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Developing Confidence in STEAM: Exploring the Challenges that Novice Elementary Teachers Face

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Abstract
This essay explores the challenges that novice elementary teachers may face as they attempt to enact the practices of STEAM education. Specifically, I will explore research that suggests that novice elementary teachers lack confidence in their ability to lead lessons rooted in either scientific inquiry or arts-integration. This has, I argue, clear implications for the development of STEAM education. Advocates of STEAM education must ensure that novice elementary teachers are provided with the necessary scaffolds and supports that will empower them to engage in authentic and ambitious STEAM practices.

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STEAM education is able to cultivate the critical, creative, and participatory dispositions necessary for authentic engagement in both science and art (Bequette & Bequette, 2012; Catterall, 2013; Radziwill, Benton, & Moellers, 2015). STEAM curriculum and instruction affords students opportunities to exercise divergent thinking (Kawasaki & Toyofuku, 2013), to appreciate the complexity of digital communication (Michaud, 2014), to experiment with new ways of expressing themselves (Rufo, 2013), and to experience the inherent beauty of the natural world (Sotiropoulou-Zormpala, 2012).

There is a risk, however, that comes with this ambitious vision. Specifically, art and science, in particular, are both content areas that, in the elementary school classroom, tend to be underemphasized by novice teachers; in the words of Chemi (2014), art is sometimes treated as "whipped cream" – i.e., a supplementary add-on. This unfortunate trend is what motivates the conceptual question of my essay: What are some of the challenges that novice elementary teachers face as they attempt to practice STEAM education?

Challenges related to teaching with scientific inquiry

Let us begin by examining what is known about novice elementary teachers and science instruction. A consistent finding is that novice elementary teachers tend to lack confidence in their ability to teach science (Jarrett, 1999; Riegle-Crumb et al., 2015; van Aalderen-Smeets, Walma van der Molen, & Asma, 2012; Westerback, 1984). As a

result, novice elementary teachers tend to design science lessons with the primary intention of helping their students to learn to "like" science. Furtak and Alonzo (2010) found that elementary school teachers, when teaching science, tend to emphasize procedural knowledge (e.g., how to do a particular lab) rather than highlight scientific content knowledge and real-world connections (see also Gillies & Nichols, 2015; Plummer & Ozcelik, 2015; Poon, Lee, Tan, & Lim, 2012; Walan & McEwen, 2016).

Being insecure in their ability to teach science may limit novice elementary teachers' ability to engage in authentic STEAM teaching, given that STEAM teaching requires not only a high degree of content knowledge but also a tolerance for uncertainty and an ability to flexibly adapt curriculum to one's students and local context (Teo & Ke, 2014). Without the requisite knowledge or confidence to lead meaningful scientific inquiry, novice elementary teachers may craft STEAM lessons simply as sets of "hands-on" activities.

Challenges related to teaching with arts-integration

A similar challenge exists in relation to novice elementary teachers' attempts at arts-integration. Many novice elementary teachers are apprehensive about teaching art, given that they do not inherently view themselves as artists (Battersby & Cave, 2014; Davies, 2010; Oreck, 2004; Russell-Bowie, 2012). Despite the fact that novice teachers tend to believe that engagement in the arts is an important component of every child's education, novice teachers rarely integrate the arts into their curriculum and instruction (Oreck, 2004). In addition to novice teachers' insecurities, the current era of accountability in schools provides an additional pressure that may make novice teachers reluctant to engage in curricular innovation, including innovation that attempts to

integrate the arts with "high-stakes" content (Donahue & Stuart, 2008; Garvis & Pendergast, 2012; Mishook & Kornhaber, 2006; Oreck, 2004; Wexler, 2014). STEAM education requires authentic engagement in the arts; and, yet, most novice teachers report using arts-integrated lessons as a way to make the classroom more engaging and enjoyable (Donahue & Stuart, 2008; Oreck, 2004). As with science instruction, novice elementary teachers tend to conceive of arts-integration as an opportunity to have students "make" art; these lessons, however, despite being "hands-on," often fail to cultivate students' artistic dispositions.

The ambitious nature of STEAM

It is critical to note that science lessons that prioritize procedural activities and arts-integrated lessons that rely solely on making crafts both fall short of the promise of STEAM education. Authentic arts-integrated education must allow students to exercise qualitative judgment (Eisner, 2002), just as scientific inquiry must enable students to gather and analyze quantitative data in an attempt to make sense of a real-world phenomenon (Windschitl, Thompson, Braaten, & Stroupe, 2012). Because qualitative and quantitative judgments are both integral parts of solving problems in the real world (Bequette & Bequette, 2012), STEAM education holds an invaluable place in contemporary education. If, however, novice elementary teachers are comfortable only with presenting science and art as procedural, "hands-on" activities, then novice elementary teachers' attempts at STEAM education will be superficial at best. STEAM will be in danger of being reduced to a "cherry on top" of the curriculum.

Implications and suggestions

I began this essay with the following conceptual question: What are some of the challenges that novice elementary teachers face as they attempt to practice STEAM education? As I have explored in this essay, one of the most salient challenges faced by novice elementary teachers is their lack of confidence in teaching both science and art. It is highly likely that many novice elementary teachers are not prepared to engage in STEAM teaching because of this lack of confidence. If novice elementary teachers are insecure or anxious in relation to their abilities to lead lessons designed around scientific and artistic inquiry, then these teachers' science and art lessons may be reduced to superficial, "hands-on," procedural activities that lack the intellectual rigor and transdisciplinarity that STEAM education requires (Guyotte, Sochacka, Costantino, Walther, & Kellam, 2014; Marshall, 2014).

Therefore, as proponents of STEAM education continue to advocate for innovations in curriculum and instruction, very careful attention must be paid to how novice elementary teachers are supported and inducted into these ambitious practices. I will close this essay with two recommendations: First, teacher education should provide novices with explicit opportunities to engage in STEAM practices (Donahue & Stuart, 2008). Second, school structures and social networks must be constructed in such a way that collaboration is encouraged (Spillane, Kim, & Frank, 2012), including between novice and expert teachers as well as between generalist teachers and art teachers (Wynn & Harris, 2012). The critical element implied within both of these suggestions is that novice teachers must be afforded the opportunity to be apprenticed into authentic, ambitious STEAM practices. Indeed, given that most novice teachers did not themselves experience STEAM education as students (Darling-Hammond, 2006; Lortie, 1975), these

novice teachers require a new apprenticeship into a practice of teaching that is challenging, ambitious, and transdisciplinary. Without explicit modeling and deliberate practice (Bronkhorst, Meijer, Koster, & Vermunt, 2014; McDonald et al., 2014), novices may not develop the confidence or competence to engage in STEAM education. Therefore, those who are passionate about advocating for STEAM education must take care to ensure that novice elementary teachers are provided – both in teacher preparation programs and in schools – with the necessary scaffolds and supports that will empower them to develop their own ambitious, integrated teaching practice.

References

Battersby, S. L., & Cave, A. (2014). Preservice classroom teachers' preconceived attitudes, confidence, beliefs, and self-efficacy toward integrating music in the elementary curriculum. *Update: Applications of Research in Music Education*, 1-8. doi: 8755123314521033

Bequette, J. W., & Bequette, M. B. (2012). A place for art and design education in the stem conversation. *Art Education, 65*(2), 40-47.

Bronkhorst, L. H., Meijer, P. C., Koster, B., & Vermunt, J. D. (2014). Deliberate practice in teacher education. *European Journal of Teacher Education, 37*(1), 18-34.

Catterall, J. (2013). Getting real about the E in STEAM. *The STEAM Journal, 1*(1). doi: 10.5642/ steam.201301.06

Chemi, T. (2014). The artful teacher: A conceptual model for arts integration in schools. *Studies in Art Education, 56*(1), 370-383.

Darling-Hammond, L. (2006). *Powerful teacher education: Lessons from exemplary programs*. San Francisco, CA: Jossey-Bass.

Davies, D. (2010). Enhancing the role of the arts in primary pre-service teacher education. *Teaching and Teacher Education, 26*, 630-638.

Donahue, D., & Stuart, J. (2008). Working towards balance: Arts integration in pre-service teacher in an era of standardization. *Teaching and Teacher Education, 24*, 343-355.

Eisner, E. W. (2002). *The arts and the creation of mind*. New Haven, CT: Yale University Press.

Furtak, E. M., & Alonzo, A. C. (2010). The role of content in inquiry-based elementary science lessons: An analysis of teacher beliefs and enactment. *Research in Science Education, 40,* 425-449.

Garvis, S., & Pendergast, D. (2012). Storying music and the arts education: The generalist teacher voice. *British Journal of Music Education, 29*(1), 107-123.

Gillies, R. M., & Nichols, K. (2015). How to support primary teachers' implementation of inquiry: Teachers' reflections on teaching cooperative inquiry-based science. *Research in Science Education, 45*, 171-191.

Guyotte, K. W., Sochacka, N. W., Costantino, T. E., Walther, J., & Kellam, N. N. (2014). STEAM as social practice: Cultivating creativity in transdisciplinary spaces. *Art Education, 67*(6), 12-19.

Jarrett, O. S. (1999). Science interest and confidence among preservice elementary teachers. *Journal of Elementary Science Education, 11*(1), 49-59.

Kawasaki, J., & Toyofuku, D. (2013). A distributed intelligence approach to multidisciplinarity: Encouraging divergent thinking in complex science issues in society. *The STEAM Journal, 1*(1). doi: 10.5642/steam.201301.10

Lortie, D. C. (1975). *Schoolteacher: A sociological study*. Chicago: University of Chicago Press.

Marshall, J. (2014). Transdisciplinarity and arts integration: Toward a new understanding. *Studies in Art Education, 55*(2), 104-127.

McDonald, M., Kazemi, E., Kelley-Petersen, M., Mikolasy, K., Thompson, J., Valencia, S. W., & Windschitl, M. (2014). Practice makes practice: Learning to teach in teacher education. *Peabody Journal of Education, 89,* 500-515.

Michaud, M. R. (2014). K-12 students see STEAM everyday. *The STEAM Journal, 1*(2). doi: 10.5642/ steam.20140102.33

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

Oreck, B. (2004). The artistic and professional development of teachers: A study of teachers' attitudes toward and use of the arts in teaching. *Journal of Teacher Education, 55*(55), 1.

Plummer, J. D., & Ozcelik, A. T. (2015). Preservice teachers developing coherent inquiry investigations in elementary astronomy. *Science Education, 99*(5), 932-957.

Poon, C., Lee, Y., Tan, A., & Lim, S. (2012). Knowing inquiry as practice and theory: Developing a pedagogical framework with elementary school teachers. *Research in Science Education, 42*, 303-327.

Radziwill, N. M., Benton, M. C., & Moellers, C. (2015). From STEM to STEAM: Reframing what it means to learn. *The STEAM Journal, 2*(1). doi: 10.5642/steam.20150201.3

Riegle-Crumb, C., Morton, K., Moore, C., Chimonidou, A., Labrake, C., & Kopp, S. (2015). Do inquiring minds have positive attitudes? The science education of preservice elementary teachers. *Science Education, 99*(5), 819-836.

Rufo, D. (2013). STEAM with a capital A: Learning frenzy. *The STEAM Journal, 1*(1). doi: 10.5642/ steam.201301.25

Russell-Bowie, D. E. (2012). Developing preseervice primary teachers' confidence and competence in arts education using principles of authentic learning. *Australian Journal of Teacher Education, 37*(1), 60-74.

Sotiropoulou-Zormpala, M. (2012). Reflections on aesthetic teaching. *Art Education, 65*(1), 6-10.

Spillane, J. P., Kim, C. M., & Frank, K. A. (2012). Instructional advice and information providing and receiving behavior in elementary schools: Exploring tie formation as a building block in social capital development. *American Educational Research Journal, 49*(6), 1112-1145.

Teo, T. W., & Ke, K. J. (2014). Challenges in STEM teaching: Implication for preservice and inservice teacher education program. *Theory into Practice, 53*(1), 18-24.

van Aalderen-Smeets, S. I., Walma van der Molen, J. H., & Asma, L. J. F. (2012). Primary teachers' attitudes towards science: A new theoretical framework. *Science Education, 96*(1), 158-182.

Walan, S., & McEwen, B. (2016). Primary teachers' reflections on inquiry and context-based science education. *Research in Science Education*. doi: 10.1007/s11165-015-9507-5

Westerback, M. E. (1984). Studies on anxiety about teaching science in preservice elementary teachers. *Journal of Research in Science Teaching, 21*(9), 937-950.

Wexler, A. (2014). The Common Core "State" Standards: The arts and education reform. *Studies in Art Education, 55*(2), 172-176.

Windschitl, M., Thompson, J., Braaten, M., & Stroupe, D. (2012). Proposing a core set of instructional practices and tools for teachers of science. *Science Education, 96*(5), 878-903.

Wynn, T., & Harris, J. (2012). Toward a STEM+ arts curriculum: Creating the teacher team. *Art Education, 65*(5), 42-47.