' view of music education, invoking the learning and making of music as a basic element of human development for all children, and embracing discoveries from the field of neuroscience as a rationale for integrative music teaching and learning. This sixth link explores field research that explores the impact of creating, administering, and evaluating Music Plus Music Integration in 21st century public schools.

The formulation of MIENC's Ten Guiding Principles described previously (see Table 1) defined the basis of the working relationships among higher education schools of music, arts learning organizations, and the network of partnership schools. These guiding principles provided a common focus for the consortium partnering organizations and the annual conferences, and site visitations and monthly conference calls provided ways of sharing practices and monitoring the research agenda. By the end of the project, each MIENC site provided an annual inquiry-based and research-driven framework for program documentation, with multiple diverse yet interlocking strategies meant to develop and make visible the rich, authentic, interdisciplinary, varied, and individualized approaches taken by the partner sites.

At the heart of the consortium work were the M+MI Curricular Frameworks and research reports of pilot programs that led to separately funded longitudinal experimental projects in conjunction with researchers from the Center for Music-in-Education. They eventually yielded qualitative and statistical evidence of the impact of the MIENC's work on student achievement that continued long after the final year of the project.

The following section specifies how M+MI frameworks underlie findings from various studies that directly link music and arts training to academic enhancement with *explicit* attention teaching and assessment strategies related to music and arts integration.

Four guiding frameworks for M+MI program development

Four frameworks now associated with M+MI program development serve as the foundation for a comprehensive musical education in which music learning draws on and contributes to learning in other arts and academic literacies. In this context, music literacy skill development becomes a bridge and leverage point between other disciplines such as math, language arts, other arts, and social–emotional development.

The first framework (Table 2) emphasizes that music requires the learner to simultaneously listen, question, perform, create, and reflect while learning to think, feel, invent, and play musically. These fundamental processes,

Table 2. Music Plus Music Integration Framework 1: Five fundamental learning processes shared between music and other disciplines.

- Listen—*perceive, focus on, observe, describe discriminate, decipher, experience, etc.*
- Question—*inquire, investigate, analyze, hypothesize, test, discover, etc.*
- Create—*invent, improvise, produce, imagine, compose, transform, etc.*
- Perform—*demonstrate, recite, practice, memorize, interpret, master skills, etc.*
- Reflect—*make connections, self assess, goal setting, plan, reconsider, heightened awareness or understanding, etc.*

Adapted from Scripp (2000b, p. 30); Davidson, Claar, & Stampf (2003, pp. 65, 71); Scripp (2007, pp. 205–206).

once internalized in a music education, also can be applied to and deepen basic and applied language arts, math, or even social–emotional skills.

The second framework (Table 3) suggests that the more a student analyzes (differentiation) and can demonstrate understanding (synthesis) of fundamental concepts in music such as rhythm, the better this student is prepared to understand specific principles of rhythm (e.g., proportion, ratio, sequence, pattern), as complements to their applications in mathematics. Similarly, additional principles of rhythm (e.g., phrasing, syntax, fluency, accent, prosody) are analogous to applications in language. Conversely, the more a student understands these shared fundamental concepts in mathematics or linguistics, the better the student is able to understand rhythm in music perception, composition, or performance.

The third framework (Scripp, 2003a, p. 78; Scripp et al., 2010) emphasizes the need for students to learn about their own learning processes and conceptual development in the context of M+MI units. Strategies for meta-cognition ensure that the focus of M+MI curricular and assessment guidelines focus on the teaching and learning principles that are of critical importance to the success and impact of programs in schools: teaching for transfer, flow, social and independent learning, understanding music as interdisciplinary cognition developed through explicit attention to learning transfer, meta-cognitive thinking strategies, and problem solving through the ability to work with multiple symbol systems, representations, and modalities of expression.

The fourth and final framework (Scripp et al., 2010) is about creating a school culture of learning that is most conducive to M+MI principles and practices. Four factors emerged from the Consortium schools' action research based program development methods that succeed best in school and arts learning organization partnerships.

With these M+MI program frameworks in mind, the following case studies represent ongoing research in arts education partnerships and arts integration practices developed over the past decade and a half. Initial qualitative and statistical results have been published in the *Journal for Music-in-Education* (Scripp, Keppel, & Wong, 2007) showing (a) the range of M+MI teaching units, (b) the teacher and student portfolio portraits and profiles, and (c) statistical results made possible by the development and refinement of the Music Literacy Skills Test (MLST[6]), used across all consortium sites to test for the effectiveness of music learning and its relationship to academic learning at each MIENC or MIENC-inspired site.

Table 3. Music Plus Music Integration Framework 2: Fundamental concepts shared between music and other disciplines.

- Language and Music—*words, theme, syntax, dialogue, expression, character, narrative, etc.*
- Math and Music—*number, unit, sequence, patterns, proportion, hierarchy, duration, etc.*
- Science and Music—*measurement, categorization, systems thinking, experimentation, etc.*
- History and Music—*timeline, cultural studies, historical events, figures, etc.*
- Movement and Music—*timing, coordination, expression, etc.*
- Visual Art and Music—*composition, abstraction, color, shape, design, perspective, etc.*
- Digital Media and Music—*composition, tone color, balance, orchestration, multimedia, etc.*
- Social–Emotional Development and Music—*risk taking, empathy, collaboration, pursuit, self-assessment, respect for others, dealing with frustration, delayed gratification, etc.*

Adapted from Scripp (2000b, p. 30); Davidson et al. (2003, pp. 65, 71); Scripp (2007, pp. 205–206).

Illustrations of M+MI principles and practices in action

In the following urban school district case study sites, each arts learning organization school partnership collaborated with the Center for Music-in-Education to demonstrate a deep commitment to developing young students' comprehensive understanding of music and music's inextricable connections to learning in other areas of the school curriculum. These connections place music at an axis point in multiple literacy skill development. That is, musical literacy skills (e.g., performing, reading, composing, analyzing music) are taught to every student and assessed individually in light of shared concepts and processes taught and assessed as part of language, math, arts, or other subjects areas. Although the research and evaluation design vary in scope and comprehensiveness, the principles of investigation for a chain of evidence for strong associations between M+MI curricular design, teacher professional development, student arts learning, and student academic learning is a common focus of each case study site.

MIENC case study site 1: The Conservatory Lab Charter School (CLCS) in Boston (1999–2015)

The prototype MIENC M+MI curriculum and assessment model

The CLCS, conceived in 1997 and initially administered by Scripp and his colleagues at New England Conservatory is a no-audition, open-lottery school that provides free in-school comprehensive music (violin, percussion, keyboard, voice, solfège) and interdisciplinary (i.e., music and arts integration) instruction eight hours a week for all students. It is now recognized as a "proven provider" of preK–8 school excellence by the state of Massachusetts

with respect to its academic achievement, intensive music instruction, and multiple arts integration projects.

At its inception, M+MI (originally called "Learning Through Music") frameworks guided the creation of the program curriculum units. The M+MI Music Matrix (Figure 2), for example, was developed by Scripp to teach simple note pattern melodies and harmonic progressions through the multiple representations and embedded concepts of sequence, order, contour, interval, pitch pattern, and so on, and the coordinate system as a foundation for developing and understanding conventional notation-reading skills and applying these skills to composing or analyzing melodic or harmonic patterns. The number for each beat runs across the x-axis, or time axis, above the lyrics. The notes to be performed fill in the boxes across the matrix in black. This approach allows students to familiarize themselves with the basic concepts of musical literacy, while giving them additional and useful references to mathematics and spatial logic.

CLCS also established a system of accountability to the school's charter by requiring individual assessment of every child's musical development in relation to the M+MI curricular focus. Statistical results have been reported extensively showing that *as both academic and music literacy learning improved, the degree of association between these learning outcomes also increased* (Scripp, 2003b, pp. 123–131; Scripp, 2007, pp. 215–221; Scripp et al., 2013, pp. 82–88).

The importance of the confluence of relationships between music and academic learning outcomes represented in the four quadrants of The "Differentiation and Synthesis" Learning Outcomes Matrix (Figure 3) match the structural elements of the Music Education "Differentiation and Synthesis" Policy Matrix (Figure 1) presented

		Music Learning Outcomes	
		–	+
Academic Performance Outcomes	–	Academic Failure + Music Learning Failure = M+MI FAILURE	Academic Failure + Music Learning Success = M+MI FAILURE of ACADEMIC Learning Transfer
	+	Academic Learning Success + Music Learning Failure = M+MI FAILURE of MUSIC Learning Transfer	Academic Learning Success + Music Learning Success High Positive Correlation* = M+MI SUCCESS of Two-Way Learning Transfer

Figure 3. The M+MI "Differentiation and Synthesis" Learning Outcomes Matrix. *Low or no positive or a negative correlation may constitute Music + Academic Success yet Music Plus Music Integration failure; correlations are considered irrelevant in other quadrants in the matrix.

earlier. The bottom-right quadrant of this matrix specifies that the combination of improving ratings in both academic and music learning outcome *plus* a high positive correlation between these ratings is the best indication that M+MI optimizes learning in both disciplines.

The added feature of intensification of correlation over time predicted by the Optimal Effects Hypothesis (Scripp, 2007, p. 215) (Figure 4) represents a pattern of correlation that would strongly suggest that there is a significant relationship between academic and music literacy skill development that strengthens over time.

This hypothesis was supported by data explicitly showing that averaged academic scores increased according to the years of participation in the M+MI curriculum (Table 4)

That is, the academic achievement ratings table (Table 4) indicates that academic achievement improved

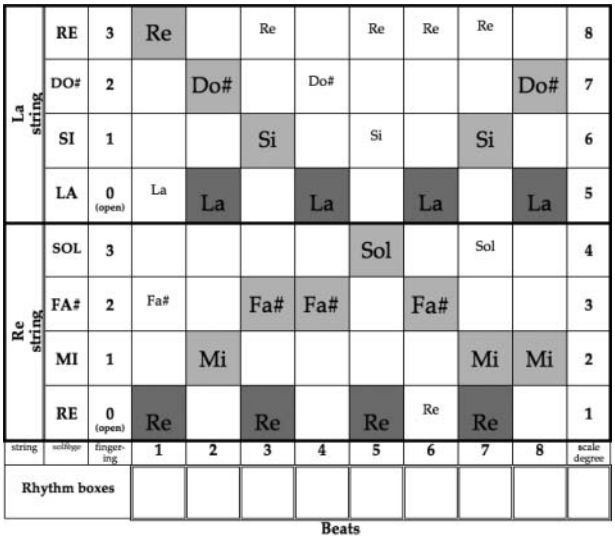


Figure 2. Pachelbel matrix.

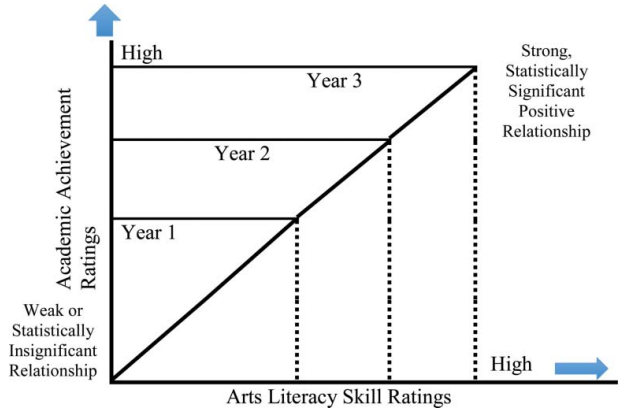


Figure 4. The Optimal Effect hypothesis. The y-axis represents the level of academic achievement, the x-axis reflects arts literacy skill development, and the diagonal line represents the increasing strength and degree of correlation between the previous ratings of musical and academic literacy skills over time.

Table 4. Academic achievement ratings by years attending the CLCS: Percent at or above 50th percentile of Stanford Achievement Ratings.

	Reading		Mathematics	
Students (Spring 2000–2002)	2001 (K–3)	2002 (1–4)	2001 (K–3)	2002 (1–4)
I. All Students at the CLCS continue and progressing 2001–2002 ($n = 68/80$)	55.7	72.1**	47.8	62.3*
II. Students with more than 2 years of M+MI program ($n = 53/60$)	60.4	78.8**	52.8	67.9*
III. Students with 2 or more years of M+MI program who started at K or 1 ($n = 41/60$)	65.9	90.9**	61.0	80.5**

*Statistically significant difference with the previous year $p < .05$.
**Statistically significant difference with the previous year $p < .01$.

in math and reading over time while the two scatterplot data displays in Figure 5 show that the positive degree of correlation between academic and MLST ratings increases according to the years students have participated in the Conservatory Lab School's M+MI program. Taken together, these statistical findings strongly suggest that these relationships can be construed as evidence of causal links between M+MI instruction and academic performance.

More recently, data from the 2014 MLST and the Massachusetts Comprehensive Assessment System (MCAS) revealed an increasing degree of correlation as grade level increased. In other words, in the third grade, there was a small but significant correlation between the MLST and MCAS, and this relationship became stronger and more significant each year through the sixth grade, as indicated in Table 5. As the school has turned to multiple arts integration, rather than exclusive focus on music integration in the school curriculum, musical literacy assessment continues to reveal the impact of intensive music instruction on the cognitive capacities that research has shown supports academic achievement.[7]

Table 5. 2014 correlations between averaged ELA + Math MCAS scores and MLST scores by grade level.

Grade	R^2	*F* Ratio	Prob > *F*
Third	0.16	4.54	0.0435
Fourth	0.26	7.83	0.0105
Fifth	0.32	11.51	0.0023
Sixth	0.34	21.93	0.0001

MIENC case study site 2: The Music Integrated Learning Environment (MILE) Project in Oakland Unified School District in California (2005–2013)

From 2005 to 2013 the Oakland Unified School District (OUSD), informed by the CLCS project in Boston, developed, implemented and researched the MILE Project, in support of early literacy intervention strategies to address school improvement through M+MI professional development, curricular units, instructional practices, portfolio practices, and musical literacy skills tests. After establishing a laboratory site in which the school earned a coveted "California Distinguished School" award substantially for its M+MI program, the OUSD proposed to investigate the impact of the M+MI program dissemination as part of a longitudinal control-treatment school study. The MILE project featured intensive professional learning for music and classroom teachers together. From the beginning, the language of M+MI shared concepts and processes (see Tables 2 and 3) was embedded in the PD materials.

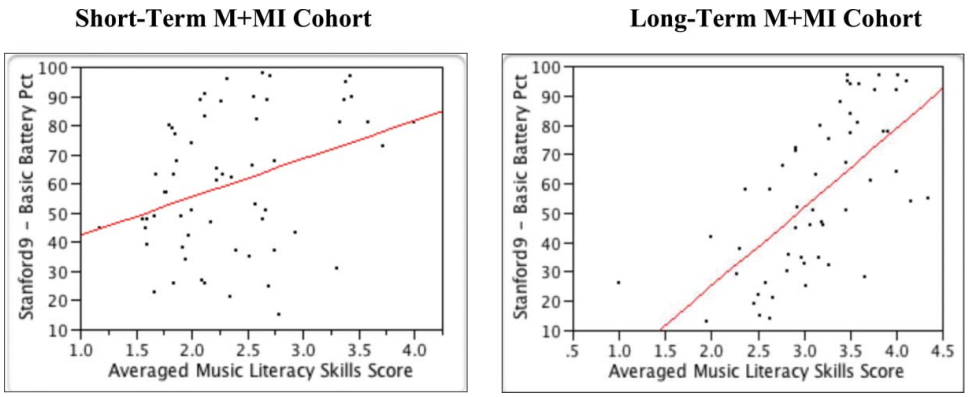
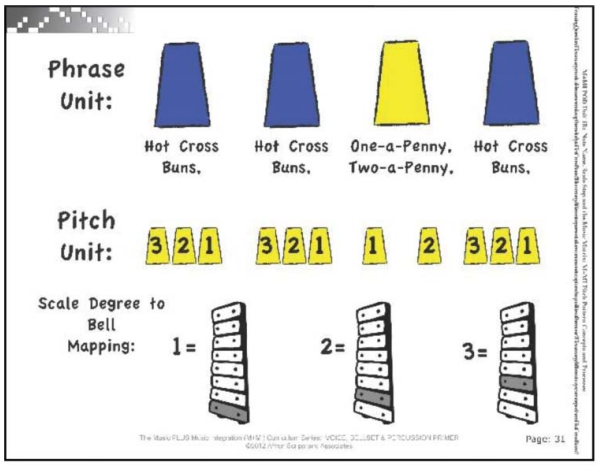


Figure 5. Scatterplot data displays that indicate the impact of long-term M+MI teaching and learning on the degree of correlation between academic and music literacy skills learning outcomes. The scatterplot charts reveal the difference in the relationship between academic and music learning according to short-term (left, less than 2 years) and long-term (right, 2 or more years) receiving M+MI instruction. Note that not only did the music literacy scores improve over time, but that the bivariate fit is highly significant ($r^2 = .43$) compared to the short-term learners ($r^2 = .12$). (See Scripp 2007, pp. 215–221 for more details.)



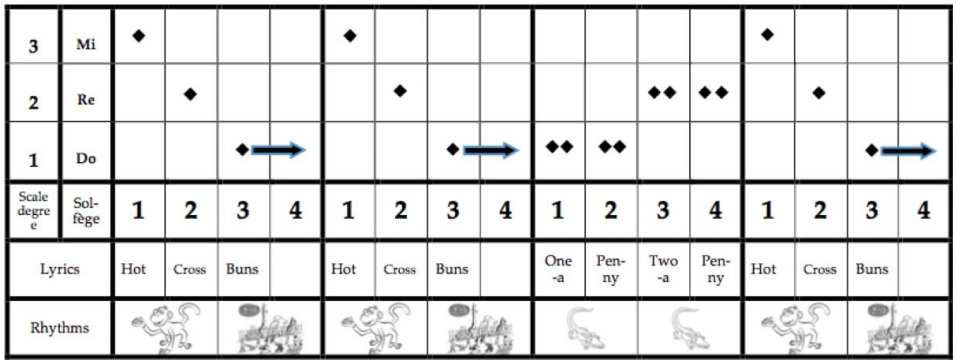


Figure 6. Two music matrices of "Hot Cross Buns": top, concepts of musical form are explored through color; bottom, language and syllables are used to better understand rhythmic content.

Inspired by the CMIE curricular projects and assessments pioneered at the CLCS in Boston, MILE created M+MI curricular projects that focused on the concepts and processes shared between music, math, and language. In the M+MI Handbook developed by the CMIE, MILE students explored two music matrices of "Hot Cross Buns." Figure 6, next page, top, explores concepts of musical form through color, and Figure 6, bottom, utilizes language and syllables as a way to better understand rhythmic content and, by extension, their application to interdisciplinary projects in physics, documented and assessed in the MILE digital portfolio system (Scripp et al., 2014).

Anticipating district-wide assessment of music literacy skills for all schools in the OUSD, MILE combined the MLST classroom assessments with a newly developed MLST large group multiple choice format music perception and notation assessments to provide data to measure the impact of M+MI in both treatment and control schools. The MLST group test also expanded the range of representations of musical patterns to include multiple mathematical and linguistic symbolic configurations to test for student abilities to support learning transfer by applying their knowledge of music in new ways using diverse, analogous representations (Figure 7).

Findings from MILE indicate that, with the advent of professional development programs aimed at fostering M+MI teaching practices and digital portfolio systems to support both MILE music and classroom teachers, treatment school student cohorts outperformed their matched control school cohorts in academic achievement and musical literacy skills (Figure 8) while low-performing MILE school results approached the level of

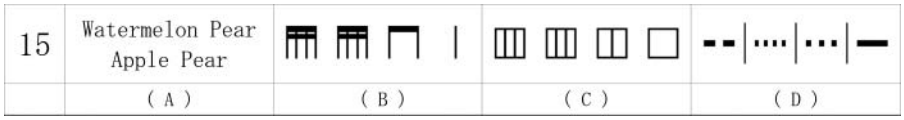


Figure 7. Example from CMIE MLST Group Multiple Choice Test: "Please circle the symbol system display that best matches the clapping pattern you heard."

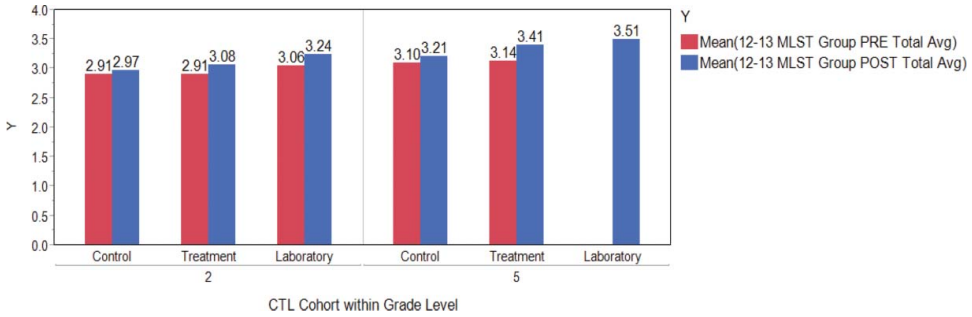


Figure 8. Comparison of pre–post MLST test results in the final year of the MILE project (MILE project year 3 MLST group total average scores, pre and post, by grade level by CTL cohort). Music literacy scores in the M+MI treatment schools were significantly higher in the post test, rivaling the scores of the original MILE laboratory school.

performance of the highest performing laboratory schools that had far more experience with MILE.

MILE schools generally had higher test scores than the control schools, but more significantly, students in the treatment schools also demonstrated a relatively higher degree of association between music learning and academic achievement outcomes. The overall MLST measures in all schools and grade levels combined provide a window on the interrelationship of conventional or M+MI species of music education. Figure 9 displays that the powerful link between musical literacy and combined Reading/Math achievement test scores is hugely statistically significant (ANOVA F Ratio = 243.8; r = .54, $p < .0001$; $n = 606$) and validated by understanding how musical concepts and processes are investigated in the course of music instruction, regardless of the level of influence of M+MI programs.

When comparing the MILE treatment to control schools, the degree of association of MLST to academic performance increases in schools that support M+MI programs (Figure 10). Results show that, when comparing MILE M+MI performance to control schools, the range and strength of statistical correlation to be significantly higher in the treatment schools (ANOVA F Ratio = 80.2; $r = .62$, $p < .0001$; $n = 133$) than in control schools (ANOVA F Ratio = 17.8; $r = .41$ $p < .0001$; $n = 91$), further indicating that adding music integration to conventional music-teaching practices optimizes both music education and its integration across the curriculum.

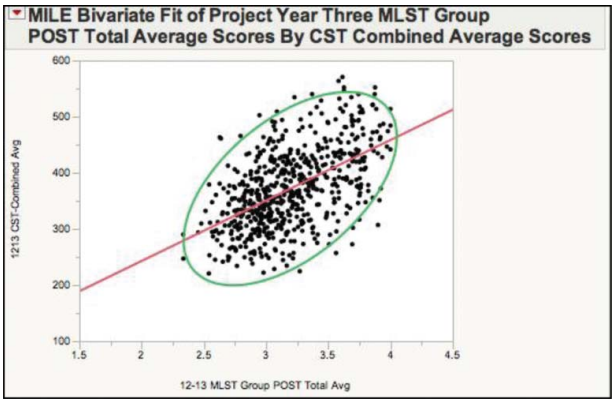


Figure 9. Combined control and treatment school data. ANOVA F Ratio = 243.8; $r = .54$, $p < .0001$; $n = 606$.

The practical significance of MILE can be detected in an analysis of the ways in which the school culture was transformed by MILE teaching and learning practices. Analysis revealed that (a) MILE digital portfolios can demonstrate high quality curriculum units that reveal both the nature and impact of MILE on critical thinking, meta-cognition, and social development, (b) adapted M+MI lessons and assessment instruments can be employed productively in both music and general academic classrooms, and (c) MILE portfolio conferences piloted at the end of the study can be used to rate teacher and student reflective understanding of M+MI principles and concepts and their impact on teaching and learning in elementary school classrooms.

MIENC case study site 3: Longitudinal Arts Plus Arts Integration projects implemented by Chicago Arts Partnerships in Education (CAPE) (2003–2015)

CAPE was recognized as the first U.S. organization to pursue sustained partnerships between artists and schools. CAPE pursues arts integration programming, ongoing site-based documentation of creative practice and research, shared professional development, and sustained professional learning communities among teachers and artists (Burnaford et al., 2001). Soon after joining the MIENC, Scripp became the co-principal investigator for four Arts in Education Model Development & Dissemination (AEMDD) arts integration projects and publications that included music

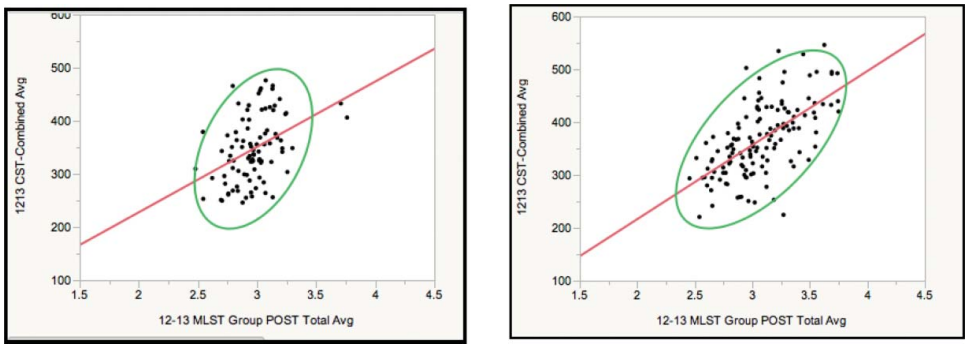


Figure 10. Bivariate fit of MLST multiple representations assessment ratings and combined Reading/Math achievement test scores. Bivariate fit of Grade 2 averaged CST standardized test scores in both control schools (left; ANOVA F Ratio = 17.8; $r = .41$ $p < .0001$; $n = 91$) and MILE treatment schools (right; ANOVA F Ratio = 80.2; $r = .62$, $p < .0001$; $n = 133$).

as a component of arts integration projects in Chicago Public Schools. CAPE further developed models of program development that emphasized a focus on the fundamental concepts from M+MI and applied them to other art forms such as visual art resulting in a documentation and assessment system that was used to measure the quality and impact of CAPE Arts Plus Arts Integration (A+AI) programs in schools.

The most recent four-year CAPE AEMDD control-treatment study, the Portfolio Development Project (PDP), is an opportunity to investigate the impact of the mutual presence of teaching artists and arts specialist practices combined with systemic portfolio documentation of student work in public elementary schools. This project provides a new vision for M+MI and Visual Arts Plus Arts Integration practices in schools during this evolving era of high focus on Common Core standards in English Language Arts (ELA) and the arts learning content alignment with the new NCCAS.

For example, Figure 11 is a graphic score from a student A+AI portfolio that combines elements of musical development, color, dramatic plot development, and character roles within the operatic performance of *Don Giovanni*. In this case the contents of the PDP portfolios were influenced by both the music specialist (who emphasized musical structure, melodic design, harmonic progress, concepts of orchestration, etc.), the teaching artist (an opera singer who focused more on character, plot, costumes, social–emotional aspects of drama and vocal expression, etc.), and the classroom teacher (who was more concerned with writing and reading comprehension skills). The joint focus on the portfolio made possible the systematic analysis of student work and students' ability to reflect on their understanding of opera, theater, movement and visual design, writing, and musical analysis and criticism as well as on the artistic, academic, and arts integrated aspects of their school work during their portfolio conference interviews.

In a classroom culture of alternative arts and arts integration based learning assessment, analysis of student work yielded surprising results. Not only did the treatment school test scores gradually outpace the control schools over time, but also stepwise regression analysis identified that student A+AI portfolio work is most likely to predict academic achievement. It is the students' ability to produce a consistently *high quantity* of A+AI portfolio work (F ratio 30.558; $p < .000004$; $R^2 = .35$) that most likely predicts the gradually increasing level of academic improvement throughout the course of the 4-year project. Conversely, it is students ability to produce *high quality* A+AI portfolio work by the end of the project that best predicts the final year level of academic achievement (F ratio 22.182; $p < .0004$; $R^2 = .31$) (Scripp, Sutherland, & Gilbert, 2015). These findings further the case that systemic, comprehensive A+AI portfolio practices serve as optimizers of student learning in other areas.

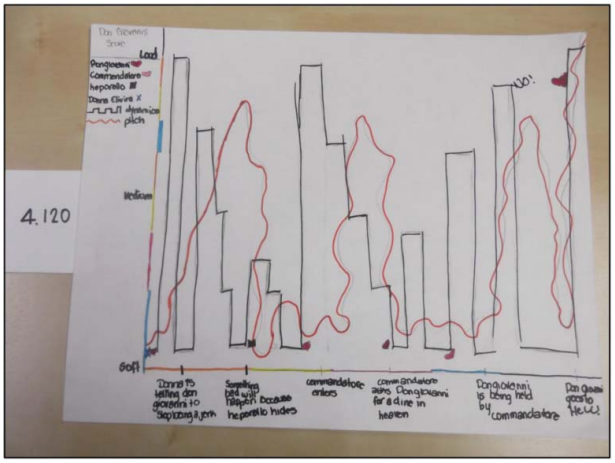


Figure 11. Example graphic musical score from a CAPE student's A+AI portfolio.

Summary of case studies

The formulation and adaptation of best M+MI principles and practices at the classroom, school, and district level will lead to a new understanding of arts learning and its essential contribution to 21st century public education. Teaching and learning innovations from Boston, California, and Chicago discussed here will include the articulation of standards of learning in multiple domains that can be best addressed in M+MI or A+AI learning environments such as:

1. the fostering and application of integrated, multiple literacies;
2. teaching and assessing fundamental learning processes that can be employed across subject areas and social–emotional development;
3. standards-based concepts that are shared across subjects areas;
4. the essential role of meta-cognitive strategies and tools (e.g., teaching for transfer, teaching reflective understanding, peer portfolio conferencing) that enhance and grow out of an arts integration curriculum;
5. strategies for leveraging transformative factors in arts plus arts integration practices that contribute to a positive school culture of excellence and equity; and
6. the formulation of alternative arts teaching and assessment practices for the purpose of supporting the complexities of sustaining M+MI practices designed to enhance academic and interdisciplinary arts learning classrooms and build stronger, more productive and positive school communities.

Closing remarks

Perhaps because arts integration research in the past has been reported in a relatively vague and piecemeal fashion, music educators have been reluctant to recognize the importance, adapt the dispositions, or incorporate the practices of integrative teaching and learning into music education policy. Though many music educators still cling to the notion that music can or should be taught for its own sake, the six links in the chain of evidence support the need for a new comprehensive policy of music education. Even with the new influx of neurological research, experiments in cognitive science, and the flow of publicized results from quasi-experimental field-based research in public schools, the momentum toward an evolution of music education policy to support music integration as an agent for both optimized music instruction and the learning connections across the curriculum is not yet sufficient for changing the overall understanding of music in education.

Nonetheless, by embracing multiple forms of recent evidence that support an overarching framework of M+MI presented here, it may have become more likely that music, classroom teachers, and administrators can reach a consensus on 21st century music education policy that links the direct effect of musical instruction to changes in the brain, the way those changes advance cognitive skill development, and consequently the likelihood that music and music integration—optimized through its integration with other subjects and the professionalization of music integration specialists as quality control checkpoints for M+MI program development—can serve as the basis for reinforcing and therefore enhancing learning achievement throughout the entire K–8 school curriculum.

The statistically significant patterns and degrees of correlation that exist between music learning outcomes and academic learning outcomes reported in the illustrations of evolving M+MI practices in experimental school programs now can be understood—not as an argument for music primarily as the tool for enhancing academic learning, but as a way for educators and parents to understand the strong bonds (and very likely the shared neural networks) that develop between music learning and its association with learning in other disciplines, especially when arts or classroom teachers ignite "associative" or "interconnected" learning by teaching explicitly for learning transfer.

If policy consensus is forged and enacted policies aligned, then M+MI professional development programs, innovative music teaching practices, interdisciplinary curricula connections, and assessments reflecting an equilibrium between "differentiation and synthesis" will be understood as an organizer and optimizer of music's essential—yet continuously evolving—role in 21st century education reform.

Notes

1. http://www.census.gov/hhes/school/
2. www.nationalartsstandards.org
3. Currently incorporated as a research and evaluation organization known as the Center for Music-in-Education (CMIE), DBA the Center for Music and the Arts in Education (CMAIE).
4. Primarily from the federal Funds for the Improvement for Improvement in Post Secondary Education (FIPSE) from 2001–2009.
5. See the *Journal for Music-in-Education* (2007) (journal.music-in-education.org) for a full report on the policies and practices of the MIENC. This section borrows in particular from Myers and Scripp (2007) for a description of the policy implication of the MIENC work for schools that value the arts as a strategy for school change and excellence.
6. The MLST, first developed by Scripp in 1999 for the Conservatory Lab Charter School, has been adapted

and refined for use in research projects from 1999–2016 as contracted by schools wishing to evaluate individual levels of musical literacy skills (pre–K through Grade 8). The MLST does not require background knowledge or training in music and is sometimes used to determine the degree of association between musical literacy skill development and standardized tests of academic achievement as evidence of the impact of music and music integration curricula in K–8 schools. (For additional information regarding the history, development and uses of the MLST see https://www.researchgate.net/publication/299537730_Assessing_the_Development_Integration_and_Reflective_Understanding_of_Multiple_Literacy_Skills_Shared_between_Music_Math_Language_and_the_Arts.)

7. Since the submission of this article another year of data analysis validating the correlations between the MLST and the new Common Core test results, and exploring the significant effect of years in program on MLST performance has become available (see https://www.researchgate.net/publication/304579808_Annual_Report_to_the_Massachusetts_Department_of_Education_An_Analysis_of_2016_Annual_Music_Literacy_Skills_Test_Results_at_the_Conservatory_Lab_Charter_School_CLCS).

References

Ball, P. (2010). *The music instinct: how music works and why we can't do without it*. New York, NY: Random House.

Bamberger, J. (2000). Music, math, and science: Towards an integrated curriculum. *Journal for Learning Through Music*, *1*, 32–35.

Barrett, J., McCoy, C., & Veblen, K. (1997). *Sound ways of knowing: Music in the interdisciplinary curriculum*. New York, NY: Schirmer.

Burnaford, G., Aprill, A., & Weiss, C. (Eds.). (2001). *Renaissance in the classroom: Arts integration and meaningful learning*. Chicago Arts Partnerships in Education. Mahway, NJ: Erlbaum & Associates.

Burnaford, G., Brown, S., Doherty, J., & McLaughlin, J. (2007). *Arts integration frameworks, research practice*. Washington, DC: Arts Education Partnership.

Catterall, J., Chapleau, R., & Iwanaga, J. (1999). Involvement in the arts and human development: General involvement and intensive involvement in music and theater arts. Retrieved from http://www.newschool.ie/_fileupload/Image/artsinvolvement.pdf

Catterall, J., & Waldorf, L. (1999). Chicago Arts Partnerships in Education: Summary evaluation. In E. B. Fiske (Ed.), *Champions of change: The impact of the arts on learning* (pp. 47–62). Washington, DC: The Arts Education Partnership.

Coyle, D. (2009). *The talent code: Greatness isn't born. It's grown. Here's how*. New York, NY: Bantam.

Črnčec, R., Wilson, S. J., & Prior, M. (2006). The cognitive and academic benefits of music to children: Facts and fiction. *Educational Psychology*, *26*(4), 579–594.

Davidson, L., Claar, C., & Stampf, M. (2003). Exploring the premises of learning through music in a laboratory school setting: interdisciplinary features and fundamental processes. *Journal for Learning Through Music*, *2*, 64–76.

Deasy, R. J. (Ed.). (2002). *Critical links: Learning in the arts and student academic and social development*. Retrieved from http://www.aep-arts.org/wp-content/uploads/2013/01/Critical-Links-for-Download.pdf

Forgeard, M., Winner, E., Norton, A., & Schlaug, G. (2008). Practicing a musical instrument in childhood is associated with enhanced verbal ability and nonverbal reasoning. *PLOS ONE*, *3*(10), e3566.

Freyberger, R. M. (1985). Integration: Friend or foe of art education. *Art Education*, *38*(6), 6–9.

Gardiner, M. (2000). Music, learning, and behavior: A case for mental stretching. *Journal for Learning Through Music*, *1*, 72–93.

Gärtner, H., Minnerop, M., Pieperhoff, P., Schleicher, A., Zilles, K., Altenmüller, E., & Amunts, K. (2013). Brain morphometry shows effects of long-term musical practice in middle-aged keyboard players. *Frontiers in Psychology*, *4*, article 636. doi:10.3389/fpsyg.2013.00636

Gee, C. B. (2003). Uncritical pronouncements build critical links for federal arts bureaucracy. *Arts Education Policy Review*, *104*(3), 17–19.

Hodges, D. A., & O'Connell, D. S. (2005). The impact of music education on academic achievement. In D. Hodges (Ed.), *Sounds of learning: The impact of music education* (chapter 2). Retrieved from https://www.nammfoundation.org/sites/default/files/Sounds%20of%20Learning_The%20Impact%20of%20Music%20Education.pdf

Hope, S. (2000). Integrity in integrative approaches to music programs. *Journal for Learning Through Music*, *1*, 12–15.

Hope, S. (2003). Questions and challenges concerning music's role in education. *Journal for Learning through Music*, *2*, 12–15.

Hutchinson, S., Lee, L., Gaab, N., & Schlaug, G. (2003). Cerebellar volume of musicians. *Cerebral Cortex*, 13(9), 9437–949.

Hyde, K. L., Lerch, J., Norton, A., Forgeard, M., Winner, E., Evans, A. C., & Schlaug, G. (2009). Musical training shapes structural brain development. *The Journal of Neuroscience*, *29*(10), 3019–3025.

Jentschke, S., & Koelsch, S. (2009). Musical training modulates the development of syntax processing in children. *Neuroimage*, *47*(2), 735–744.

Lee, D. J., Chen, Y., & Schlaug, G. (2003). Corpus callosum: Musician and gender effects. *Neuroreport*, *14*(2), 205–209.

Levitin, D. (2006). *This is your brain on music: The science of a human obsession*. New York, NY: Dutton.

Mannes, E. (2011). *The power of music: Pioneering discoveries in the new science of song*. Bloomsbury Publishing USA.

Mishook, J. J., & Kornhaber, M. L. (2006). Arts integration in an era of accountability. *Arts Education Policy Review*, *107*(4), 3–11.

Moreno, S., & Bidelman, G. M. (2013). Examining neural plasticity and cognitive benefit through the unique lens of musical training. *Hearing Research*, *308*, 84–97.

Moreno, S., Bialystok, E., Barac, R., Schellenberg, E. G., Cepeda, N. J., & Chau, T. (2011). Short-term music training enhances verbal intelligence and executive function. *Psychological Science*, *22*(11), 1425–1433.

Myers, D., & Scripp, L. (2007). Evolving forms of music-in-education practices and research in the context of arts-in-education reform: Implications for schools that choose music as a measure of excellence and as a strategy for change. *Journal for Music-in-Education*, *1*, ii–vii.

Noblit, G., Corbett, H. D., Wilson, B., & McKinney, M. B. (2009). *Creating and sustaining arts-based school reform: The A+ Schools Program*. New York, NY: Routledge.

Proverbio, A., Manfredi, M., Zani, A., & Adorni, R. (2013). Musical expertise affects neural bases of letter recognition. *Neuropsychologia*, *51*(3), 538–549.

Rabkin, N., & Redmond, R. (Eds.). (2004). *Putting the arts in the picture: Reframing education in the 21st century*. Chicago, IL: Center for Arts Policy at Columbia College Chicago.

Schellenberg, E. G. (2004). Music lessons enhance IQ. *Psychological Science*, *15*(8), 511–514.

Scripp, L. (2000a). Introduction: The premise of learning through music. *Journal for Learning Through Music*, *1*, 2–11.

Scripp, L. (2000b). Interlude 2: Introducing multiple representations of music into the elementary school curriculum. *Journal for Learning Through Music*, *1*, 28–31.

Scripp, L. (2002). An overview of research on music and learning. In R. J. Deasy (Ed.), *Critical links: Learning in the arts and student academic and social development* (pp. 132–136). Washington, DC: Arts Education Partnership.

Scripp, L. (2003a). From conference to coalition: The makings of a national music-in-education consortium. *Journal for Learning Through Music*, *2*, 1–7.

Scripp, L. (2003b). Critical links, next steps: An evolving conception of music and learning in public school education. *Journal for Learning Through Music*, *2*, 119–140.

Scripp, L. (2007). The Conservatory Lab Charter School-NEC Research Center "learning through music" partnership (1999–2003). *Journal for Music-in-Education*, *2*, 202–223.

Scripp, L., Aprill, A., Burnaford, G., Dik, D., Marron, V., Myers, D., & Rasmussen, A. (2007). Generative principles for music-in-education research. *Journal for Music-in-Education*, *1*, 177–182.

Scripp, L., Burnaford, G., Bisset, A., Pereira, S., Frost, S., & Yu, G. (2007). DELTA: Developing early literacy through the arts: A final report. Retrieved from http://www.capeweb.org/wp-content/uploads/2011/05/delta.pdf

Scripp, L., Burnaford, et al. (2013). Partnerships in Arts Integration in Research Comprehensive Report. Retrieved from http://pairresults.org/downloads/PAIR1.pdf

Scripp, L., Freed, K., Lundell, D., Sevett, C., & Vaillancourt, J. (2007). The evolution of the learning through music consulting group-Ramsey IFAC school learning laboratory school partnership. *Journal for Music-in-Education*, *2*, 224–275.

Scripp, L., Keppel, P., & Wong (Eds.). (2007). *Advancing music in changing times*. Special issue of *Journal for Music-in-Education*, *1/2*.

Scripp, L., Keppel, P., & Wong, R. (2010). *The Music-in-Education National Consortium Dissemination Project: 2008–2010 final project report*. Retrieved from https://www.researchgate.net/publication/281589930_The_Music-in-Education_National_Consortium_Dissemination_Project_2008-2010_Final_Project_Report_US_DOE_FIPSE_Grant?ev=prf_pub

Scripp, L., & Paradis, L. (2014). Embracing the Burden of Proof: New strategies for determining predictive links between arts integration teacher professional development, student arts learning, and student academic achievement outcomes. *Journal for Learning through the Arts: A Research Journal on Arts Integration in Schools and Communities*, *10*(1).

Scripp, L., & Reider, D. (2007). New ventures in integrated teaching and learning: Working toward a model of general symbolic literacy based on the growing understanding of fundamental literacy skills shared between music and language in grades K–2. *Journal for Music-in-Education*, *2*, 337–380.

Scripp, L., & Subotnik, R. F. (2003). Directions for innovation in music education: Integrating conceptions of musical giftedness into general educational practice and enhancing innovation on the part of musically gifted students. In L. V. Shavinina (Ed.), *The international handbook on innovation* (pp. 471–484). Quebec, Canada: Elsevier.

Scripp, L., Sutherland, S., & Gilbert, J. (2015). Chicago Arts Partnerships in Education's Portfolio Development Project Principal Investigator's Report. Retrieved from https://drive.google.com/file/d/0B18c-IMtmGDIeXNNXzdPaS1WTFE/view

Scripp, L., Ulibarri, D., & Flax, R. (2013). Thinking beyond the myths and misconceptions of talent: Creating music education policy that advances music's essential contribution to twenty-first-century teaching and learning. *Arts Education Policy Review*, *114*(2), 54–102.

Scripp, L., Ulibarri, D., Southerland, S., Gilbert, J., & Sienkiewicz, F.. (2014). The Oakland Unified School District's Music Integration Learning Environment (MILE) Arts in Education Model Development & Dissemination (AEMDD) Project (2009–2013): Principal investigator's final report. Retrieved from http://centerformie.org/wp-content/uploads/2014/05/MILE-PI-Report.pdf >

Shenk, D. (2011). *The genius in all of us: New insights into genetics, talent, and IQ*. Random House.

Skoe, E., & Kraus, N. (2012). A little goes a long way: How the adult brain is shaped by musical training in childhood. *The Journal of Neuroscience*, *32*(34), 11507–11510.

Tierney, A. T., & Kraus, N. (2013). The ability to tap to a beat relates to cognitive, linguistic, and perceptual skills. *Brain and Language*, *124*(3), 225–231.

Trainor, L. J., Shahin, A. J., & Roberts, L. E. (2009). Understanding the benefits of musical training. *Annals of the New York Academy of Sciences*, *1169*(1), 133–142.

United States Census Bureau. (2010). Retrieved from http://www.census.gov/hhes/school/

Wan, C., & Schlaug, G. (2013). Brain plasticity induced by musical training. In D. Deutsch (Ed.), *The psychology of music* (pp. 565–581). Waltham, MA: Elsevier.