

ARTICLE

Sharing Power: Leadership Lessons from Interdisciplinary Practices in an Art Museum

FRANCESCA CASADIO **Correspondence**

Francesca Casadio,
The Art Institute of Chicago,
111 S Michigan Ave.,
60603 Chicago, IL, USA.
Email: fcasadio@artic.edu

Abstract Fine arts museums are undergoing a radical transformation, from closed containers of “things” to porous spaces onsite and online where the visitor experience is paramount. The current moment is accelerating this transformative evolution of museums into institutions that feel relevant and attractive to diverse audiences, now increasingly on multiple platforms. This change on the visitor-facing side needs to mirror a change in practices and attitudes on the inside. As part of this transformative effort a few art museums are supporting a new generation of leaders that have traditionally been in the shadows—those in charge of conservation and scientific research. The infusion of conservation and science narratives in art museums can change visitors’ mode of engagement, diversify content entry points to art for those drawn to science, inspire new public offerings, transform museum spaces to make the practice of conservation and scientific research visible, and attract new funding streams. In this paper we share recent experiences at the Art Institute of Chicago, distilling some key elements that can help transform museums into more equitable and multidisciplinary spaces of inquiry. The work underway builds on the values of STEAM (Science, Technology, Engineering Art and Math) education and takes place in the context of a growing field of collaborative and interdisciplinary museum practice.

INTRODUCTION

In recent years, internal and external forces—like powerful magnetic fields—have triggered a process of radical transformation in art museums. Gallery spaces are changing as museum buildings are transformed from closed containers of objects to open, porous spaces where the visitor experience is at the center. As Lonnie Bunch articulated in one of the most visionary tales of Museum leadership of the 21st century, the central question for any museum that wants to have an impact in society is: “No museum can become a community center, but how could this museum be at the center of its many communities”? (Bunch, 2019, p.50).

Francesca Casadio (fcasadio@artic.edu) joined the Art Institute of Chicago in 2003 and is currently Associate Vice President and Grainger Executive Director of Conservation and Science. Francesca holds a PhD and MS degree in Chemistry from the University of Milan, Italy and an honorary doctorate from the Sorbonne University in Paris (2019).

Numerous art museums are supporting the development of a new approach to visitors' engagement as part of this evolution towards institutions that feel relevant to a broader range of people and succeed in attracting diverse audiences. The museum workers who have a voice in content creation and who are afforded a platform are also changing. "Leadership" in art museums has traditionally come from the top, mostly through those in the director's office and in curatorial ranks. A large, encyclopedic museum like the Art Institute of Chicago would generally speak with one voice, the "institutional" voice. However, a new generation of leaders in diverse areas of museums is demanding that power be shared. Among these emerging voices are those of professionals in conservation and scientific research, museum education, and what used to be called "digital" departments. Traditionally conservators and scientists have had visibility in their professional circles, while remaining mostly behind the scenes at art museums. A pervasive view of conservation used to be that the work of a conservator is well done if the public has no notion of it. Recently though we have seen a substantial shift. Institutions worldwide have realized that putting the visitor at the center means offering a variety of stories and entry-points to the artworks in our care, and that science and technology can be drivers of interest in the public and in the media, opening up avenues to reach new audiences for art museums.

In parallel, individuals and professional organizations have realized that if conservators and scientists want to be recognized as leaders they need to start to engage more extensively with content in the galleries, programming, and the media, which are the most visible part of a museum's presence in the community.

In this paper, I will describe what leadership in interdisciplinary collaborations and visitor engagement looks like through the lens of a partnership between the Conservation and Science Department and the Departments of Learning and Public Engagement and Experience Design at the Art Institute of Chicago. We call this constellation of collaborative initiatives "intersections of art and science", and throughout our work we use the term "science" broadly to encompass a set of practices involved in conservation of works of art, scientific research, and mindsets involved in scientific inquiry. We also use an expanded notion of inquiry to go beyond the simple act of examining facts and principles, to include a broader understanding of science as inquiry, experimentation, collaboration, and process. Embracing an institutional commitment to inquiry therefore becomes an unexpected leadership tool. It provides a framework for sharing power that frees us to recognize what we don't know as individual contributors, and empowers us to ask the right questions and take risks as a team, leading to innovation and productive new discoveries.

In this article, we distill some key elements of research and practice that can help transform museums into interdisciplinary spaces of inquiry. Our collaboration is grounded in the belief that direct encounters with authentic works of art can support the well-being of communities in which they operate (Fancourt, 2019; Fancourt & Steptoe, 2019). We write from our experience at the Art Institute of Chicago, and contextualize that work within a growing field of collaborative and interdisciplinary museum practice, and the increasing appreciation of the value of STEAM (Science, technology, Engineering Art and Math).

Why Science in an Art Museum?

Nothing brings me as much joy as when thinkers from disparate fields collaborate in public settings. It requires vulnerability, risk, generosity and curiosity as we reach across disciplinary divides to better understand human experience. Dario Robleto¹

The emergence of conservators and scientists as powerful and original voices in art museums can be related to a growing interest in connecting materials with meaning in museum interpretation, education, and academic scholarship. Conservation and scientific research are key to unraveling the steps that lead to the making of a work of art. This content—strongly enhanced by close-looking—is readily available in art museums. In fact, direct engagement with art within the physical space of our galleries maximizes that impact. A recent large-scale national study on single-visit art museum programs for K-12 students in the US showed that, by experiencing, describing, and interpreting art in a museum, students think of art in terms of its material properties more than when seeing art in reproduction, ask more complex questions about art, are more accepting of multiple interpretations, and experience greater emotional recall.²

Research on the merits of combining art and science to forge effective approaches for formal and informal pedagogy abounds. Below is a summary of demonstrated strengths and emerging trends in various contexts.

1. In *K-12 education* STEAM approaches promote the most effective learning when the pedagogy focuses on the creative process, i.e., all those steps involved in planning and making a work of art (Perignat & Katz-Buonincontro, 2019). Going beyond an exclusive emphasis on the finished product enhances creativity because making art involves exploration, self-expression, meaning-making, risk-taking, failing and learning from failure. Ultimately, an approach that starts from real-life problems, and can happen in the classroom or in a gallery, leads to the development of problem-solving skills that transcend a single discipline. Furthermore, exploring context beyond the art object itself (for example trade routes for artists' materials) hones skills that are necessary for interpreting and contextualizing high volumes of information, which is an essential human skill in a future marked by complexity and where Artificial Intelligence will be pervasive.
2. In *higher education*, the connection between creativity and the self that is prevalent in art-making can benefit students in other fields where creativity and problem-solving matters, such as engineering. Sochacka et al. (2016) articulate the value of integrating art in a science curriculum in a forceful way: "In the arts, meaning is embedded in interactions between the artist's inner and external realities. Both realities are seen as complex, subjective layers that must be drawn out and negotiated in order to be understood. Conversely in Engineering, students are seldom encouraged to examine their relationship to the problem at hand and the influence of their beliefs and values on the process and product of their labor." (Sochacka et al., 2016). Deepening this understanding through encounters with art objects can better prepare students for the challenges and complexities of the future of work.

3. *A focus on the art and science of making flattens hierarchies of value that have been pervasive in art history and museums.* Academic research is showing a growing interest in using reconstruction as a theoretical model for studying historical objects. Led by Pamela Smith's "Making and Knowing Lab" (Smith, 2016; Smith et al., 2017), certain scholars are arguing for a different approach to understanding knowledge that elevates making as an important cognitive tool. This focus on making, in connection with indigenous histories and the science of the materials used to make functional and non-functional aesthetic objects can also have a transformative impact on indigenous youth, facilitating connections to their heritage and to the natural world in powerful ways (Barajas-López & Bang, 2018). Pedagogical offerings of indigenous making and sharing, according to those authors, "demonstrate that Indigenous people can exert agency to restore futurities by, among other things, reclaiming traditional forms of making as a living legacy of Indigenous scientific and technological activity".
4. *The value of STEAM for professional development of museum staff* is only beginning to be recognized: Saraniero and Kelton (2019) recently discussed the benefits and challenges of training museum professionals at science centers and art museums to design interdisciplinary programs fostering informal science education with university faculty.

This brief overview of the literature unambiguously demonstrates that pedagogical and interpretive approaches focused on STEAM foster critical thinking skills, creativity, intuition, divergence, and a wide knowledge base that can assist with creating shared cultural frameworks. Like in the art studio, where the artist is allowed to fail and solutions often emerge from material practices, training the mindset, not only the skillset, as well as creating a more diverse shared cultural ground is highly relevant in today's world where a "a radical diversity of thoughts" (Ayala, 2018) is urgently needed.

At the Art Institute we strongly believe that, in the future, we will continue to see an increased interest in inquiry, discovery and exploration related to the relationship of art and science in art museums. Our pervasive digital culture is combining things together by association based on search terms, favoring non-linear paths of access to information, non-linear ways of learning, literally forcing interdisciplinarity. Furthermore, the public wants to know how we know what we know about the objects in our care, creating an enhanced desire to go behind the scenes at institutions. Combined with the expectation to have access to everything, our society is creating a fertile ground for intersections of art and science.

Conservators and scientists in art museums are perfectly poised to be co-leaders of this new approach that has the potential to be transformative for institutions.

OLD PARADIGMS, NEW PARADIGMS

A Brief Overview of the State of the Field

The last decade has witnessed an increasing number of presentations of art and science that have conservation as their leading theme or are part of immersive environments that seek to intensify the

visitors' experience of art. With titles such as "Time Will Tell: Ethics and Choices in Conservation" (Yale Art Gallery, May 22–September 6, 2009); "Close Examination: Fakes, Mistakes and Discoveries" (National Gallery of Art, London, 30 June–12 September, 2010), and "Where Art and Science Meet" (Colonial Williamsburg, June 26, 2010–September 4, 2012), these exhibitions and many others have communicated to the public the methodologies, decision-making, investigations and ethics that inform the practice of conservators and scientists in museums.³ Videos exploring behind the scenes conservation stories, illustrating the scientific analysis of art materials, and illuminating artists' techniques are among the most popular online museum offerings, garnering hundreds of thousands of views.⁴ Press interest and coverage has further amplified public awareness, nourishing an appetite for this content. This trend and appreciation has been strengthened by expanding possibilities in the digital space, as seen for example in the Art Institute's exhibition "Van Gogh's Bedrooms" (February 14–May 10, 2016) and its related video "Under Cover: The Science of Van Gogh's Bedrooms".⁵ The exhibition included immersive environments in which the public could explore individual brushstrokes in each of the three Bedroom versions, just like conservators do in their labs under the microscope. The highly innovative and critically scrutinized exhibition "Leonardo Experience a Masterpiece" at the National Gallery in London (November 2019–January 2020) went as far as including a full reconstruction of the Gallery's conservation studio and a highly cinematic narration of the latest scientific discoveries on the Leonardo masterpiece.⁶

These developments are exciting forms of innovative disruption through interdisciplinary collaborations,⁷ however, they are still very sporadic, and have yet to lead to systemic change or be theorized or researched from a visitor perspective. To date, no foundational museological text exists detailing the integration of heritage science and interpretation. Most of the published case studies of public engagement with conservation are told from the perspective of conservators and other practitioners involved in specific outreach efforts, but not in term of visitors' impact or changes in institutional practice (Chitty, 2018; Saunders & International Institute for Conservation of Historic & Artistic Works, 2008).

Outside this growing number of temporary exhibitions, the comprehensive integration of conservation and science narratives in displays in permanent galleries is still in its infancy and filled with gaps. In a survey of twenty institutions in the US and Europe that we conducted we found that only a few museums house permanent galleries dedicated to conservation and conservation science.⁸ The Wallace Collection in London and the Ashmolean Museum at Oxford University for example, have conservation galleries that illuminate the compelling stories that can be told when conservation is given enough public space within a museum, yet, they appear to be segregated from the rest of the museum's galleries. For instance, the Ritblat Conservation Gallery at the Wallace Collection lives in the basement floor of the museum, below the café.

Staging open-air conservation studios is an increasingly popular mode of sharing conservation and science stories with the public. When integrated in museum galleries and not part of a special exhibition, these visible labs often feel less isolated. In some cases though, the poor graphic identity and lack of professional design of the interactives and labels relegate these as "second-class" spaces. In

surveying a variety of museum professionals about open-air conservation studios in the US, it became clear that in the majority of cases no substantive visitor research had been undertaken prior to or after design and implementation. Only a few institutions surveyed (among them the Walters Art Museum, the Victoria and Albert Museum, the Museum of Fine Arts, Boston and the Harvard Art Museums) noted that they have a dedicated strategy to incorporating conservation and science into the infrastructure of the museum. This widespread lack of overall strategy, which requires the collaboration of multiple departments and requires conservation leadership, highlights a major issue within the field that museums will need to address if they want to succeed in offering a variety of portals for visitors' engagement.

Overall, these site visits and case studies from other institutions highlighted the tendency to include conservation narratives as one-offs rather than integrated stories. In the words of Nina Simon they unlock an experience (Simon, 2016), but —we continued to ask ourselves—how can we make them more integrated, consistent, and relevant?

Our Paradigm and Method

This review of current research and practices led us to develop a robust conceptual, pedagogical, and experiential design framework for connecting art and science at the Art Institute.

We articulated our strategy along the following principles:

1. Build an institutional commitment to interdisciplinary inquiry

We—a core working team comprised of staff in Conservation and Science, Learning and Public Engagement, and Experience Design—began by starting with questions about the value of interdisciplinary work in art and science.

- What makes the engagement with both art and science special?
- How does foregrounding the intersections of art and science enhance the museum experience?
- How does this approach support interdisciplinarity and plurality of voices in the museum?
- By leading with questions rather than value-hierarchies of who provides knowledge and who delivers it, we fostered collaboration and shared power, creating a leveling playing field. Inquiry in an art museum is a powerful tool to highlight the similarities, instead of the differences, between art and science. such as the threads of scientific history that parallel, diverge from, and run through art history; the scientific practices embedded in an artist's process; and the hygrothermographs nestled in the corners of galleries—monitoring humidity and temperature to help preserve art. Inquiry as a guiding value makes sense at the Art Institute of Chicago—a research-based museum that is also, at its core, an educational institute committed to scholarship and access.

2. Create entanglement

Firstly, we determined that we would not establish separate galleries or spaces dedicated to conservation. Our guiding logic is that the work of conservators and conservation scientists is closely linked to that of curators in our museum practice, just like the fields of art and science are closely linked in history. Therefore, conservation narratives should be integrated into object stories in existing displays, exhibitions in permanent collection galleries, museum-wide digital strategies and live programming.

We also conceived our initiative not as a special project but rather as part of comprehensive, ongoing, and strategic efforts, supported by robust visitor engagement research and broad institutional support. This solid basis of theory, research and collaboration informed the design and implementation of an evaluative framework, which we, in turn, applied to a number of interpretive and programming case studies. They included digital labels for collection objects on display, school tours and career-exposure programs for teens, fellowship training programs, collection rotations, public programs, and collaborations with medical professionals.

3. Start small, scale up and cluster funding

The effort to bring the public into intersections of art and science was, quite intentionally, not conceived as a discrete project with a beginning and an ending, solely dependent on external project funding. Instead, it grew out of an existing commitment to a type of cross-departmental, interdisciplinary, inquiry-based practice that could continue to unfold over time at larger or smaller scales depending on resources available to ensure sustainability beyond a single grant cycle. We intentionally secured external funding to pilot a design-thinking phase,⁹ and subsequently obtained long-term support to fully braid this initiative into our institutional fabric.

By leading with conservators and scientists and focusing on the value of informal science education that can be deployed in art museums we were able to bring to the Art Institute funding from the National Science Foundation (NSF) for the first time in the museum's over 140 years history. Specifically, the work described here has been supported by a research partnership with Northwestern University and other international research partners in Italy, France and the Netherlands to engage the public where art, conservation, and science intersect.¹⁰ Partnership with a large research University meant that we could leverage the expertise and gravitas of its science faculty within NSF and expand the footprint of our impact. The University, on the other hand, recognized the potential of the museum as a platform to reach a larger community. Importantly, this major grant followed in the footsteps of smaller awards that cemented the collaboration between the museum's conservators and scientists with museum educators and university scientists. For example, a popular Art & Science school tour, developed, in 2015¹¹ continued to support dialogue and collaboration between middle school art and science teachers, with the goal of inspiring art and science integration in curriculum and foster a science mindset among students. Our original focus on art and science also led the museum to receive support for two consecutive Kress Foundation Fellowships in museum interpretation. These

initial, “seed grants” contributed to changing organizational culture and provided a fertile ground for bolder initiatives to develop over a longer temporal horizon.

4. Bring in an international perspective

In most organizations, when planning and implementing systemic changes to established practices it is useful to bring in an outside viewpoint. In our case, we recognized the importance of including an international perspective because, firstly, heritage science is a specialized field that is highly international in nature, and secondly, public awareness of the value of cultural heritage conservation is much greater in Europe than in the United States. The Rijksmuseum in Amsterdam is a partner in the NSF grant that supports this work, and demonstrated field-wide leadership in this area of intersection of art and science with the launch of “Operation Night Watch” in September 2019.¹² Through a kick-off workshop in the Netherlands in 2018 and a series cross-institutional conversations with our counterparts in conservation, education and digital engagement at the Rijksmuseum we were able to clearly identify ways in which art and science intersect in art museums in a collaborative fashion that ensured validity well beyond our institution.¹³ By checking in consistently with our partners in the Netherlands throughout the course of our initiative, we effectively built the scientific process of international peer-review into our practices while broadening the global impact of our thinking and doing. A tangible impact of the international collaboration was, for example, the decision to expand the focus of our own programming to engage all the senses (artists-educators at the Rijksmuseum lead an olfactory tour of the smells of the Dutch Golden Age). Our Dutch colleagues also inspired us to commission replicas of artists’ materials and processes (an embroidered textile, a tempera panel) from artists, as the beauty and craftsmanship of the materials have a profound effect on visitors, focusing their attention on makers. The trip to Amsterdam early at the start of the initiative also strengthened our leadership team, creating a valuable shared experience that we could go back to in times of difficulty or disagreements regarding the direction of the project—overcoming potential roadblocks in our system of distributed leadership.¹⁴

5. Incorporate design and design thinking

Understanding the deep impact that design has on the visitor’s experience, we committed to applying the same high-level treatment of graphic design and editing to designing conservation and science displays. These design principles should be simultaneously in harmony with general display practices of the institution while specific to the needs of conservation-driven presentations. For example, we were inspired by the compelling design of wall labels and interactives at the Smithsonian American Art Museum’s Lunder Conservation Center, because they attract the public and promote close looking. Similarly, the sophisticated design of the open conservation and scientific research displays deployed for the Huntington Art Gallery’s 2018–2019 “Project Blue Boy”¹⁵ were key to creating a complete and engaging experience.

Applying design-thinking principles that put the visitor at the center, we selected digital solutions such as interactive labels because they are a versatile and flexible medium to highlight

conservation stories. We are convinced that these media will remain relevant even in subsequent phases of this COVID-19-era where touch screens have stopped being a viable option. This is because the content of digital interactives, when designed appropriately, can be easily translated across delivery platforms to become online interactives available on people's own devices.¹⁶

Rather than working towards creating a static report of our activities, we decided early on to create a toolkit for other art museum professionals highlighting examples, research and tools to engage 21st century audiences with intersections of art, conservation and science. An attractive design was essential to this effort, to enhance readability and facilitate adoption by the field.¹⁷

6. Create a feedback loop-iterate, repeat

The novel aspect of our approach was not only to robustly integrate art and science in our galleries and programming, but also realizing that because the content of these museum presentations is underpinned by in-depth scientific and conservation research, interpretation and audience engagement research should be equally deep so as to create a valuable feedback loop. The current lack of visitors' research in the literature highlights the divide between education and conservation departments in most museums. We firmly believe that this gap needs to be overcome in order for museums to evolve and for this new model of shared leadership to thrive.

By adopting a unified yet flexible evaluation framework, we were able to test our initial hypotheses, surface unexpected outcomes, and draw broader conclusions from the process of assessing the impact of engaging art museum visitors with conservation and science narratives as well as with programs that draw out conceptual and dispositional connections between artistic and scientific processes. Developing our initiative over a long period of time allowed us to be agile and embrace a start-up mentality, piloting initiatives, and sustaining them or readily pivoting if visitors' research proved our efforts unsatisfactory.

CASE STUDIES AND MEASURING IMPACT

In our work, we explored a multitude of modes of engagement with art and science narratives and epistemologies. The specific activities that have been part of our initiative and related visitors' research have been described in detail elsewhere (Molina et al., 2021) and include:

- An exhibition, entitled *Conserving Photographs* (November 21, 2018–April 28, 2019), illuminating the relationship between conservation and the history of photographs and photographic techniques.
- In-gallery iPads developed to share three different stories about conservation in the museum: a yearlong conservation treatment and study of the painting techniques of El Greco's *The Assumption of the Virgin*; 1577–79; the material study of John Singer Sargent's watercolors; and the treatment and scientific study of a 19th century Dentzel Carousel Company horse.

- A live public event entitled *Materials of the Medieval World* that featured pop-up talks and demonstrations by conservators, scientists, and educators in the galleries, as well as a lecture series, “Secrets of the Collection”.
- An Art + Science tour for middle school student groups and their art and science teachers—an ongoing program.
- Professional development opportunities that give higher education students and scholars the opportunity to develop interdisciplinary work in the museum context, using art as a vehicle to develop skills in professional practices beyond our walls.

To guide our visitor evaluation we followed the National Science Foundation’s “Framework for Evaluating Impacts of Informal Science Education Projects” (Friedman, 2008) and The Smithsonian Institute’s Office of Policy and Analysis’s standards and protocols for evaluating museum visitors (Pekarik et al., 2014). It was crucial to embrace an evaluation methodology that was flexible enough to adapt to various contexts and modes of engagement.

We proposed specific impacts, which reveal whether or not visitors benefit from the museum sharing intersections of art and science. Specifically, our research tested whether interpretive and programmatic interventions resulted in visitors:

- Gaining a new lens for engaging with art objects
- Having a deeper understanding of materials and techniques used to make art
- Having a deeper understanding of an artist’s process
- Developing their curiosity
- More deeply valuing the experience of seeing an object or work of art in person
- Placing a greater value on the preservation of art objects
- Thinking more deeply about the relationship between art and science

DISCUSSION: TRANSFORMING MUSEUMS THROUGH INTERDISCIPLINARY RESEARCH AND PRACTICES

Specific Takeaways from our Experience

Building on the lessons learned from the design, implementation and evaluation of our case studies, we are able to draw some refined principles and insights into the key elements that make intersections of art and science relevant for our art museum audience.

In terms of *spaces*, to offer relevant experiences, we need to meet visitors where their barrier to access are the lowest (Simon, 2016). This is most successfully done by deploying multiple modes of audience engagement, and transforming our galleries in the broadest sense:

- through activation with the professionals involved in the work of conservation and science;
- through digital tools;
- through the more traditional medium of wall text and labels, shifting the focus on conservation and science through a STEAM approach (Figure 1)



Figure 1. Installation views of the exhibition *Conserving Photographs* (November 21, 2018–April 28, 2019). An estimated 175,884 visitors engaged with the exhibition. Photo: Alice Feldts [Color figure can be viewed at [wileyonline library.com](https://onlinelibrary.com)]

In terms of *content*, our case study focused on the exhibition *Conserving Photographs* revealed that, while visitors were familiar with notions of conservation relative to painting and sculpture, for instance, a focus on other media (photography) helped them think about conservation more broadly and see the value of the science behind preserving photographs. Quantitative data obtained by engaging participants in a card sorting activity both before (control) and after (test) walking through the exhibition showed that the biggest change affected by the exhibition was visitors' rating of the card "I am thinking about the relationship between art and science" (Table 1 and Figure 2).

The effectiveness of the exhibition in making manifest the role of science in the preservation of photographic heritage emerged powerfully also from qualitative intercept interviews. While terms related to the basic elements or roles of conservation were mostly consistent before and after the visit, the biggest changes involved more visitors mentioning science, technology, time, storage, and reversibility after walking through the exhibition (Figure 3). These changes suggest that although visitors had prior knowledge of the most basic tenets of conservation, the exhibition gave them more specific contexts and details for understanding conservation, such as the important role science and technology play in extending the lives of objects and the role of reversibility, as one visitor noted "[I think of] methods that are reversible if superior methods come up [in the future]." Although a number of visitors mentioned preservation prior to walking through the exhibition, no one discussed storage in the pre-terms. In the post-terms, a number of visitors mentioned cold storage and described being surprised by the existence of cold storage: "I never really thought of cold storage, and this has

Table 1.
Average control and test ratings for the card sort activity for the exhibition *Conserving Photographs*, showing a shift in perceptions

Card statements	Materials	Preserve	New ways	Curiosity	In-person	Process	Art & science
Control group	3.24	3.73	3.31	3.54	4.16	3.19	2.97
Test group	4.05	4.48	3.68	3.94	4.30	3.64	3.94
Change	+0.81	+0.75	+0.37	+0.36	+0.14	+0.45	+0.97

Note. Visitors were asked to sort the following prompts on a scale of 1 (least relevant) to 5 (most relevant): “I have a deeper understanding of the materials and techniques used to create art.” (Materials); “I place a greater value on the preservation of art objects” (Preserve); “I am seeing art or artists in a new way” (New ways); “My curiosity has been sparked. I am curious about.” (Curiosity); “I more deeply value the experience of seeing a work of art in person” (In-person); “I have a greater understanding of an artist’s (or artists’) process” (Process); and “I am thinking about the relationship between art and science” (Art & science).

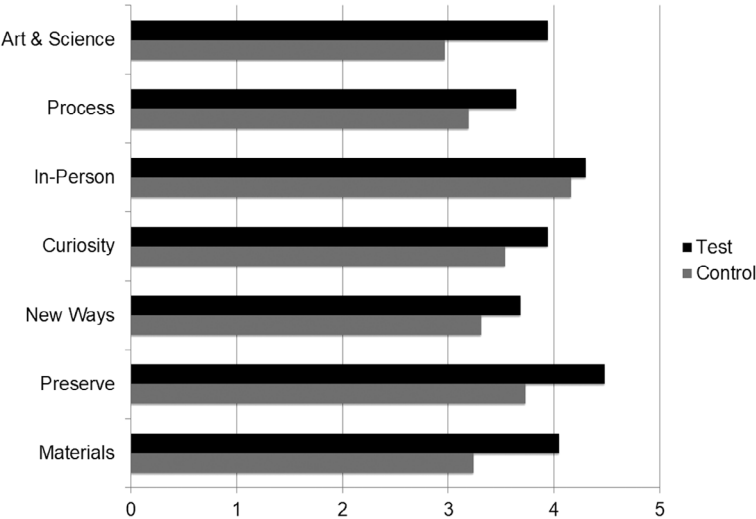


Figure 2. Average card sort rating for the different prompts (from 1 -least relevant -to 5 -most relevant) in both the control and test groups interviewed for the *Conserving Photographs* exhibition. Our evaluators conducted 100 pre-interviews and 100 post-interviews. On average, intercepted visitors spent 17 minutes in the exhibition. For abbreviations and prompts see Table 1. Source: authors.

made me realize how much light and temperature affect preservation.” Cold storage was mentioned often as a memorable and science-related aspect of conservation. As one visitor said: “the notion that cold storage has an impact on color. . .interesting to see that difference side by side. . .that was really helpful, seeing it side by side. So much precision and math involved in this that I didn’t appreciate before.”

In terms of *delivery*, we were able to demonstrate that digital labels are successful in cultivating prolonged engagement by examining qualitative visitor’s research in combination with data analytics about frequency and length of engagement provided by the platform. Our case

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study on John Singer Sargent's watercolors showed that, on average, the visitors spent 2.04 minutes using the digital label, which is much greater than the length of time visitors normally spend looking at objects and reading analog labels (28.63 seconds, according to a study conducted using objects from the Art Institute's collection) (Smith et al., 2017). We also learned that interactive media can successfully foreground materials, techniques, and artistic process, creating stronger emotional connections between the public and makers. For example, almost half of visitors who used the interactive on John Singer Sargent's watercolors were more likely to talk about or model empathy, make connections to their own lives, and discuss how using the digital interactive brought Sargent and his process of painting to life (Figure 4). In the words of one of the visitors: "[This digital interactive] makes the art more real world. There's a humanity to carrying your artwork around. Can actually picture him working, can have greater empathy with his life." Furthermore, by including in the concluding page of our digital interactive a prompt for visitors to look for a detail in the object or ponder an open-ended question related to a specific artwork, 99% of the observed sample looked back at the object after using the digital label.¹⁸

Through our live programs evaluation, we learned that having in-person interactions with conservators and scientists sparked visitors' curiosity, presented objects as open-ended, illuminated new knowledge, opened new questions, and helped young people relate more to scientific processes and content (Figure 5).

Overall, our experience and findings illuminate the ways in which addressing artworks through the lenses of both art and science foster greater empathy between visitors, artists, and artworks, enhancing visitor appreciation for the professionals working behind the scenes at the museum and powerfully illuminating the role of science in society. Our research also allowed us to identify gaps in our approach, and made us realize that in addition to sharing knowledge on the materials, making and preservation of works of art, efforts to connect art and science at the museum should present the many complexities of conservation and highlight conservation as a scientific and humanistic decision-making process. Surfacing the issues and, at times, controversies in conservation can help visitors engage with objects in new ways and compel the public to take their own stances on these choices. These issues can range from matters of competing cultural values in terms of preservation methods, the relationship between artistic intent and an object's afterlife, and understanding artworks as continuously changing objects rather than static entities.

Sharing Power: Leadership Lessons From Interdisciplinary Practice

What would our museums be if they divested from entrenched hierarchies within their collections, programming, and workplace, and invested in a culture of transparency, collaboration and mutual understanding? This might mean our museums become sites of convening where knowledge is unfixed, practices of care evolve with the times, and institutional accountability becomes second nature. In short, we

COMPLEXITY AND SPONTANEITY IN SARGENT'S PAINTING PROCESS

Building a Watercolor



Starting from Scratch

Before painting, Sargent composed a sketch in graphite pencil. He captured this intricate composition with its receding colonnade in two-point perspective.



This infrared image emphasizes the underdrawing, revealing Sargent's preparatory work and his talent for outlining architecture freehand.

Figure 4. Screenshots of the digital interactive label created to illustrate John Singer Sargent's process of making watercolors. The landing page and a page illustrating the underdrawing revealed with infrared imaging are shown here. Photo: Alice Feldts. [Color figure can be viewed at wileyonlinelibrary.com]



Figure 5. Images from the May 2, 2019, *Materials of the Medieval World* evening program, which activated our medieval galleries with pop-up talks and demonstration of the materials and processes of art production. (a) A visitor engages with the interactive evaluation station; (b) Frame conservators Kirk Vuillemot and Christopher Brooks give a demonstration of gilding; (c) Painting Conservator Julie Simek explains the painting techniques, history and conservation of the Ayala Altarpiece, Spain, 1396. Photo: Alice Feldts. [Color figure can be viewed at [wileyonline library.com](https://onlinelibrary.wiley.com)]

cannot just seek to change the individuals and the art histories represented in museums. We have to rethink the entire model and be open to the myriad forms that they might take. Yeosomi Umolu¹⁹

Critical to developing best practices through an interdisciplinary lens is an institutional commitment to values of transparency, equity and multivocality. At the Art Institute, we integrated and intentionally practiced key lessons of team leadership in order to successfully share power. Using Patrick Lencioni's model (2002) we implemented a structure that nurtured aptitude and dedication to collaboration among the leaders of relevant departments and allowed for sustained and effective engagement:

1. We created a shared foundation of *trust* by adhering to a commitment to inquiry as an institutional value. Framing inquiry as curiosity we cultivated a radically interdisciplinary space that encouraged individuals to keep their mind open to unexpected discoveries. Because nobody was the dominant subject-matter expert, we all shared areas where it behooved us to listen more than we talked. Our agreement to share power also made us less guarded and less fearful of failure, because we shared in both successes and failure with the leadership team, and this, in turn allowed for more innovative thinking and taking greater risks.
2. We created a space where we could engage in *unfiltered dispute about ideas*. Having built trust, we could disagree more and innovate better. Organizational leadership literature is clear on the fact that constructive disagreement in diverse teams is an essential tool to foster innovation and creativity (Gallo, 2018). Working in an interdependent, interdisciplinary leadership team also forced us to become "more comfortable with ambiguity" and realizing that "we could not solve these issues alone" (Bunch, 2019, p. 85)
3. We maintained project members *committed* to the project by defining clear plans of actions through shared documentation. Because we were working with a diverse leadership team it was essential to clearly delineate objectives, actions and responsibilities, in a more explicit and clear way than when working within a single division, to accommodate for different styles and aptitudes. Having two dedicated Kress fellows co-supervised by the Director of Conservation and Science and Director of Interpretation in Learning and Public Engagement, kept us focused and propelled us forward.²⁰ Recently many organizations in both the for profit and not for profit world are recognizing the importance of hiring young people and giving them the freedom and agency to shape a project and effectively mentoring senior staff members, essentially serving as a "youth board" (Jordan & Sorell, 2019). In our experience, empowering the most junior members of our team, the shared Art + Science Kress fellows, to lead regular stakeholder meetings not only provided a tremendous growth opportunity for the fellows themselves, but also contributed to weaving all our individual strengths and initiatives into a cohesive tapestry and gave them a platform for implementation of their ideas.
4. We held each other *accountable* for delivering on our goals. Our success was so interdependent that we needed one another and were motivated to deliver because of our responsibility to our

funding bodies and to each other. We rigorously tracked measures for success and led the iterative implementation of improvement steps based on feedback from ongoing evaluation. We were intentional in sharing findings at internal staff meetings across departments and at external conferences, thus contributing to building this area of research-based innovative practice.

5. By setting up the initiative as a space where we shared power since the beginning, it was clear that the finish line was *a collective achievement*. Everybody was brought to the table as equal among the leaders of the departments involved and among the staff who have been contributing to this ongoing initiative, overcoming previous divisions and hierarchies of values and positional power. We were able to develop a conceptual framework and action plan, experiment and test, iterate along the way, and gain enough of a perspective on the value of the effort to start sharing its outcomes with the field by year four. This includes the publication of scholarly articles (Molina et al., 2021) but also, importantly a practical tool kit for the field entitled *Intersections in an Art Museum: Where Art Meets Science*.¹⁷

CONCLUSIONS

*Museums need to think about futuring: recapturing the past with a broader circle. Theaster Gates*²¹

Ongoing research and practice at the Art Institute of Chicago over the last several years has consistently demonstrated the public value of integrating conservation content, scientific research and scientific modes of inquiry across the many dimensions of visitor engagement at art museums, whether within the galleries or across digital platforms.

To lead this work we have built a team of like-minded leaders from conservation, education and engagement, and experience design that has centered our practice on inquiry. Leading with curiosity, we have built a culture of collaboration scaffolded with feedback loops that are focused on the value of ideas over the value of any single leader. Sharing power inside the organization has led to more inclusive practices in our galleries too, as naturally by bringing around the table the perspectives of museum workers with a wider varieties of backgrounds and expertise has provided more than a single “hook” for the many members of our public.

What the Art Institute’s example offers other museum practitioners is the value of adopting long-term, systematic, integrated approaches to interpretation and programming strategies that connect art with science. Our work has revealed that these efforts can: a) provide audiences with new or deeper perspectives for understanding and valuing art objects; b) highlight the often profound impact of interdisciplinary thinking; c) diversify entry points to art museum for visitors who are mostly interested in science and technology; and d) help museums transform into multivocal, interdisciplinary spaces for creativity and inquiry. This work has transformed our institution, while also bringing in new sources of funding to advance it. This type of interdisciplinary practice can change notions of where and how research happens and who brings knowledge to the table, bridging scholarship and access and showing their

interdependence. Importantly, we have also found that this initiative has promoted staff engagement: those traditionally behind the scenes feel more deeply part of the public mission of the museum while those who often engage with the public had a chance to model what practice-based (rather than object-based) research looks like at the museum. This impact on our professional identities and self-perceptions made us all feel no longer strictly defined by a professional title or by a single department, but united by shared inquiry and a commitment to taking risks.

This approach is extremely relevant today. Beyond the palpable impacts on learning, audience engagement, meaningful visitor connection to art and artists, or even staff engagement, manifesting the intersections of art and science can address postcolonial challenges to museums as mere “container of things” sometimes acquired with dubious methods. The lens of open-ended scientific inquiry into making can open promising avenues to restoring futurities. It can open new ways for thinking both about the laden histories of objects as well as present and future ways of understanding them. This approach unlocks different stories and viewpoints on the objects entrusted in our care, and presents both knowledge and museum practice as critical, constantly evolving endeavors. By mining the objects for broader cultural circles, we see opportunities for thinking about serving multiple communities rather than just multiple visitors, and, as a result, we can expand the circle of stories we tell with our objects. To do this we need to take a holistic view of our objects, not only the lifecycle of the object from creation, to collection, to its preservation and decay. This calls for bringing into the spotlight the people who created the art, the communities they were or are part of, and those who care for these objects today. These approaches can also offer ways of thinking about environmental themes, positing the preservation of our cultural patrimony as a counterpoint to our disposable and commodified society. In other words, by shifting the focus from the object to their makers through STEAM approaches to our interpretation and public programming we can also better support institutional practices towards equity, flipping a narrative of products over people that has been associated with normative white cultural values (Barajas-López & Bang, 2018).

At a time when we contemplate, with urgency, the relevance and future of museums, an orientation towards inquiry, adaptation, and a willingness to experiment are more important than ever. These principles lie at the root of possibility and discovery and serve as bedrocks for both art and science. They also offer us a further reason for why it matters that visitors engage in learning processes related to these seemingly separate disciplines—that they, and us museum professionals, grow an unending capacity for curiosity and the pursuit of a deeper understanding about our world. **END**

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NOTES

1. @darioobleto and <http://www.darioobleto.com/media/73> The citation is from one of Mr Robleto's Instagram postings related to a panel discussion hosted by Harvard University's Radcliffe Institute for Advanced Study featuring the artist with Dr. Doris Taylor, Texas Heart Institute director of Regenerative Medicine Research and director of the Center for Cell and Organ Biotechnology (November 2019).
2. The specific findings are in Randy Korn & Associates, *Impact Study: the effects of facilitated single-art museum programs on students grades 4–6*, September 2018, pp. 21–30 (Summary Report and Discussion) <https://www.arteducators.org/research/articles/377-naea-aamd-research-study-impact-of-art-museum-programs-on-k-12-students>.
3. For more on this topic see Ian McClure's and Emily Williams' articles in *The Public Face of Conservation*, 2013, containing useful overviews of conservation- focused exhibitions that have been produced over the years (Williams & Colonial Williamsburg Foundation, 2013).
4. At the Metropolitan Museum of Art, changing attitudes towards conservation made the restoration of a damaged renaissance sculpture the centerpiece of a media and educational campaign that brought positive attention to the museum and nearly a quarter million view for the Youtube video "After the Fall: The Conservation of Tullio Lombardo's Adam" (https://www.youtube.com/watch?v=3oznnP6SkSc&list=PLsc7hDuLlCv98o6ZMaL9G_7IfHXfNhFru&index=3). At the Art Institute of Chicago one of our most popular video of all times on our YouTube channel is "Conserving Ancient and Byzantine Art at the Art Institute of Chicago", with 250,000 views (<https://www.youtube.com/watch?v=FYZJ2hfINUQ&t=72s>). As a frame of reference, popular exhibition videos, such as the recent "Manet and Modern beauty" launched in May 2019, has about 13,000 views on the Art Institute of Chicago's YouTube channel at the time of writing.
5. The video can be found at <https://www.youtube.com/watch?v=9SsUzaIDsHo> and has received over 53,000 views since its launch despite its long durational form, which is generally considered a detriment to the appeal of online content.
6. For more on the critical reception of this innovative exhibition see, for example Will Gompertz' review for BBC news on November 9, 2019 <https://www.bbc.com/news/entertainment-arts-50296585>.
7. One additional notable example to the ones cited in this paper is "The Girl in the Spotlight" held at the Mauritshuis in The Hague, The Netherlands, from February 25 to March 11, 2018. <https://www.mauritshuis.nl/en/discover/exhibitions/the-girl-in-the-spotlight/>.
8. Sarah Molina, *Museological Report: Conservation & Science*, 2018. Unpublished report on file in the Learning and Public Engagement department at the Art Institute of Chicago. The institution visited are listed in the following:
NYC: Metropolitan Museum of Art, Rubin Museum of Art, Cooper Hewitt, Making & Knowing Lab at Columbia University, New York Historical Society, Newark Museum.

Boston: Museum of Fine Arts Boston, Harvard Art Museums, Harvard Collection of Scientific Instruments.

DMV: Freer & Sackler Galleries, George Washington Textile Museum, Phillips Collection, Smithsonian American Art Museum, the Walters Art Museum.

Milwaukee: Milwaukee Art Museum.

London: Victoria & Albert Museum, the Ashmolean Museum, the Wallace Collection.

Copenhagen: University of Copenhagen, Housing of Technology in Art.

9. Substantial seed funding for the initiatives described in this paper was provided by grants from the National Science Foundation, the Kress Foundation, the Woman's Board of the Art Institute of Chicago and ongoing operational support.
10. The full description of the grant and the high-level summary of the proposal can be found on the National Science Foundation's website. NSF Award #1743748 Partnership in International Research and Education (PIRE): Computationally-Based Imaging of Structure in Materials (CuBISM) (https://www.nsf.gov/awardsearch/showAward?AWD_ID=1743748&HistoricalAwards=false).
11. Thanks to a previous NSF grant (DMR-1241667) we developed an Art + Science curriculum resource for middle school teachers, which is available on the Art Institute of Chicago's website: <https://www.artic.edu/collection/resources/educator-resources/7-art-science>.
12. The Rijksmuseum has a dedicated website for this project, with related social media presence and live-streams (<https://www.rijksmuseum.nl/en/nightwatch>). The project has also widely resonated with the media, with two particularly insightful examples being Nina Siegel, "Rembrandt's 'Night Watch' to Undergo Years of Restoration," *New York Times*, October 16, 2018 and Victoria Turk, *Wired* 12 December 2019, "Hidden for centuries, Rembrandt's secrets are finally being revealed" (available at <https://www.wired.co.uk/article/the-night-watch-painting-rembrandt>).
13. We theorized the loci of intersections of art and science in an art museum as follows: (1) Artistic practice; (2) Materials, Techniques and Process; (3) History of Science and Technology; (4) Conservation, Conservation science and Technical Art History; (5) Psychophysical Aspects of Perception.
14. While international travel is not an experience that is affordable or possible for all institutions, it has been widely mentioned as a valuable element for success (Bunch, 2019) and could be replicated with a retreat or visit to a local museum, creating a powerful shared experience outside of one's own institution for a diverse team of leaders.
15. For more, see <https://www.huntington.org/project-blue-boy>.
16. In this arena many museums have deployed valuable digital strategies, extending from their galleries to their websites. Some recent examples from the Art Institute are collected here: <https://www.artic.edu/interactive-features?page=1>. In my opinion the absolute benchmark remain the "Unravel Van Gogh" interactives from the Van Gogh Museum in Amsterdam <https://www.vangoghmuseum.nl/en/unravel-van-gogh-app?v=1>.
17. The toolkit is available for free download at <https://www.artic.edu/about-us/departments/conservation-and-science-2>. The link to the PDF is under Resources/Intersections of Art and Science and the toolkit can be adapted by other institutions to their own needs.
18. More details and specific metrics can be found in (Molina et al, 2021).
19. Yesomi Umolu "On the Limits of Care and Knowledge: 15 Points Museums Must Understand to Dismantle Structural Injustice" June 25, 2020, Artnet News <https://news.artnet.com/opinion/limits-of-care-and-knowledge-yesomi-umolu-op-ed-1889739>.
20. Project fellows Sarah Molina (2018–2019) and Giannella Ysasi-Tavano (2019–2020) were instrumental in both the research and execution of many of our projects.

21. This quote has been extracted from my transcript of Gates' contribution to the symposium "Arts, Humanities, Higher Education, and Just Societies," held by The Andrew W. Mellon Foundation in celebration of its 50th anniversary on November 18, 2019 <https://mellon.org/news-blog/articles/join-our-mellon50-symposium-live-stream-november-18/>.

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