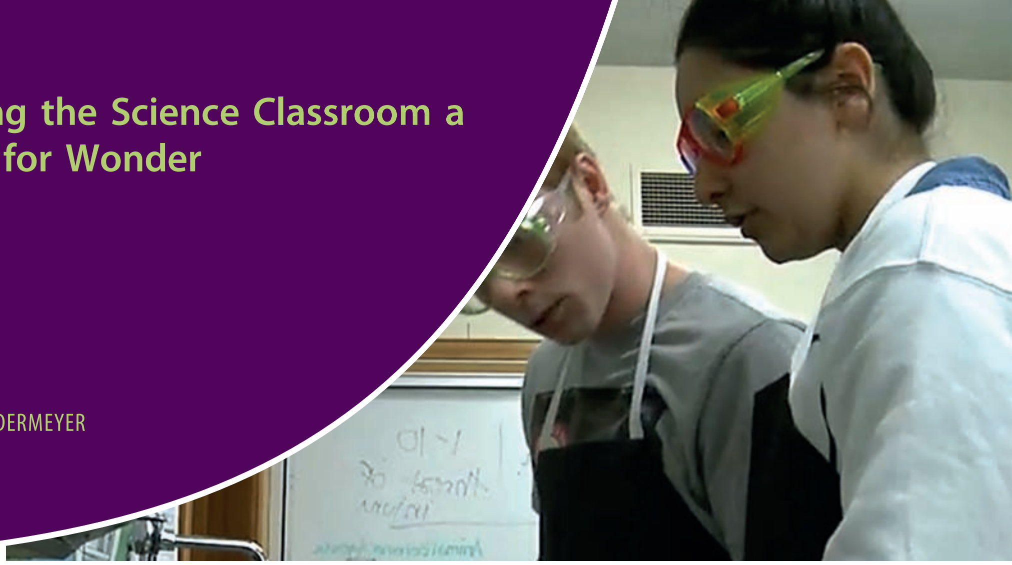
FEATURE ARTICLE

Making the Science Classroom a Place for Wonder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Abstract

What is the role of wonder in a classroom? And how does a teacher activate this most human of emotions? This paper investigates the role wonder—and the subjects most closely associated with it, art and science—should play in our students' school lives. The work connects my lived experiences as a high school teacher and college professor with the philosophy of John Dewey and contemporary literature on pedagogical practices. My findings suggest that it is a moral imperative to encourage wonder in our classrooms and to do so in an authentic way.

Key Words: *science education; art education; inquiry; John Dewey; interdisciplinary education; wonder.*

○ I wonder. . .

As a science teacher, this is the most powerful phrase I can hear come out of my students' mouths or register on my students' faces. I have seen this emotion inspire a high school junior to design a study to determine which type of garbage bag would be less likely to attract crows to his apartment complex's waste disposal area. It even emboldened him—a child who would be the first in his family to attend college—to dig through the primary literature to contextualize his findings in a way that enabled him to present his work at a local university's research symposium. I have also seen wonder propel a first grader, charged with inventing a tool to open a sunflower seed that she could have easily eaten, outright puzzle for two pregnant minutes and ignore the chaos around her before coming up with a solution. She proceeded to grab two popsicle sticks and two rubber bands, fashioning a sort of spring-loaded seed-cracker that required a third popsicle stick as a wedge to pry it open wide enough to fit a seed between the original sticks. Once the seed was placed in the opening satisfactorily, she yanked out the wedge stick, and the force generated popped the seed right open.

> *Wonder is the emotion responsible for inspiring the creation of art, science, and religion.*

○ I wonder. . .

As a professor in charge of preparing pre-service teachers, I have seen wonder compel adults seeking future employment to junk the "tried and true" unit plans of their supervisors in order to have fourth graders design new landscaping for the school. This experimental method resulted in his students presenting their plan to the school board, the mayor, and local businesses in hopes of achieving funding for the project (which they received). I have also seen student teachers realize that the reason they have grown up thinking they weren't math people is because they were only ever taught how arithmetic could help them solve problems on a page; they never were put in a position to wonder how math could help them solve a problem in real life. They are now seeking ways to ensure their students never lose the purpose of math in the practice of arithmetic.

○ I wonder. . .

As a researcher in the emerging field of evolutionary education, I am finding that the primary heuristic for learning across species is trial and error, which in my estimation rests at the foundation of wonder. In asocial animals, trial and error is the method by which an individual's agency is exhibited and problems are solved. For social animals, the orientation of others can help direct one's trials whether through social facilitation or apprenticeship, but there still exists the need to identify the causal relationship between action and outcome (van Schaik & Burkhart, 2011). These all require a rudimentary curiosity to transpire. That curiosity is elevated in species that transmit cultural traditions vertically and obliquely but also horizontally. Traditions required for survival in stable environments in both human and non-human cultures are transmitted vertically (from parent to child) or obliquely (from older to younger), while emerging practices that will aid

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survival in changing environments—i.e., those that are derived through rudimentary experimentation—are transmitted horizontally (between peers) (Thornton & Clutton-Brock, 2011). Unlike traditions that have remained stable for generations—chimpanzee termite fishing, human religious ceremonies—new cultural practices are discovered by an individual and transmitted through a group within a single lifetime. It has been demonstrated that for both human (Ridley & Ganser, 2010) and non-human primates (Sapolsky, 2006), such discoveries can change the trajectory of a group's success.

I do recognize, however, that full-fledged wonder may be a uniquely human emotion. As described by the philosopher Jesse Prinz, wonder is the emotion responsible for inspiring the creation of art, science, and religion (Aeon Video, 2016). It is what has driven us to explore what it means to be human from aesthetic, naturalistic, and spiritual perspectives, and it may have served as the impetus for the very development of the modern human mind. And, once that emotion is placed in the context of a culture and all of its philosophical and aesthetic trappings, it can inspire intellectual progress.

○ The Wheel of Wonder and Understanding

The great educator/philosopher/humanist John Dewey (1980) wrote in his book *Art as Experience*, "Philosophy is said to begin in wonder and end in understanding. Art departs from what has been understood and ends in wonder" (p. 270). If one were to develop a simple diagram of this statement, and modify it to reflect Dewey's (1960) sentiment from *The Quest for Certainty* that when it comes to philosophical inquiry, "Both logically and educationally, science is the perfecting of knowing, its last stage" (p. 219), it would provide a wheel that, given the right environment, would turn itself. By engaging in scientific inquiry, students will move themselves from wonder to understanding; by creating art, students will move from understanding back to wonder. It is no wonder that a recent evaluation of finalists and winners of the National Teacher of the Year program has determined that "arts-based teaching leads to more motivated, engaged, and effective disciplinary learning in STEM areas" (Henriksen, 2014, p. 2).

Therefore, as someone who has used this as the template for teaching students and for preparing future teachers, I have been left to wonder, why are we attempting at every educational turn to stifle wonder?

I ask because, as of this moment, the tests required for high school graduation in my state are only tests of reading, writing, and math. For teachers of other fields, there exists the expectation that we will list on our syllabi the common core standards that our course will address in our quest to get every student to graduate. While this common purpose is commendable, and the common core codifies skills deemed necessary for college and career readiness, the unforeseen (but predictable) outcome has been the diminution of science and art education, particularly at the elementary level (Fitchett & Heafner, 2010; Griffith & Scharmann, 2008; Irwin, 2016; Zimmerman, 2016).

I realize that I seem to be suggesting that only art and science can activate and utilize wonder, but I approach the two fields from a broad perspective. I look at art from the ethological perspective developed by scholar Ellen Dissanayake (1995), meaning I consider it the "making of things special." This simple yet profound definition incorporates what the philosopher/motorcycle repairman Matthew Crawford (2009) describes as the stochastic arts in his book *Shopclass as Soulcraft*. Dewey (1980) himself recognized that the "intelligent mechanic engaged in his job, interested in doing well and finding satisfaction in his handiwork, caring for his materials and tools with genuine affection, is artistically engaged" (p. 5). The teacher-scholar Karen Gallas (1994) discovered the power of this assumption in her own classroom, concluding in her book *Languages of Learning*,

> It is intense artistic activity . . . that begins in the early stages of learning and continues throughout a study that enables children to become immersed in a subject. The deep involvement in representing the form of an insect, whether it is one that has been observed or one only pictured in books, expands the child's basic knowledge of that organism and his or her ability to represent it in both thought and form. (p. 135)

For the educational theorist, such statements suggest that in providing students with the opportunity to turn what they know into something special—by doing art—we are destined to inspire wonder.

Conversely, if we adopt Dewey's notion of science, its application also becomes much broader. He concluded:

> Science is experience becoming rational. The effect of science is thus to change men's idea of the nature and inherent possibilities of experience. By the same token, it changes the idea and the operation of reason. Instead of being something beyond experience, remote, aloof, concerned with a sublime region that has nothing to do with the experienced facts of life, it is found indigenous in experience:—the factor by which past experiences are purified and rendered into tools for discovery and advance. (1966, p. 225)

Dewey's emphasis on discovery and experience evokes the process of inquiry. And inquiry is the educational method most often invoked as a potential panacea and certainly an expected pedagogical practice. As defined by the National Research Council (1996),

> Inquiry is a multifaceted activity that involves making observations; posing questions; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. (p. 23)

Upon reading this definition, it is no wonder that inquiry is a pedagogical practice expected by not only the National Research Council but also the Next Generation Science Standards, and the Common Core State Standards.

○ The Ignorance of Inquiry

It would seem that the power of art and science not only to move students between wonder and understanding but also to activate the very processes emphasized by current educational expectations would have art and science in favor among contemporary curriculum designers. That, however, is not the case. But why?

I posed this question to my high school students. The students (almost entirely seniors in a small elective class introducing them to

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teaching) immediately articulated that, for them, understanding was synonymous with being in possession of knowledge. (One student, a gifted thespian with a flair for cynicism, added "or at least what information would be on the test.") I asked them if understanding requires knowledge, what does that mean for someone who fails to possess knowledge?

My question elicited silence, even from the typically effervescent students at the center table.

I waited it out, curious what responses they were reluctant to share.

"Are you wanting us to be mean?"

"Ummm . . ." I cocked my head at the question from student who had identified herself as sensitive in an earlier class period. "Sure."

"They're ignorant."

I looked at the sensitive student and then raised my gaze to the rest of the class. "Is that mean?"

Their response was the closest thing to collective confoundedness I have ever observed.

"Yeah. Who wants to be called ignorant? Would you Mr. Niedermeyer?"

That two-minute exchange made me wonder: Are we trying to get students to memorize facts and rigidly apply skills in the hope that they become understanding, or are we simply trying to help them avoid ignorance? And does it matter?

I think it does matter, and not simply because I prefer to take action out of hope rather than fear. I say this because I agree with the cognitive neuroscientist, Stuart Firestein (2012), who in his book *Ignorance* writes, "Mucking about in the unknown is an adventure; doing it for a living is something most scientists consider a privilege . . . But they don't own it, and you can be ignorant too" (p. 15). By embracing our students' ignorance, we are encouraging them to wonder. And perhaps more importantly, by valuing not knowing, we prevent students from assuming that the acquisition of knowledge means they have achieved some educational end. According to Dewey (1966), this is a faulty assumption because, "The educational process has no end beyond itself; it is its own end" (p. 50).

Rather, if we take Firestein (2012) at his word, we should have our student scientists not "stop at the facts [but] . . . begin there, right beyond the facts, where the facts run out" (p. 12). As a teacher, in practice this means we need to be thoughtful about how the "Facts [should be] selected, [using] a process that is a kind of controlled neglect, for the questions they create, for the ignorance they point to" (p. 12). It is our role as educators not to focus so much on what we are teaching but how what we teach will help our students ask questions about the world. In light of Firestein's insight, it should not come as a surprise that practices that encourage students to wonder not only "*why* the rainbow appears, or *how* it appears . . . [but] also (continue to) wonder *at* the rainbow" can inspire students to see the ingenuity behind something as arcane as a mathematical proof (Sinclair & Watson, 2001, pp. 40–41). Extending Firestein's use of the selective neglect of facts even further, students should be encouraged to not just ask questions but to identify problems and to design potential solutions for them. This form of teaching, referred to by some as design-based learning (DBL), has been shown to effectively teach difficult concepts to myriad learners, with the greatest success (and engagement) observed in those students previously perceived to be low achieving (Doppelt et al., 2008).

It seems that there is justification for encouraging students to embrace their ignorance. Therefore, I was curious what might prevent my pre-service teachers from doing the same. So I asked them.

"The curriculum." The response from the Bachelor of Education program seniors was almost choral.

"What do you mean, 'the curriculum'?"

"If understanding means having knowledge, the curriculum is what the students are supposed to *know* at the end of the year."

"But what are they supposed to *do* with what they know?"

Silence.

I would love to say that this response was troubling, but it was not; it was expected. Much of the literature on teacher preparation suggests we become the teachers we have had; if our teachers considered themselves curriculum delivery devices, then we will be too. It is as if there is a collective view that students' minds are empty vessels that exist to be filled with the knowledge that pours forth from our classes, but there is little concern for what happens next.

This kind of practice has an effect on students—and not a positive one. As described by students in various stages of their science career to Pelaez, Ryder, Packer, and Cohen (1997),

> It was a struggle for me and it became an unpleasant experience because I don't feel I have a firm base even yet. In some cases it's a matter of simple memorization. It's not a matter of necessary comprehension. You have to get through the course and you decide, boy, I'll never do anything that involves this type of science!
>
> Science is hard and boring, especially those terms you have to remember, like in Biology, what's a biome.
>
> They even had a lecture based on vocabulary, but we walked out of it not knowing a single vocabulary word. (p. 5)

The breadth of knowledge taught in science seems to ensure student exposure to the vast expanses of scientific knowledge, but with there being so much coming so fast, students seem overwhelmed; it is less that their cup runneth over, and more that it seems to have sprung leaks. But for those students who do manage to grab hold of what is mentioned in class, what constitutes a sufficiently full vessel? And what is a student to do when their vessel is sufficiently full? The students in Pelaez et al.'s (1997) study explained that in the absence of context, the memorized material is effectively meaningless.

By embracing students' ignorance through inquiry-based teaching, context can easily be generated, but what is it that prevents young teachers from embracing this practice in their own classrooms? It has long been assumed that it is a lack of content knowledge that effects the comfort of pre-service teachers with regard to quality science teaching, but it has recently been shown that it may instead be their lack of exposure to inquiry itself that limited the pedagogical practice (Smit et al., 2017). This issue could be ameliorated through inquiry-based approaches like the Hands-on-Science (HoS) program at the University of Texas at Austin, where pre-service teachers' exposure to inquiry increases their perception of the relevance of, enjoyment with, and confidence in science (Riegle-Crumb et al., 2015).

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○ The Curiosity of Wonder

What I would have loved to hear from my own pre-service teachers is that we are not a product of what we know, but what we do with that knowledge, that knowledge comes from observation but wisdom comes from action. By acting on our knowledge and experiences, we are moving into the realm of what Dissanayake (1995) refers to as *dromena*, the Greek word for "things done." The things that are done are thought to be in response to the impulses generated by "powerful sentiments," deriving often from the ceremonial rituals of a culture. From a traditional anthropological perspective, this would often be tied to religious practices; in the kind of classroom I am advocating, it may be elicited from a teaching culture centered on valuing wonder.

Consequently, I am heartened by the phrasings in the common core state standards that require students to "Conduct short as well as more sustained research projects to answer a question (*including a self-generated question*) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation" and recognize that "Modeling links classroom mathematics and statistics to everyday life, work, and decision-making" (CCSSI, 2018). Unfortunately, rather than incorporate the aforementioned Design-Based Learning or use Llewellyn's (2013) models for teaching science through inquiry and argumentation, school districts have instead continued to use heavily scripted inquiry (Doppelt et al., 2008) while adopting curriculum like Eureka/EngageNY that prescribes what teachers are supposed to do down to the minute. To paraphrase Firestein (2012), there seems to be such a concern for *covering* the material that we forget that learning happens when students do the opposite: *dis-cover*.

For students to want to discover requires not only wonder, but also curiosity. As described by Opdal (2001), "Curiosity . . . [is] a motive to do exploration within definite and accepted frames" whereas "wonder . . . [provides] doubt about the frames themselves" (p. 331). Framed this way, though curiosity may be sufficient to initially motivate a person to seek an answer, it is wonder that can cause the emotional investment necessary for deep investigation (Hadzigeorgiou, 2012). Wonder can therefore be inspired by curiosity, and curiosity comes in two forms: diversive and epistemic (Leslie, 2014). The former is grounded in the perception of one's immediate environment (Leonard & Harvey, 2007); it is the sort that is often thought of pejoratively because it is what killed the cat, or in this digital age, the sort that inspires a person to watch cat videos on YouTube. The latter is the form that sends us on quests for answers, the one that takes us down the rabbit hole. This sort of curiosity is often associated with achieving a specific goal or acquiring a specific piece of information (Leonard & Harvey, 2007).

Epistemic curiosity is the form that drives artists and scientists (i.e., it causes wonder), and it is the sort that, in this era of (mis) information, needs to be exercised. It was epistemic curiosity that drove Leonardo da Vinci to take deep dives into architecture and painting, philosophy and the human body. Epistemic curiosity drove microbiologists Thomas Block and Hudson Freeze to investigate extreme thermophilic bacteria in the 1960s. For years, research was conducted on their unique chemistry, feeding the scientists' desire to understand the organisms. It was not until the 1990s that it was discovered that the heat-tolerant enzymes possessed within the cells were exactly what was needed to spark the modern genetic revolution (Leslie, 2014). The researchers' understanding produced a new field of investigation, thereby inspiring a new generation of wondering, in this case about the limits of the technology.

When students develop epistemic curiosity, it can have lifelong effects. In a recent *Washington Post* article (Mooney, 2016), researchers demonstrated that people with a higher degree of what they consider science curiosity—their synonym for epistemic curiosity—are more likely to read articles that challenge their beliefs. Amazingly, the effects held true for individuals regardless of political leanings, meaning it was science curiosity that drove people to read articles that challenged their thinking on issues like climate change, not their degree of liberalism.

If it is our goal to encourage students to develop their epistemic curiosity in the hope that they too will become citizens who will allow their beliefs to be challenged, we can't focus solely on developing the wherewithal—or to use the word *du jour*, grit—associated with intense self-inspired investigation because it gives us no place to begin. With the impetus for curiosity having been identified as a desire to reconcile environmental incongruities and to test one's competence in achieving a desired end (Loewenstein, 1994), it seems that for a teacher to inspire epistemic curiosity—and ultimately wonder—in the classroom, students must be provided with some sort of motivational nudge. That nudge need not—and perhaps should not—be from some discrepant event that causes students to pay attention in the absence of the appropriate context. Rather, it should focus on what Musaio (2012) calls "the moral dimension of wonder." She concludes

> The *moral dimension of wonder* . . . [has an] educational role: when we open ourselves to wonder we fight the passive attitude by which we tend to reflect reality as if through a mirror, limiting ourselves to repeating what we see or hear. What makes the difference in the things that attract our attention by arising wonder, is the peculiarity of the approach: it doesn't consist in a mere registration of the images imprinted in our view, nor in the simple observation and recording of something happening outside of us. (p. 22)

To elicit wonder requires more than simply providing a phenomenon for students to watch. Students must be provided with the opportunity to play with their ideas. That is where diversive curiosity comes into play. For a classroom to inspire wonder, it has to offer the opportunity for students not only to flip over proverbial rocks and but also to try out fanciful ideas.

○ The Advantages of a Messy Classroom

I recognize that such a view, particularly for those with experience in education, could conjure images of an unmitigated mess. As someone whose classroom always appears to be in some stage of recovery from a weather-induced disaster, I would be the last to argue with that expectation. But then anyone who thinks science and the process of inquiry is clean, is not doing it correctly. In his book recounting his ascension as scientist—aptly titled *An Appetite for Wonder*—Richard Dawkins (2013) explains that "scientific research doesn't develop in the same orderly sequence as the

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final published 'story.' Real life is messier than that" (p. 185). Art too is messy, requiring not only materials but also inspiration. It progresses in fits and starts, resulting in abandoned projects and ever-changing masterpieces (Lewis, 2015). Therefore, it is interesting to note the necessity of allowing this messiness to proceed in the classroom. As stated by Zimmerman (2016) in his examination of why novice teachers have trouble producing quality STEAM lessons,

> 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 . . . just as scientific inquiry must enable students to gather and analyze quantitative data to make sense of a real-world phenomenon . . . (p. 3)

Classrooms that value such chaos as the product of diversive curiosity and a wellspring for its epistemic sibling can produce seemingly unfathomable outcomes.

Among the greatest curricular manifestations of this value is the creation of "boss level classrooms" demonstrated at the Quest2Learn public school in New York (Vallon, 2013) and the "Genius Hour" that is being adopted by schools and districts across the country (Kesler, 2013). In the former, teachers frame open-ended challenges to students (e.g., design Rube Goldberg machines) then allow students to work in collaborative groups to develop solutions. In the latter, students are given (ostensibly) an hour a day for a set time to investigate and develop a project in a topic of their own interest.

On a smaller scale, Gallas (1994) describes how her second grade students brainstorm a list of questions they have about the world, and a 20–30 minute discussion is held each week about a single one of those questions. Throughout the discussion, "Children take observations from their own lives and attempt to relate them to the question at hand" (p. 88). These bits of evidence allow them to have rich discussions about the likelihood of conflicting explanations (e.g., whether wind is a product of atoms bashing into each other or of giant fish fighting and swimming together). One of the teachers of the year profiled by Henriksen (2014), Mr. Geisen, actively utilizes the creativity art brings into his classroom by having students design advertisements that would allow plant cells to "sell" parts like chloroplasts to animal cells. More than just incorporating visual art, however, he explained:

> We do a lot of theater and kinesthetic movement, where students might represent different creatures in an ecosystem or they might represent different elementary particles of an atom . . . they're moving and demonstrating what they know or coming up with their own little science theater pieces. (p. 3)

As a student, I can recall similar integration of art with science by a gifted teacher. My fifth grade teacher—Ms. Bales—so valued collaborative creativity that she invested a week in our own "boss level" project: creating a haunted house for our school's second graders. As a teacher, I have incorporated salesmanship into my own classroom, with my International Baccalaureate students developing teaching products for the biochemical processes of replication, transcription, and translation, and then selling them to the class as if we were the board of Carolina Biological Supply. I have also attempted to incorporate the idea of the genius hour into my animal behavior class, where students complete field research on local wildlife and then develop posters that are presented at local events. The quality of the research never ceases to amaze me (three have presented their work at the Urban Ecology Conference alongside undergraduates and graduate students). I attribute their success mostly to placing a high degree of value on their curiosity and their research process, and giving them an hour a week to invest in the project over our two-month research cycles.

○ The Promise (and Peril) of Embracing Wonder

One need not overhaul a curriculum or teach a unique elective course, however, to reap at least some of the benefits from working from a position of wonder. In elementary classrooms where reading is linked to science, student literacy scores are better than in a traditional classroom where lessons are separated by subject (Lutz et al., 2006). Additionally, classrooms that incorporate art into the curriculum have had students demonstrate improved learning retention. The authors concluded that using art ensured students were rehearsing and elaborating on the information and skills presented, representing what they had learned visually and kinesthetically, generating ideas and talking about them, and perhaps most importantly, becoming emotionally invested in the work to such a degree that they invest greater effort in the endeavor (Sousa & Pilecki, 2013). Finally, in a quasi-experimental study done in Greece, it was demonstrated that students whose wonder is intentionally activated through demonstration, activities, and inquiry perform better on standardized evaluations than those students taught from lectures and supplementary textbook work (Hadzigeorgiou, 2012).

While I am heartened by these examples, I do have concerns about a compromising approach to the activation of wonder. If we put time or curricular constraints on using wonder, does it denude the idea of its emotional heft? When Herbart outlined his planning process for education at the dawn of the twentieth century, it was revolutionary. His five-step process of (1) Preparation, (2) Presentation, (3) Association, (4) Generalization, and (5) Application was revolutionary because of its insight, simplicity, and flexibility (Webb, 2006). It encouraged teachers to think deeply about their subjects and the processes associated with learning, and viewed from a certain lens, one could say it changed education for the better (it is, after all, the foundation for the 5E instructional model advocated by professional science teaching organizations) (Bybee, et al., 2006). But as with any practice, it became formalized and came to be deployed in a rigid fashion by teacher educators and curriculum designers, thereby stripping it of the flexibility that could inspire creative teachers to invent lessons. It may have raised the floor on education but it also lowered the ceiling. I wonder if the same will happen as we (hopefully) rediscover the role of wonder in education.

I wonder because even students in STEAM academies have perceptions of scientists as people with limited creativity. In their paper evaluating fifth to seventh grade female students in a summer STEAM program, Tsurusaki et al. (2017) asked a student,

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> *Interviewer*: Do you think scientists use creativity in their work?
> *Interviewee*: I'm going to go with no because if they're trying to draw something they can't use their creativity because they're science and they have to draw the exact thing otherwise if you're discovering a new species and you sketch if you can't really use creativity. (p. 268)

This perspective of scientists as uncreative suggests students expect to find the right answer by performing prescribed procedures for their inquiries. On an institutional level, I have watched as International Baccalaureate's (IB) biology curriculum has moved from an emphasis on content to one about the nature of science. At the same time, the expected methodology for delivering this curriculum has changed from allowing teachers to develop laboratory assessments of their own choosing to a suite of required labs students are required to perform. As a result, it feels as if for the first time I am being told I need to formally teach the role of curiosity and ingenuity during the scientific process of famous discoveries, while at the same time being forced to have limited parameters for my students' *own* discoveries.

Recently, one of my building's most gifted teachers was filmed for a professional development presentation telling her IB history students prior to a Socratic seminar that their discussion was going to be a free space to "wonder and ponder" about the reading—a powerful statement. Unfortunately, her delivery was happening in a classroom where the walls are covered in poster-sized checklists of the constraints of the IB history exam. Concurrently, the administrator in charge of that professional development on inquiry-based teaching actually used inquiry-based teaching to deliver the message, only to end the lesson declaring that doing so "was a risk." It is almost as if organizations are realizing inquiry is valuable but feel as if it must fit within the self-constructed limits of what it means to be a professional educator.

From my vantage point, it appears that we are witnessing the potential rebirth of wonder in the classroom, but as I see it, we are faced with a difficult decision. Are we going to adopt inquiry and invention as another educational initiative and place it alongside literacy and math as the subjects to be taught? If so, we will again raise the floor, moving the quality of our educational practices and schools incrementally forward. But we will also be lowering the ceiling, effectively articulating to students that there is a time and a place for curiosity and creativity and it is during the curiosity and creativity block; therefore, get back to your workbook and finish your math problems.

It won't be until we realize that wondering is the impetus behind developing understanding in all subjects, and that the creations that spring forth from new knowledge inspire more wonderings, that the ceiling—and the roof—will be blown off of education. Our classrooms should be a place for students to wonder and ponder about the curriculum but not worry about whether their thoughts are going to be valued by an international examiner. Teachers should be taught and encouraged to use inquiry as the basis for their instruction and not feel as if they are taking some kind of significant risk. Students should feel emboldened to learn from their ignorance, not shamed into silence by it.

If we are able to embrace these principles, we won't need to cordon off time for students to be geniuses or make special declarations that this is the week we defeat the proverbial boss; these practices will simply be called what they should have been in the first place: teaching. And the school will become exactly what Dewey wanted it to be for all students: a place for wonder.

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