

Drawing on the arts: Less-traveled paths towards a science of learning?

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A growing body of data suggests that connections between the art and science of learning are rigorously supportable by quantitative studies. Contemporary research is beginning to explore explicit neuroscientific hypotheses concerning the beneficial effects of activities such as musical performance, drawing, visual aesthetics and dance observation.
 Tyler, Levitin, and Likova (2008)

In June of 2008, the National Science Foundation convened a distinguished group of scientists and artists to ask whether it was now time to study the role of art in the science of learning. As noted above, this panel resolutely concluded that a “growing body of data” made this a frontier worth exploring. Mission statements from the field of education agree. When the U.S. Department of Education published its response to No Child Left Behind in March of 2010, it suggested that college- and career-ready students require a well-rounded education that covers history and mathematics, science *and* the arts. To date, this focus on the arts has not been realized. As a nation, six percent of elementary schools offer no music instruction, and 13 percent lack visual arts instruction; dance and theatre are only offered to 20 percent and 19 percent, respectively (NCES, 2002). Further, a recent survey of 254 classrooms in New York City and Los Angeles mirrored this trend (Miller & Almon, 2009). Fifteen percent of schools in New York City and 13 percent of schools in Los Angeles had only enough art supplies for half of their class. Music, dance, drama and visual arts bring students to an understanding of social or historical events and to satisfy the craving of beauty in its own right (Gardner, 2011). They might also prove to be a gateway to how we amass general knowledge in areas like reading, mathematics, and language and a route that supports the growth of attention and memory – skills that promote learning to learn.

This chapter reviews budding research suggesting that the arts might play a role in the science of learning. It asks more questions than it provides answers. For example, where might we find connections between the arts and general learning? What research exists to support

connections between artistic training and learning outcomes? How can our theories of learning explain these nascent connections and how might we build a new path towards learning that draws on the arts?

Finding connections: Speculating on links between the arts and general learning

The foundation for connecting learning to the arts comes largely from qualitative studies. Some of the research and theorizing asks us to consider learning processes that students use when engaged in the arts – when they are learning to draw, to sing or to dance. In what has become a landmark study, Hetland, Winner, Veenema, and Sheridan (2007) observed 38 visual art classrooms throughout one academic year in two Boston high schools dedicated to the visual arts. Each class lasted approximately two or three hours. After observing students in these classrooms, they distilled a set of *studio habits*, or ways of thinking, that are fostered through arts instruction. While learning technique (i.e., *developing craft*) was a prominent activity in these classrooms, student-teacher interactions also isolated 7 additional skill sets that move beyond content and onto processes that support learning.

Among them was self-regulation (i.e., *engage and persist*). The assigned tasks were designed to challenge students. When frustrated, teachers encouraged students to be patient, acknowledging that process was demanding. *Stretch and explore* is another habit fostered through the arts. Students were challenged to move beyond the familiar and to embrace mistakes. As one teacher described it, “you ask kids to play, and then in one-on-one conversations you name what they’ve stumbled upon” (Winner, Hetland, Veenema, Sheridan, & Palmer, 2006). Such discovery is a critical element in Eisner’s (2002) thesis. He borrows Dewey’s (1938) term, *flexible purposing*, to describe the importance of improvisation; he writes, “in choosing to pursue surprise, one selects an uncertain path” (p. 79). An unanticipated line on paper or movement on

stage may be just the spark needed to move forward in a new direction, and the arts foster the courage to follow that lead. Students are also asked to suspend their usual ways of perceiving the world and instead notice the lines, patterns, colors, textures, and spatial relations in their work, developing the habit of *observation*. Viewfinders are but one tool to reinforce this habit.

The participants in Hetland et al.'s (2007) study were talented high school students. Yet some of our recent work suggests that many of the habits witnessed by Hetland and colleagues are also present when preschool children participate in dance, music and visual art classes during their school day (Reed, Hirsh-Pasek & Golinkoff, in preparation). The Settlement Music School is the largest community school for the arts in the United States, with six branches in Philadelphia, Pennsylvania. In addition to the music lessons within its walls (Kevin Bacon is but one of many notable alumni), the Settlement Music School also houses a local Head Start program. Preschool children attend music, visual art, and dance classes throughout the day, with artists and art instructors. Like Hetland and colleagues, we followed the five preschool classrooms as they attended their arts classes across a six-month period. Preliminary analyses reveal that processes in these preschool arts classrooms parallel those in the Boston arts high schools. Our question turned on whether the arts assist children in fine-tuning their attention and focus – in addition to any benefit the arts might yield for academic learning. That is, we asked how might an arts-enriched pedagogy foster executive function alongside content? By way of example, children receive a pair of drumsticks; at three and four years of age, their first instinct is to bang them together. The experience is structured, however, to reinforce self-regulation and inhibitory control while also to practice proper technique. Immediately after passing out the sticks, the teacher demonstrates “giving them a rest” through a series of fun movements that require the children to resist the urge to strike them together but instead follow the teacher’s lead,

pretending that the sticks are bug ears, among others. Once the children are thoroughly immersed in the task, the teacher begins with soft taps and the students follow suite. This tapping becomes progressively more difficult, as the teacher integrates foot taps and body movement with the steady tapping. To succeed, students must focus, control themselves, and observe the teacher, who does not announce the next movement but simply acts so that students must monitor her behavior in addition to their own. In this way, even young “art” students build executive function *habits* like attention, self-regulation and observation.

A second body of research linking the arts and learning comes from Martin Gardiner (2000). He identifies the process of *mental stretching*, whereby a change in one's representation in one domain aids in the understanding of a different domain via analogous thinking. Take, for example, an elementary curriculum that focuses on pitch and melody. Because musical pitch and melody require attention to linear order and sequence, learning music might bolster children's understanding of the number line. Additionally, children who learn to compare high and low notes attend to spatial thinking in action. Some evidence adds credence to this theoretical perspective. First graders in arts classrooms with a specific curricular focus on sequenced skill development outpaced their peers in control arts classrooms on a standardized assessment of mathematics (Gardiner, Fox, Knowles, & Jeffrey, 1996). Gardiner posits that participation in the arts builds the kinds of mental representations that reinforce learning in other domains. *In this sense, the medium itself leads learners to find abstract relationships that can be of broad use to their conceptualizations.* Such research offers a reconciliatory note with regard to the often-elusive evidence of transfer (e.g., Winner & Hetland, 2000). Perhaps the arts foster a kind of learning to learn or what Katz (1995) called "dispositions for learning" - like the studio habits - that are critical for learning in all domains.

Schellenberg (2005) adds that music offers pointed lessons on abstraction. Analogous to logic and mathematics, music is a symbol system that is not dependent on the individual notes in a tune, but rather on the *relations* between those notes as they spin a familiar melody. Even infants attend to the common melody line across key changes (e.g., Plantinga & Trainor, 2005; Trainor & Trehub, 1992). For older children, understanding how music is built on relations may offer a powerful analogue to mathematical thinking.

Children's drawings offer a similar foundation for building representations and learning skills. Rhoda Kellogg (1979) collected and analyzed two million pieces of children's art from around the country. As she categorized the drawings of children between 24- and 40-months-old, she found remarkable similarities in the kinds of scribbles they created and in the way that the non-intentional marks of the infant transformed into the intentional fine motor marks of the toddler and onto the budding human form of the preschool child. Hirsh-Pasek and Golinkoff (2007) traced the development of children's scribbles from 9 months to three years and saw the expansion of children's representational capacity in action. Lowenfeld and Brittain (1987) examined similar drawings to explore the creative and mental growth of young children. Children move along a developmental continuum from a mark on a page, to endowing scribbles with names (at around 3.5 to 4 years), through a pre-schematic phase where children draw recognizable geometric forms and nascent human figures to two-dimensional spatial representations (7-9 years) and beyond. We note, however, that recent work, such as Kindler (2004), offers an alternative to this model, in which she contends that instead of "endpoints" in artistic development (i.e., from scribbles to three-dimensional representations), the progression should focus on "repertoires," or advances in artistic thinking. Nevertheless, traversing this continuum we meet children who are forming visual representations, learning about space and sequencing and mastering pattern production and recognition. Indeed, Gibson and Levin (1975, 235) called scribbling "the fundamental graphic act" noting that in the seemingly random marks of young children are found the rudiments of writing. When children as young as 15 months are offered a pencil or crayon that doesn't work, they throw it aside, knowing that these implements are meant to make marks on the page.

Howard Gardner's (1980) book, *Artful Scribbles*, addresses why children's art is so appealing. He posits that "in striving for symmetry, the child instead achieves balance... In striving for realism, he achieves charming, recognizable deviations from a photographic likeness" (p. 141). Gardner argues that children's art is not simply a product of development; the art of drawing affords children opportunities to "explore in his own way" fears, worries, themes, and ideas (p. 115). As such, creations reflect not only an emerging appreciation for realism as embraced by our culture but also an expressiveness of thought.

The connections between art and learning implied above are but speculative. Hetland et al.'s work gives us reason to suspect that children are learning more than still life composition and sculpture when they enter the high school art classroom. And theories like Gardner (2000), Kellogg (1979), Lowenfeld and Brittain's (1987) and Gardner's (1980) force us to look beneath the surface to ask what children might be gleaning as they practice a rhythm or draw a self-portrait. To be sure, there is value in song and dance even if it only provides aesthetic pleasure (Gardner, 2011; Kagan, 2009), but the works cited in the qualitative studies - admittedly descriptive in nature - suggest that art experiences may offer children more than meets the eye.

What quantitative research exists to support real connections between artistic training and learning outcomes?

Recent research has begun to directly explore the hypotheses that exposure to and training in the arts is related to school outcomes. Most of this research comes from adults or elementary school children offering a smattering of observational, random assignment and quasi-experimental field studies. This work is in its infancy; however, the available research suggests that exposure to the arts might foster reading and mathematical outcomes as well as promoting executive function skills like attention and memory.

The arts meet language and literacy. Musical notes and alphabet letters, rhythm and rhyme – the hypothesized links between the arts and language and literacy development depend upon their shared structure. Indeed, for young children, the line between art and narrative is often blurred (e.g., Dyson, 1986; Thompson & Bales, 1991). Dyson urges educators to “allow time for the often messy, noisy, and colorful process of becoming literate” (p. 408). Johnson (2007) shares this sentiment, describing the “communicative significance” of creating art (p. 316). Harris’ (2011) observations of parent-child dyads facilitated by a music specialist highlighted the shared reciprocity inherent to both language and music. Indeed, Kirschner and Tomasello’s (2009) research on joint drumming posits a similar link between language and music through shared intentionality.

Research suggests that music participation may foster a variety of emerging literacy skills, such as reading fluency (Wandell, Dougherty, Ben-Shachar, Deutsch, & Tsang, 2009), receptive vocabulary (Brown, Benedett, & Armistead, 2010), understanding and comprehension (Phillips, Gorton, Pinciotti, & Sachdev, 2010), and phonological awareness (Bolduc, 2009; Anvari, Trainor, Woodside, & Levy, 2002). For example, four- and five-year-old children

completed a battery of musical (e.g., rhythm, melody, and chord discrimination tasks and literacy assessments (Anvari, Trainor, Woodside, and Levy). Hierarchical regression analyses revealed that musical scores predicted reading scores, even after controlling for the child's phonological awareness.

Drama may also support children's literacy development (Moore & Caldwell, 1993; Nicolopoulou & Richner, 2007; Nicolopoulou, de Sá, Igaz, & Brockmeyer, 2009). Utilizing Paley's (1990) storytelling method, Nicolopoulou and colleagues found that the process of dictating and then acting out their stories fostered narrative development (Nicolopoulou & Richner, 2007), as well as story comprehension and print and word awareness (Nicolopoulou et al., 2009). In this line of research, children dictate stories; children's peers become actors as these stories are then performed live. In her theorizing about the role of dramaticization in the Paley storytelling method, Cooper (2005) describes the process as the "psychomotor embodiment of narrative text" (p. 246), thus allowing children to engage with the material in ways not possible when the story is simply in written form. Cooper describes how teachers may make inferences more salient to students when the plot is unfolding before them. For example, the teacher may pause the performance to ask students how a particular character is feeling, given the circumstances. These opportunities for reflection allow students to read beneath the surface, fostering the very competencies that will mature into critical thinking. Indeed, new research on "embodiment" (e.g., Glenberg, Gutierrez, Levin, Japuntich, & Kaschak, 2004) suggests that activity can enhance children's reading comprehension and understanding of narrative.

Moore and Caldwell (1993) draw upon the theorized links between the visual arts, drama, and narrative in their intervention study. Second and third grade lower middle-class participants

in the Rocky Mountains were randomly assigned to one of three conditions – a drama group, a reading group, and a discussion control group. An initial assessment of writing level revealed no differences among the groups prior to the intervention. After 15 weeks, both the drama and drawing groups had superior scores on the writing assessment relative to the children in the control condition. Moore and Caldwell suggest that planning through the arts scaffolds writing development.

The Arts and Mathematics and Spatial Development. The arts are inherently spatial. Music notation is represented graphically; we hum melodies based on the relations among notes. Patterns emerge in rhythm and paintings. Although there is relatively less literature linking art with mathematical and spatial thinking as compared to language and literacy, research suggests that participating in the arts bolsters performance on measures of mathematics and spatial thinking (e.g., Gardiner, 1997). Edens and Potter (2007) analyzed fourth and fifth grade children's artwork for spatial relations, and this score correlated with their performance on a mathematical problem-solving task. While Spelke (2008) did not find a link for younger participants, adolescents with intensive music training excelled at a geometrical reasoning task relative to their non-musician peers.

Fischer, Moeller, Bientzle, Cress, and Nuerk (2011) analyzed performance on a number line estimation task. Five- and six-year-old children compared number magnitudes and responded, utilizing either a dance mat or computer tablet (non-spatial control). In the dance mat condition, images were projected on the ground and children compared one stimulus (e.g., a box with many squares inside) to an initial stimulus (e.g., a box with few squares inside). This initial stimulus was presented along a number line. If the new display is greater than the original, children moved to the right; if smaller, children moved to the left (corresponding to the

principles of a number line). In the control condition, two stimuli were presented on the tablet's touch screen and children responded by clicking the larger one. These images were not presented spatially on the tablet's screen. Those children who worked with the dance mat outperformed their peers in the control condition on a 0-10 number line task (performance did not differ on a 0-20 task, postulated to be too difficult for this age). Furthermore, these children scored higher on the *counting principles* subtest of the TEDI-MATH assessment, but not for any other subtest (e.g., object counting, Arabic digits, number words, and calculation subtests), suggesting that this finding is not simply a result of heightened attention. A mediation analysis revealed that scores on the counting principles measure mediated the superior performance on the number line task. While the dance mat task was not inherently aesthetic or creative, the activity coupled movement with spatial relations, which facilitated performance on a number line task.

The Arts and School Readiness Skills. In addition to links with specific content areas, our research (Reed, Fisher, Hirsh-Pasek, & Golinkoff, 2011; Reed, Hirsh-Pasek, & Golinkoff, in preparation) suggests that arts experiences may also bolster school readiness skills. Sixteen children attending the arts-enriched preschool at the Settlement Music School and 15 children in a more traditional program were followed longitudinally from the fall to spring of an academic year. Both schools serve their local Head Start families and have earned the highest Pennsylvania Keystone Stars rating and are accredited by National Association for the Education of Young Children. Because the two schools are matched for quality, the differential impact of an arts-enriched pedagogical approach can be explored. At both time points, participants completed several measures that tapped content knowledge (i.e., Woodcock-Johnson-III letter-word identification and applied math subtests). Additionally, a measure of executive function (*Grass/Snow*; Carlson, 2005) required children to pair the words *grass* and *snow* with the

opposite colors (i.e., experimenter prompted *grass* and the child touched a white square). While children at both schools made similar gains in early literacy and numeracy skills across the school year, the children in the arts-enriched program outperformed their peers on the measure of sustained attention. Pedagogy (i.e., arts-enriched or traditional) was a significant predictor of the proportion of correct responses before children made their first mistake in the task – a finding that remained when controlling for age and initial attention score.

This study is among the first to quantitatively test the *studio habits* thesis. Children spent several hours each day engaged in the arts – music, movement, and drawing. In these classes, letters and numbers were not the explicit focus; instead teachers instilled an appreciation for form, rhythm, and color, and pattern across the different mediums. The arts then became the medium through which the academic content was integrated while also reinforcing such school readiness skills like attention and self-regulation.

How can our theories of learning explain these nascent connections and how might we build a new frontier for learning science that draws on the arts?

The available research is relatively limited, especially with respect to the lack of studies with true experimental designs and tight controls. Yet, both the qualitative and quantitative work are suggestive that exposure to and training in the arts might augment children's general knowledge in ways that will also relate to school readiness and school outcomes. What are the psychological mechanisms through which the arts might exert their impact on learning? Several have been proposed. First, as Hetland et al. (2007) suggest, working in the arts might bolster basic learning processes that feed into later academic and social outcomes. Second, the arts themselves provide first hand lessons in a variety of symbolic representations that can support later learning. Third, exploring a problem space through the arts (e.g., counting through rhythm

and beat) uses the kinds of engaged, interactive and meaningful pedagogical approaches known to foster optimal learning. Each of these areas is itself a frontier for future research.

On basic learning processes. The Hetland et al. (2007) work and our follow up study (Reed, Hirsh-Pasek, & Golinkoff, in preparation) describe some of the learning processes that children recruit when engaged in the arts. One of the most exciting new areas of research concerns processes like these that support general knowledge acquisition. Dubbed “approaches to learning” or “learning to learn,” this research examines how skills like persistence, emotion regulation and attentiveness are related to later outcomes in reading and mathematics, even up to fifth grade (Li-Grining, Votruba-Drzal, Maldonado-Carreno, & Haas, 2010). Similar findings emerge in the highly touted *Tools of the Mind* curriculum, which uses playful learning through dramatic play, throughout the school day to help children practice and learn emotion regulation (Bodrova & Leong, 2007). Results from under-privileged Head Start children in a randomized study suggested that the *Tools* curriculum improved inhibitory control on two measures of executive function (Diamond, Barnett, Thomas & Munro, 2007). Further, improved executive function skills were related to concurrent and latent academic outcomes. Correspondingly, using results from the Early Childhood Longitudinal Study (ECLS-K) Grissmer, Grimm, Aiyer, Murrah, and Steele (2010) find that approaches to learning (here defined as attention) is a better predictor of 4th grade reading scores than are kindergarten reading scores.

Until recently, it was not clear whether approaches to learning skills were malleable (NICHD ECCRN, 2005) but increasingly we are learning not only that the environment can alter the trajectories of these skills, but that these skills relate centrally to academic outcomes. Further, the budding research from Hetland et al. (2007) suggests that exposure to and engagement in the arts may support children’s development of these learning skills. In fact, a burgeoning focus on

executive function in children (e.g., Blair, 2002; Diamond et al., 2007) has led researchers to hypothesize a direct link between the arts and such skills as attention (Posner, Rothbart, Sheese, & Kieras, 2008; Neville, Andersson, Bagdade, Bell, Currin, et al, 2008) and self-regulation (Winsler, Ducenne, & Koury, 2011). In the Dana Consortium Report on Arts and Cognition, for example, Posner, Rothbart, Sheese, and Kieras (2008) proposed that training in the arts might strengthen precisely those areas of the brain involved in attention, mediated by children's interest and motivation to engage in the arts. Thus, while it remains an untested assumption, one might speculate that training in and exposure to the arts might foster precisely the kinds of skills that will support general knowledge development and specific outcomes that are related to school success.

On the arts and symbolic representation. In his address to the Learning, Arts, and the Brain conference, Kagan (2009) emphasized the critical role that mental representations play in transforming children's knowledge, in line with Gardiner's (2000) thesis. The ability to think like an artist – spatially, visually, or in notes and keys – offers a perspective that can scaffold thinking in other areas. Eisner (2002) argues that, “representation stabilizes the idea or image... and makes possible a dialogue with it” (p. 6). Consequently, Eisner posits that the arts bolster one's attention to relationships through explorations of “the interactions among the qualities constituting the whole” (p. 76). The aesthetic perspective thus allows one perceive qualities of an experience that may not be perceived with a scientific lens (e.g., Eisner, 2002; Gadsden, 2008; Seidel, Tishman, Winner, Hetland, & Palmer, 2009).

Kirsh, Muntanyola, Jao, Lew, and Sugihara (2009) describe a process in creative thinking called *tasking*, whereby a choreographer presents her dancers with a “choreographic problem or task.” Dancers then respond to these problems by through body movements. The director

described the process as one whereby “by assigning the dancers problems to solve they stretch their repertoire more effectively – they discover new ways of moving themselves; he, the choreographer, has the opportunity to see new things that the dancers can do” (Kirsh et al., 2010, p. 192). The process may be no different for children who lack the expert technique of professional artists but nevertheless are motivated to create within a new representational form.

Using engaged, interactive and meaningful pedagogical approaches. Another area where the arts might prove a powerful tool in education is through pedagogy. Teaching about math and science through the arts offers exciting cases of discovery learning– from rhythm to fractions as one student drums whole notes while another student overlaps with a four quarter note pattern to demonstrate the concept of fractions to the use of space through preschool architecture. By way of example, the recently designed Imagination Playgrounds introduced by New York architect David Rockwell encourages children to be the construction team for their own mobile playgrounds. Equipped with large pieces of foamed building blocks, these children fill blank spaces as they test the structure of tall towers and the slopes required for sliding objects down an incline. At the end of the day, the pieces are put away, only to be assembled anew by the next team of children.

A large research base supports the kind of learning that emerges when children are engaged and when the learning is meaningful. Chi (2009) reviews this literature suggesting that the best learning occurs when children are *active*, *constructive*, and *interactive*. While active learning requires only that the learner engage with the material, constructive activities lead to the generation of new information not previously presented in the material within a context that allows for active engagement. For example, the process of drawing connections between different storybooks may foster tolerance and empathy (e.g., Wan, 2006). Interactive learning

involves a dialogue, with either a more-knowledgeable partner (*instructional dialogue*) or a peer (*joint dialogue*). When paired with a teacher, the conversation lends itself toward scaffolding, in which the child responds to prompts designed to spur thinking; the dialogue builds upon student responses and teacher elaborations. A joint dialogue is collaborative, as each partner builds upon the other's ideas and thoughts. Because interactive experiences offer individuals the opportunity to generate new knowledge together with a partner, Chi hypothesized that such activities will engender better learning outcomes than either constructive or active ones; all three types of activities are hypothesized to outperform passive ones. Research lends support to these ideas. Alfieri, Brooks, Aldrich, and Tenenbaum's (2011) meta-analysis reveals that enhanced discovery pedagogical approaches, such as elicited explanations and guided discovery, lead to better student outcomes in a variety of domains than a direct instruction approach.

Critically, these experiences are *authentic*, such that the selected activities are indisputably connected to the curricular goals (e.g., Fink, 2003). Seidel, Tishman, Winner, Hetland, and Palmer (2009) interviewed 16 arts education theorists and practitioners and observed 16 programs nominated for their arts commitment in order to distill the essence of excellence in the arts and present their findings under one of four lenses (i.e., student learning, pedagogy, community dynamics, and the environment). Paramount from the pedagogical perspective is the authenticity of the experiences themselves. Authenticity is evident in the quality of the content presented to students; children must be exposed to a variety of exemplars in order to draw connections and pinpoint differences among the pieces, at which point a deeper understanding of a particular style or genre may be reached.

Additionally, engagement and purposeful experiences are critically important when defining quality from the perspective of the student. Creating art, regardless of medium, requires

improvisation and surprise (Eisner, 2002). Drawing, choreography, and composing involve both imagination *and* problem-solving; Seidel and colleagues (2009) parallel purposeful art experiences to that of project-based learning. The aim is clear, and students understand the motivation behind the task, sustaining students through the revising process. Seidel et al. also describe how “many arts settings have almost a laboratory atmosphere” (p. 32); exploration and experimentation are key mechanisms linking the arts to learning.

It is notable that the arts also present the same possibilities for engagement that are discussed in the literature on playful learning (Hirsh-Pasek, Golinkoff, Berk & Singer, 2009; Miller & Almon, 2009). Play activities are varied but like visual art and music share several defining features; they are fun, voluntary, flexible, and can have no extrinsic goals. They involve the child’s active engagement, and often contain an element of make-believe (e.g., Pellegrini, 2009; Sutton-Smith, 2001). Both playful learning and the arts offer a forum for learning through guided play.

“Guided play” is a pedagogical approach to playful learning that incorporates both enriched environments and supportive adults as resources to promote children’s general learning (Fisher, Hirsh-Pasek, Golinkoff, Singer, & Berk 2010). First, teachers, parents, and other adults support children’s learning when children’s play areas are strategically peppered with materials designed to foster imagination through activities aligned with curricular goals. The presence of a supportive adult is another element of guided play as a pedagogical approach. Within an “empty vessel” philosophy, teachers are obliged to heap facts into children’s minds; learning is but a process of accumulation, akin to the assembly of a prefabricated bookcase from Ikea. Guided play, in contrast, adheres to the constructivist philosophy, in which children create knowledge through their interactions with materials, teachers, and peers. How might guided play unfold in

the domain of arts enrichment? The preschool program at the Settlement Music School offers us a portrait of just this kind of an educational supplement. For example, listening to fast and slow Celtic orchestral songs in music class highlights the concept of opposites that was earlier discussed with the homeroom teacher. In dance class, children creatively move their bodies to match the tempo and tone of the piece - sometimes emulating a thunderstorm's fervor, sometimes pretending to blossom to Vivaldi's *spring* concerto from "Four Seasons." As they match rhythm and tone, they learn patterns and practice counting the beats.

In sum, the arts are currently an underutilized resource for schools that would broaden children's general knowledge and offer a possible forum for introducing positive approaches to learning, new types of symbolic representations and scaffolding for reinforcing the learning presented in other parts of the curriculum. In theory, training in and exposure to the arts provide potentially powerful supplements to current educational practices and a pedagogical tool that is consistent with best practices.

Looking forward: From theory to research to practice

Research on connections between the arts and the science of learning are, at this point, more suggestive than compelling. Yet, as the NSF (2008) document proposes, there is indeed a “growing body of data” to suggest that exposure, training and engagement in the arts might provide important pathways for learning. Indeed, the literature on how young children might benefit from exposure to the arts and whether this exposure might be more or less potent for young children is still an open question. Further, it is becoming increasingly clear that even talking about the “arts” as a unified construct will prove misleading. Exposure to and engagement in music is likely to offer different advantages and learning opportunities than exposure to and engagement in the visual arts or drama or dance.

Thus future research might focus on several areas of inquiry. First, in what ways does preschool exposure to various arts training translate into executive function skills and approaches to learning? For example, do kindergarteners who have visual arts every day for half an hour demonstrate more persistence or self regulation in a non-artistic task? Second, we need to be more specific about the mechanisms that might link say, music training and mathematics. Within the domain of music, for example, is it only rhythmic training that relates to the number line or might recognition of melody also support mathematical learning? Third, we need to research head-on claims that training in domains like music or drama promotes near and far transfer or mental stretching. Here there is a clear debate in the literature with scholars like Winner, Hetland, Veenema, Sheridan, and Palmer (2006) suggesting that there is near transfer from drama participation to verbal skills, but little transfer from visual arts or music. Gardiner (2000), on the other hand, expects the linkages between music or art and academic outcomes to be more transparent and broadly applicable. Fourth and finally, it would be interesting to see whether

exposure to the arts might supplement current pedagogical practices in ways that encourage children to be more interactive and engaged in meaningful learning. Like guided play, the arts might provide a forum through which we can use best practices to expand children's general knowledge and to reinforce the learning that goes on in more traditional subjects.

Conclusion

Picasso once noted, "All children are artists. The problem is how to remain one once he grows up." When children hear music, they dance; their countless drawings (and murals) demonstrate their natural propensity to draw. Understanding how we may best harness children's motivation to engage in the arts has significant implications for children's development. Approaching a problem with an artist's mindset invokes certain dispositions for focus and engagement. Frustration is to be expected and mistakes may abound but glorious surprises can result. In this chapter, we reviewed not only potential links between the arts and other domains of content knowledge but also the processes that foster such learning. In a time when Google is now a verb, the kind of thinking promoted by the arts is no less imperative than knowing.

Aaaarrttt! Art is obviously one of the three R's.
Peter William Brown

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