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The Value of the Arts and Humanities to Science in the Philippines:

A report to the British Council on The Creative Turn in the Sciences project

Prepared by:
Diego S. Maranan
Associate Professor, University of the Philippines Open University
Co-founder, Space Ecologies Art and Design
diego@seads.network

With contributions by Franchesca Casauay and Patricia Calora

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1. Introduction: "Thinkering" with models for creative industries

This report provides an update to the state of *The Creative Turn in the Sciences* (*TCTS)*, a research project primarily enabled by the British Council's Connections Through Culture program, with additional support from the University of the Philippines Open University (UPOU) and the international nonprofit Space Ecologies Art and Design (SEADS). *TCTS* aims to explore and describe the state of art and science activities and collaborations—what has been variously referred to as "sciart"{Anker, 2013} or "artscience" {Schnugg, 2019}—in the Philippines. The research team is composed of Diego Maranan (principal investigator), Franchesca Casauay (research associate), and Patricia Calora (research assistant).[1] This report is a polyvocal one, reflecting our multiple roles as artists, scientists, educators, researchers, public servants, and cultural workers.

This project was originally proposed in response to a call from the British Council for projects addressing creative industries and creative economies. While we did not focus on the economic aspects of artscience in SBWA, what the study (as well as TCTS project) does is a form of "thinkering" {Francis et al, 2017} with the existing frameworks on cultural industries and the creative economy, in order to expand the current discourse on the value that the arts and humanities can contribute to economic activity in the Philippines. To the best of our knowledge, such opportunities have not been systematically exploited nor accounted for in frameworks related to the creative economy of the Philippines. Fiven the results of the SBWA study and existing potential contributions that the arts can make to the sciences (see sections 2.2.2 and 2.2.3), it stands to reason that there is potential for more frequent and meaningful engagement between artists and scientists, opening up not only new creative possibilities but also economic opportunities for those in the creative sector.

[1] Throughout this report, there will be pronoun shifts in order to attribute appropriately the points of views being represented; "I/me" refers to the principal investigator alone, while "we/us" references the entire research team. These pronoun shfits are intended to give credit where credit is due, but will be corrected when portions of this report are submitted for peer reviewed publication.

In 2017, the British Council commissioned a report proposing the establishment of a baseline measure of the Philippines' creative economy {Fleming, 2017}. The report describes in broad terms a framework for sectoral engagement, data collection, data analysis, and quality assessment. The proposal focuses on two general domains that might contribute most significantly to the creative value chain: the cultural domain (a broad category encompassing a range of themes from natural heritage to creative services), and other related domains, which consists of only tourism and sports & recreation {Fleming, 2017, p. 14}. The British Council subequently commissioned and released additional research that builds on the proposed strategy. These reports suggest that creative hubs in the Philippines foster communities {Arago & Ferrer, 2017} and provide social and economic value through providing platforms for artists; central marketplaces for exposure and sales opportunities; skills training; mentorship and talent development; job creation; new products; quality of life enhancement; and cultural preservation {Ormston et al., 2020}. A deep dive into the creative industries of two cities — Makati and Baguio—supports the findings of these reports and additionally provides a look at how creative and artistic activity contributes to the social, cultural, and economic life (and face systemic hindrances) in different ways {Mercado, 2019}.

Several weeks before my writing of this report, the Philippine Creative Industries Development Act (House Bill 10107)—which seeks to develop creative industries in the Philippines and make them globally competitive {Soliman, 2021; Almazan, 2021}—was approved unanimously on final reading by the House of Representatives {Cervantes, 2021}. The Bill identifies specific industries and domains belonging to the creative economy, such as audiovisual media, digital interactive media, creative services, design, published and printed media, performing arts, visual arts, traditional cultural expression, and cultural sites {de Venecia et al., 2021}. This framing of the creative economy is consistent with frameworks and regional policies in Southeast Asia that determine what constitutes a creative industry {Tabuga, 2021}, whose value is typically defined by its ability to generate goods (such as copyrighted works and and tangible products) or services that can be protected by intellectual property laws {Serafica,

2021}.

All of this suggests a reinscription and reinforcing not only of the characteristics and asserted value of the cultural industry, but also of policy frameworks for determining how creative activities should be identified, measured, classified, standardized, nurtured, scaled up, and monetized, whether in the context of the Global South or industrialized countries (from which the the notion of creative industries originated {Flew, 2012; Moore, 2014}). To what extent this is the optimum approach in the Philippines remains to be seen. However, the intent of this project is not to critique this approach in creative economy policy, which for the most part demurs from directly naming or confronting the problems of late stage capitalism {Hadley et al., 2020}, as others have done this either partially/obliquely {UNESCO, 2021; Kong et al, 2006} or fully/directly {de Jesus et al., 2020}. Nor does this project aim to provide an alternative economic model to account for and predict shifts in the creative industry {Potts, 2020}.

Among research and creative communities, there has been increased interest in the relationship between the arts and the sciences in recent years {Braund and Reiss, 2019}. *TCTS* aims to explore and describe the extent to which artscience initatives spur creativity and innovation in basic science and technology research in the Philippines, and whether there are untapped or under-utilized opportunities to do so. To what extent might collaborations between creative industries and scientific research in which artistic and humanistic forms of practice and inquiry productively influence the conduct of science research in the Philippines?

In this report, we argue that *artscience could be framed as part of a future-proofing strategy for any creative economy policy*; that is to say, the arts and humanities can provide value to multiple types of audiences, including scientists—even as scientists need to accept that creatives, philosophers, and other practitioners in the humanities and the arts have more to offer than what scientists reckon. And while we are at it: why not dream a bit? What if the Philippines could pioneer and advance artscience as a unique contribution to the creative economies discourse? The need for policy future-proofing became evident during the COVID-19 pandemic, which hit the Philippine creative sector particularly hard

{ilostmygig.ph, 2020}, prompting widespread public discussion and mobilization {Caruncho, 2020; Cervantes, 2021; Soliman, 2021; Inter-Agency Task Force Technical Working Group for Anticipatory and Forward Planning, 2020}. The pandemic revealed areas of the creative value chain that are brittle and susceptible to disruptions. While some have argued that the pandemic is a rare " black swan" event {Mishra, 2020} that we could not have prepared for, many have argued otherwise {Mishra, 2020; Drake, 2021; Avishai, 2020}. Disruptions like the COVID-19 pandemic should therefore be considered infrequent but inevitable features of a volatile, uncertain, complex, and ambiguous world in the grips of an unfolding climate catastrophe; any attempt to design and grow a creative economy must proveed from this asumption. By proposing a new avenue for contribution of the arts to public life, we hope that this research contributes towards the argument that a systematic and sustained engagement of the arts with the sciences can help bake in resilience into the creative sector. We are proposing not an alternative to creative hubs but rather a complement to it. The arts can generate products, services, *and* ideas, all of which can enrich public life by way of enriching our scientific culture.

In the course of conducting this project, we have come to realize that responding to this question with a high degree of breadth and depth requires more time, effort, labor, and resources than what was currently available. However, in this report, we document a research study (section 3) and present an in-depth case study (section 3) that offers initial approximations to an answer, and offer recommendations (section 4) that can impact practitioners, supporters, and other actors in the fields of the arts, humanities, and the sciences.

1.1. Overview

This report is divided into an introductory section, four main sections, and a set of appendices. This introductory section contains the following:

- This overview of the main sections of this report
- An executive summary of the conclusions and recommendations to date

the project

Each of the remaining four sections is offered as a deliverable of the project, and will be strategically disseminated in the future through a variety of channels (see section 4.4.2).

- Section 2, *Artscience: Divergences and convergences in the sciences and the arts*, is a discussion of divergences and convergences in the sciences and the arts as way to contextualize the rationale of this project.
    - Subsection 2.2.3, *Disciplinal Dancing: A case study on UK-enabled artscience practice and research in/for the Philippine context*, is a case study of my own history of artscience research and practice over the past thirteen years. In writing this section, I aim not only to describe my personal motivations for conducting this project, but to document for the first time my own practice in a way that adds value to the argument that artscience has relevance in the Philippine context. This documentation of my own previous and current artscience collaborations (many of which were supported through UK partnerships) serves as a contribution to the literature on artscience practices in the Philippines.
- Section 3, *Science By Way of Art: Exploring the current state of artscience in the Philippines* , is a report on the qualitative study that forms the heart of this project. The study, *Science By Way of Art,* collected 89 written contributions sourced from an Open Call asking for examples of artscience projects in the Philippines. From the responses, we selected and interviewed 30 individuals in order to understand how and why they engage in artscience.
- Section 4, *Conclusion and moving forward*, reflects on the discussion in the previous sections and extrapolates recommendations for various sectors on why they should—and how they can—actively engage artscience for mutual benefit. Our main contribution is a framework for artscience engagement, SHARES (Support from the Humanities and the Arts for Radical Excellence in the Sciences). We conclude by documenting our next steps in pursuing this line of research and practice.

1.2. Executive Summary: Results, Conclusions, and Recommendations

In this report, we argue that creative, transformative science can be supported along multiple fronts by engagement with the arts and humanities. As such, our view of creative industries need not be limited to currently identified ranges of cultural products and services. Artists can access new sources of not only funding and support, but also knowledge and inspiration, through engaging artscience in their work.

- If one of the value propositions of the arts is that it can provide a service, we propose that the arts and humanities could productively offer their services to the science R&D community in novel and underexplored ways. Our main contribution is the SHARES framework for enabling arts and humanities contribution to science research and translation (section 4).
- Funders, professional research organizations, and educational institutions can contribute to enabling shares through a number of ways:
    - Keep (or include) the Arts in the ST(R)EAM acronym
    - Retrofit existing programs to include discussion on and practice in artscience
    - Create opportunities for internships and real-world alternative learning activities
    - Ringfence funding for artscience collaborations
    - Provide mechanisms for long-term monitoring and evaluation
    - Consider new forms of cultural work and new models for patronage
    - Take the lead as coordinators and mentors
    - Provide opportunities for both formal disciplinal dialogue and serendipitous interactions
    - Strike while the iron is hot

- The arts and humanities can lead to transformative and creative science processes and outcomes; we argued for this in section 2.
- There is a nascent artscience community of practice in the Philippines (as revealed through the SBWA study discussed in section 2) that could benefit from support.
- Based on our interviews, the arts only minimally influences science and tech R&D in the Philippines, but only because it is usually not usually afforded the opportunity to do it more regularly or more deeply, if at all. We had previously discussed in section 3.3.5 future work that can be done following the SWBA study in particular.

The UK has a particularly strong history in producing and supporting artscience programmes and projects, as suggested in the theoretical and review sections of this report (see for instance sections 2.2.2 & 2.2.3). These initiatives were notably enabled through institutions such as the Wellcome Trust, Leverhulme Trust, and the South West Creative Technology Network, among others. Any future programming for artscience by funding institutions like the British Council Philippines could benefit from a partnership with such institutions. We also note that UK institutions were also mentioned a number of times during our main study of artscience practices (section 3).

2. Artscience: Divergences and convergences in the sciences and the arts

Given the intended audience for this report, we first offer a brief review of divergences and convergences in science and art as way to contextualize the contributions of *TCTS* as a whole. We present this section as a deliverable separate from and on top of the review of related work in the report of the study in section 3, as it covers and integrates discussion from a range of themes that is outside the scope of a literature review for the study for *SBW0A*. It also sets the stage for the SHARES framework that we develop in section 4.4.1.

2.1. Processes of science

Like the arts, the sciences is a dynamic and complex endeavour. In this section, we discuss processes involved or implicated in scientific enterprises: induction-based scientific inquiry, science public policy formulation and public engagement, and scientific revolution. This review is presented not as an exhaustive taxonomy but rather a demonstration of the plurality of activities involved in the sciences. For instance, we mention but defer extended discussion on post-normal science {Funtowicz and Ravetz, 1993}, a process of science engagement that is mobilized during high-stakes situations characterized by urgency and uncertainty {Fetalvero et al., 2013}; this intersects with discussions on science policy, which we do cover. The main contribution of this research project to date—the SHARES framework for artscience engagement—can accommodate science process, as we discuss in section 4.4.1.

2.1.1. Induction-based scientific method and normal science

Science as it is often carried out in laboratries across the world focuses on the application or stepwise extension of existing theories, methods and principles—what philosopher of science Thomas Kuhn {1970, p. 10} called activities of "normal science". Normal science uses inductive principles of investigation whose development is popularly attributed to the 17th-century British philosopher Sir Francis Bacon {Moore, 1980}. Normal science continues to be an important and legitimate foundation for science literacy, particularly in the context of the Philippines, where a basic understanding of Baconian scientific principles could stand to be strengthened {Imam et al., 2014}. Figure 1 below shows one illustration of the scientific process within normal science.

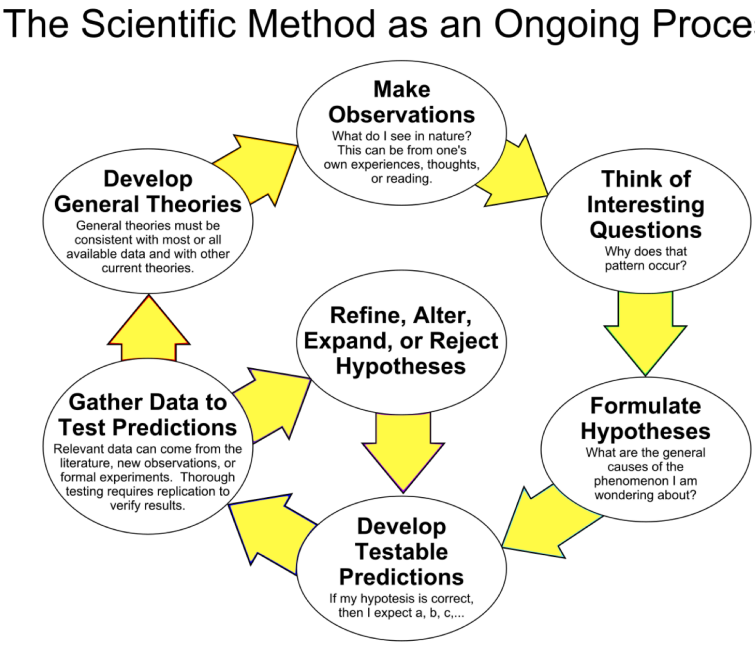


Figure 1: The scientific process within normal science. Image by ArchonMagnus {2015}. Licensed as CC BY-SA 4.0

2.1.2. Technology transfer

Scientific discoveries need to be developed and utilized in various ways in order to have more value to the public. This process often collaborative engagements between public research organizations, government, and private industries {Perkmann and Walsh, 2007; Correa & Zuniga, 2013}. Many universities—including those based in the Philippines[2]—have an office that manages technology transfer and business development from research conducted institutionally {Matkin, 1990}.

In the medical sciences, translational science refers to the discipline of bridging of research done in laboratry settings to public policy and clinical practice that directly impact patients {Waldman and Terzic, 2010}. Disciplines and research areas that may not have immediately appear to have importance to the public sphere can produce exploitable knowledge. For instance, research in spaces sciences and space exploration have led to technological advances that are now in use everyday by the general public, such as food packaging and consumer-grade media devices {Greicius, 2016; DiCicco, 2020}.

Figure 2 shows an example of a technology transfer process at a public research organization (the King Saud University).

[2] For an example, see the University of the Philippines Technology Transfer and Business Development Office: https://ttbdo.up.edu.ph

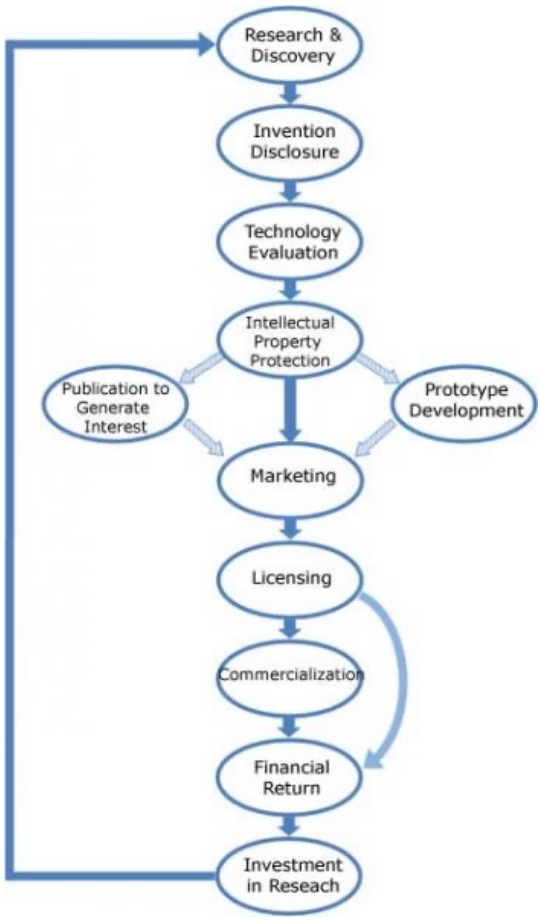


Figure 2. Technology transfer process at King Saud University {2013}

2.1.3. Science policy formulation and public engagement

Public engagement covers a host of activities. In the Philippines, efforts appear to be concentrated in the ever-growing field of science communication {Montemayor, 2020}. However, science communication in the Philippines faces challenges both common to the discipline as well as unique to the Philippine context {Navarro and McKinnon, 2019; Yu et al., 2021; Montemayor et al., 2020}, and opportunities for science communication training, while available, are nonetheless limited {Navarro and McKinnon, 2019}. Science communication and science public engagement intersect other fields such as knowledge management for policy impact. Figure 3 is a framework from Topp et al. {2018} on the skills

related to science-based policymaking from a knowledge management perspective.

Figure 3: Eight skills to support evidence-informed policies. From Topp et al. {2018}

2.1.4. Scientific revolution

The biggest leaps in the sciences--such as Einstein's theory relativity, Darwin's theory of evolution, and Bohr and Planck's quantum theory, to name a few--did not come from mere application and extension of existing principles: it came from a radical reordering of knowledge through creative insight, or what Kuhn

first descibed as a "paradigm shift" {Kuhn, 1970}.[3] Though it is we do not necessarily side with any faction of epistemological debates whether these shifts represent any kind of "improvement" or move towards truth, we note that these large-scale shifts in science have spawned since their advent innumerable economic benefits through job creation and product innovation—see for example Schellman {2008}. Most if not all paradigm shifts have been initiated by researchers in industrialized countries, where scientific inquiry is seen at the most advanced levels of research as an evolving and reflexive endeavor in which there is room for fundamental assumptions to be contested. This kind of engagement does not exist quite in the same way in the Philippines, notwithstanding a growing body of postnormal science work carried out in the country {Fetalvero et al., 2013; Vallejo and Ong, 2020; Aligaen and Capaciete, 2016}. Figure 1 illustrates the Kuhn's cycle of paradigm change in the sciences.

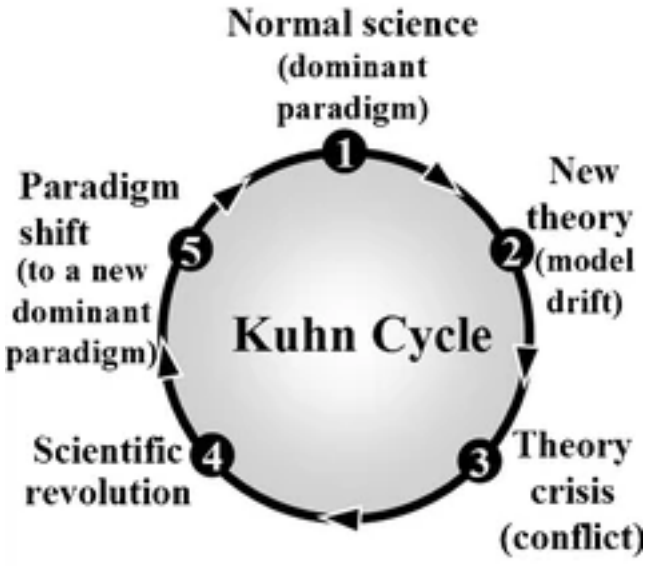


Figure 4. The Kuhn Cycle: How paradigm shifts occur. From Ashkenazi and Lotker {2014}

[3] We note here that we do not necessarily endorse the notion that these shifts are indicative of progress towards truth any more than Kuhn did .

2.2. Relationships between art and science

The modern divide between the arts and the sciences was famously characterized in a 1959 lecture by British novelist and trained scientist C.P. Snow as a divide between "two cultures" {Snow, 2012}. To this day, this divide is reflected in the organization of academic disciplines in most academic institutions. This has not always been the case, as Meyer {2019} notes:

> Science and art have long been studied interchangeably, with notable polymaths emerging in the Renaissance such as Leonardo da Vinci (artist, inventor, engineer and anatomist) and Alexander von Humboldt (explorer, geographer and naturalist) with his fellow investigators Johann Wolfgang von Goethe (scientist and writer) and Friedrich Schiller (philosopher, physician and historian). However, this polymathic attitude and the co-operation between scientists and artists seemed to go into hibernation in the second half of the eighteenth century.

2.2.1. Artscience: (re)braiding the "two cultures"

For the purposes of this project, we use the term *artscience* to refers to **conceptual frameworks, projects, and other activities in which there is a thoughtful engagement between the arts and humanities with fundamental and applied scientific research, predicated on or leading to shared approaches, topics, concerns, and/or results**. The mission of the Sciart Initiative {n.d.} takes up this notion of convergence in their mission statement:

> Artists and scientists seek answers to the same fundamental questions: who are we, why are we here, and where are we going? Both art and science build models of human experience in order to extend the boundaries of human capacity. Despite this common ground, artists and scientists are too often separate in their endeavors.

Interestingly, the Arts Director for the UK branch of the Gulbenkian Foundation, Sian Ede, has suggested a provocative relationship between art and science that goes beyond mere sharing or convergence {Ede, 2005}:

> Contemporary scientists often talk about 'beauty' and 'elegance'; artists hardly ever do. Scientists weave incredible stories, invent extraordinary hypotheses and ask difficult questions about the meaning of life. They have insights into the workings of our bodies and minds which challenge the way we construct our identities and selves. They create visual images, models and scenarios that are gruesome, baffling and beguiling. They say and do things that are ethically and politically challenging and shocking. Is science the new art?

While we will not attempt to respond to Ede's provocation (not in this report, at any rate), it reinforces the possibility that the arts and the sciences have much more in common than is often understood.

2.2.2. Arts-based contributions to science

The arts and the sciences influence each other in a feedback loop. For instance, Miller {2014} has argued that throughout history, cutting-edge science has fundamentally shaped contemporary art in the West. In section 3.3.1.3.1.1, we note how media technologies have led to the development of whole new forms of artistic practices. Many contemporary new media artworks as showcased in festivals such as Ars Electronica,[4] documented in influential journals like Leonardo,[5] or popularized in art blogs such as We Make Money Not Art,[6] owe their existence to science research and development.

What is perhaps less discussed in creative communities are the contributions that the arts and humanities have to science. For instance, arts training appears to help scientists excel in a variety of ways {Shneiderman, 2019}, such as developing increased perceptual and observational skills that aid in clinical work {Braverman, 2011; Katz and Khoshbin, 2014}, spatial visualization skills useful in chemistry {Collins et al., 2014}, or fundamental traits such as the curiosity and patience needed to study natural phenomena {Stevens and O'Connor, 2017}. In a

[4] https://ars.electronica.art
[5] https://www.leonardo.info
[6] https://we-make-money-not-art.com

paper titled “Arts Foster Scientific Success: Avocations of Nobel, National Academy, Royal Society, and Sigma Xi Members”, Root-Bernstein et al {2008} suggest that Nobel Prize-winning scientists tend to have more art and craft avocations than the “average scientist”, and that the Nobel Prize winners’ success do not depend merely on general intelligence. Evidence exists from brain imaging studies suggest that “very gifted artists and scientists” exhibit similarities in the firing in certain brain circuitry {Andreasen, 2012}, which supports research suggesting that creativity in the arts and creativity in the science is ”more alike than unalike” {van Broekhoven et al., 2020}.

The arts can also facilitate scientific insight. It is thought that Albert Einstein’s discoveries were inspired by his deep affinity for classical music {Miller, 2006}, to which Einstesin himself attests {Root-Bernstein and Root-Bernstein, 2010}. A more contemporary example involves a case of how representations of butterfly wings by the artist M.C. Escher has been the inspiration for a whole new field of science, structural DNA nanotechnology {Seeman, 2014}.

The arts and humanities can also inspire the development of novel experimental methods to investigate phenomena. British researcher Kathryn Francis and her colleagues collaborated with Royal College of Arts-trained speculative designer Agi Haines to design a novel experiment into moral decision-making using a prosthetic body {Francis et al., 2017a; Francis et al., 2017b}. London-based designer Dani Clode’s artscience work—a robotic finger that was initially ”more a novelty than a prototype, exploring futurist ideas surrounding body augmentation” {Haridy, 2021}—was later picked up by neuroscientists and used in their research on brain plasticity {Kieliba et al, 2021}.

2.2.3. Pluridisciplinarity: Possible forms of engagement between the arts and sciences

The discussion from the previous section points to different forms of pluridisciplinary engagements that are possible between the arts and the sciences. We use the term pluridisciplinary as a term that encompasses other

ones such as multidisciplinary, interdisciplinary, and transdisciplinary (amongst others). While these terms are frequently used interchangeably and without specific definitions, there are differences in their intended meanings. Multidisciplinarity draws on information from several disciplines while remaining within disciplinary limits; interdisciplinarity both unites and synthesises links between disciplines to form a coherent whole ; and transdisciplinarity brings disciplines together in new contexts, transcending any existing disciplinary boundaries. Figure 4—taken from a previous publication of mine—illustrates these distinctions.[7] This model for pluridisciplinarity was developed out of my involvement with CogNovo, an artscience programme at the University of Plymouth in the UK; I expound on this topic in the next section.

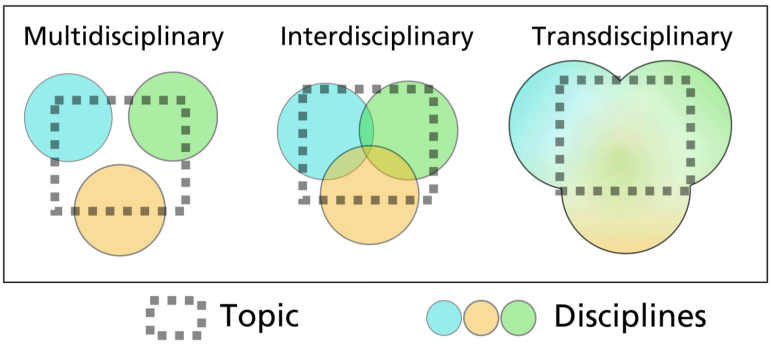


Figure 4: Visualisation of multidisciplinarity, interdisciplinarity, and transdisciplinarity as instances of multiple disciplinarity. From Torre et al {2018}.

2.3. Disciplinal Dancing: A case study on UK-enabled artscience practice and research in/for the Philippine context

TCTS was initially motivated by a long-standing personal interest in creative and research undertakings in the arts and humanities that have led or can lead to

[7] Portions from this paragraph were previously published in Torre et al., 2018.

advancing science research and development. Over the past twenty years of doing artscience work as a cultural worker, artist, and researcher living in the Canada, the UK, and the Philippines, I observed how social, cultural, economic, and intellectual environments in which the arts and humanities are valued as legitimate and important forms of inquiry are often the same environment that encourages and rewards creative thinking and innovation in fundamental scientific research. This observation was first motivated by my experience as a Master's student at the School of Interactive Art and Technology at Simon Fraser University (Canada) from 2009 to 2012,[8] during which I conducted research into dance technologies {Subyen et al, 2013}, embodied methodologies {Maranan, 2012}, perceptual psychology {Maranan et al., 2013}, and human motion data capture {Maranan et al., 2014}. Drawing from my experience as a then-early-career dancer and choreographer and applying it to the field of perceptual psychology, I advanced a theory of visual cognition—which I called *structural illusion from embodied motion*—which offers a framework to explain virtuosity in and audience reception of a unique genre of urban dance {Maranan, 2012}.

In order to contextualize the conclusions I have arrived at through this project, I provide a partial overview of artscience work I have undertaken which were either supported, enabled, or inspired by the radically interdisciplinary, EU-supported doctoral training programm[illegible]ogNovo,[9] at the University of Plymouth in the UK. These works include solo and collaborative artistic and scientific projects. As in all qualitative research {Cresswell and Roth, 2018}, the stories I tell here are presented, interpreted, and interrogated through my own experience an sciart practitioner and researcher; this is my axiological assumption (Creswell and Poth, 2018). I position myself in this study not as disinterested party whose discipline and practice is distinct from those of the participants of this research, but as a member of a (nascent) community of practice in the Philippines. I offer this section as a *TCTS* deliverable that contributes to the research literature on artscience and pluridisciplinary creative practices in the Philippines.

[8] The fact that Canada is a Commonwealth country is worth noting here!

[9] Programme website: https://www.cognovo.eu

2.3.1. About CogNovo

From 2014 to 2017, I was one of 25 funded PhD fellows at CogNovo, which aimed to foster interdisciplinary research in cognition, novelty, and creativity through exploration, speculation, explanation, and synthesis. The twenty-four research projects at CogNovo were conducted by doctoral students from experimental psychology, interactive and creative arts, cognitive neuroscience, the humanities, computational modelling, and cognitive robotics {Maranan et al., 2015}. In addition to committing to interdisciplinarity, CogNovo also attempted to bridge the gap between academic institutions and the larger community through public outreach initiatives, and to discover solutions that may have potential commercial applicability. As such, the initial part of the my PhD involved a secondment Kin,[10] a design company based in London, UK. Additionally, I held first the prototype-evaluation workshop of my research in collaboration with Curiosity,[11] a design strategy firm I had previously co-founded in Manila, Philippines.

My arts-led PhD was supervised by a supervisory team composed of professors in the arts (Jane Grant, John Matthias, Mike Phillips) and cognitive neuroscience (Sue Denham). The projects I have pursued that build on my PhD have generated in health-related research and technology product development {Maranan et al., 2016; Maranan et al., 2017; Woodman et al., Manuscript in submission}, including one that recently won a UK South West Creative Network Data Prototype grant for medical technologies {South West Creative Technology Network, 2020; dbs-i, n.d.). Though the CogNovo programme has finished, it has profoundly impacted artscience projects I have pursued and organized since then {University of Plymouth & UP Open University, 2020; UP Open University & University of Plymouth, 2020}.[12] I describe these projects in subsequent sections.

[10] Company website: https://kin-design.com

[11] Company website: https://www.curiosity.ph

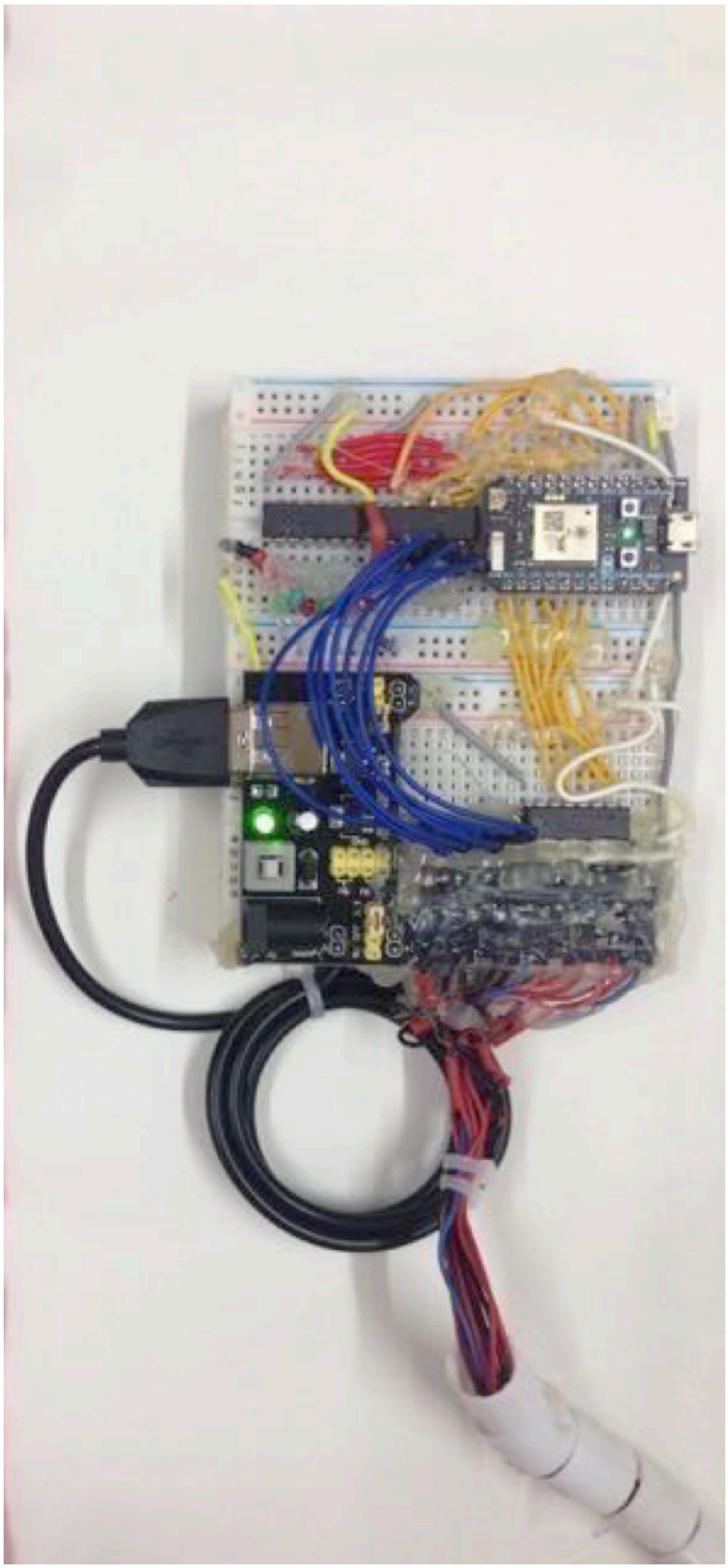
[12] We note that many of these projects involved support from or partnerships with other, non-UK organizations, includiung SEADS and UPOU.

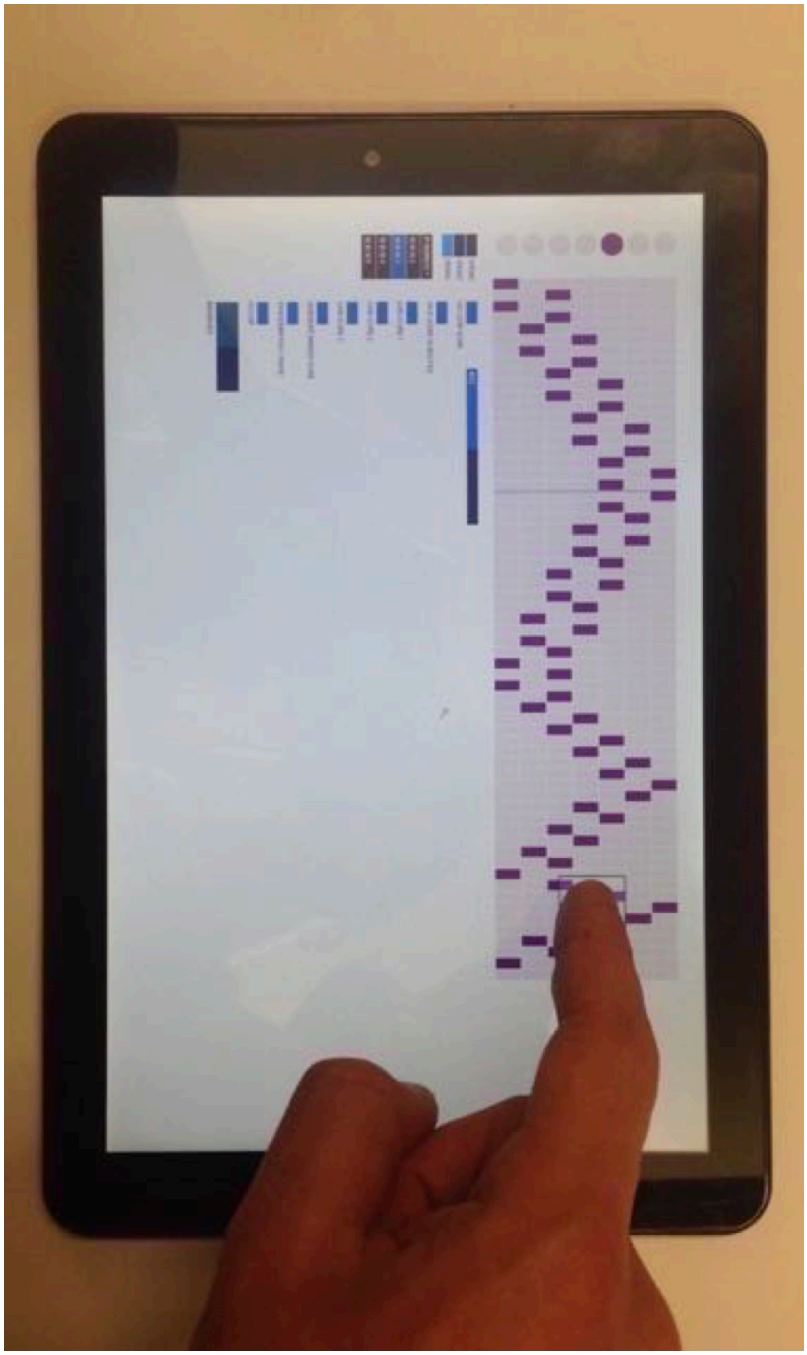
2.3.2. Haplós: Cognitive Science x Contemporary Dance x Wearable Technology Design

The main outcome of my arts-led PhD research at CogNovo was Haplós, a low-cost, wearable technology that applies vibrotactile patterns to the skin, can be incorporated in existing clothing and implements, and can be programmed and activated remotely {Maranan, 2020}. Inspired by somatic methodologies and neurophysiology, Haplós is a body awareness tool that applies programmable, vibrotactile patterns to the skin using small, vibrating motors. It is inspired by research and design in clothing and human-computer interaction, in which clothing and wearable artifacts generate novel, embodied, "somatic" experience {Dean, 2015; Schiphorst, 2011}. Through a two-year intensive immersion into the Feldenkrais MethodTM (hereafter abbreviated as FM), we translated the assumptions, aims, epistemologies, and techniques of FM into the hardware, textile, and software components—as well as application- dependent instructions—that comprise Haplós. Originally developed by Moshe Feldenkrais, FM is an educational approach to sensorimotor learning that relies on attending to the experience of small, gentle movement in order to facilitate greater freedom of movement and increase kinaesthetic and proprioceptive awareness {Feldenkrais, 1972}. Haplós was a transdisciplinary project in that it made contributions to a number of disparate fields—human-computer interaction, aesthetics, music, and neurophysiology—through a single line of inquiry, centered on evidence-based use of customizable patterned vibrotactile stimulation for sensorimotor reorganization.

The images below show different aspects of Haplós.


HAPLÓS
Create a pattern
Play recorded patterns
Settings
< Back to interactions
cer Mode: Create a repeating vibration pattern.
teractions
Stroke Mode: Run your finger on either side of the back to create a stroking sensation. You can also use multiple fingers.





In the succeeding sections, I document projects that were spin-offs of Haplós.

2.3.2.1. Good Vibrations: Reducing food cravings through vibrotactile music

Haplós caught the attention of research psychologist University of Plymouth Professor Jackie Andrade, who was curious about whether the prototype could be used to reduce food cravings. The basis of this conjecture is the Elaborated Intrusion theory of desire {Andrade, May, & Kavanagh, 2008; D. J. Kavanagh, Andrade, & May, 2005}. In this theory, craving starts with the triggering of an intrusive thought related to the object of desire—for instance, a bar of chocolate. The trigger may come from the environment or from physiological cues. The intrusive thought may then get subsequently elaborated, and a discrepancy develops between the individual's current physiological and emotional state, and a mental image of their state that would arise if the desire were fulfilled. A craving is the felt experience of that discrepancy. In short, the Elaborated Intrusion posits "the conscious experience of craving as a cycle of mental elaboration of an initial intrusive thought." {D. K. Kavanagh et al., 2012}.

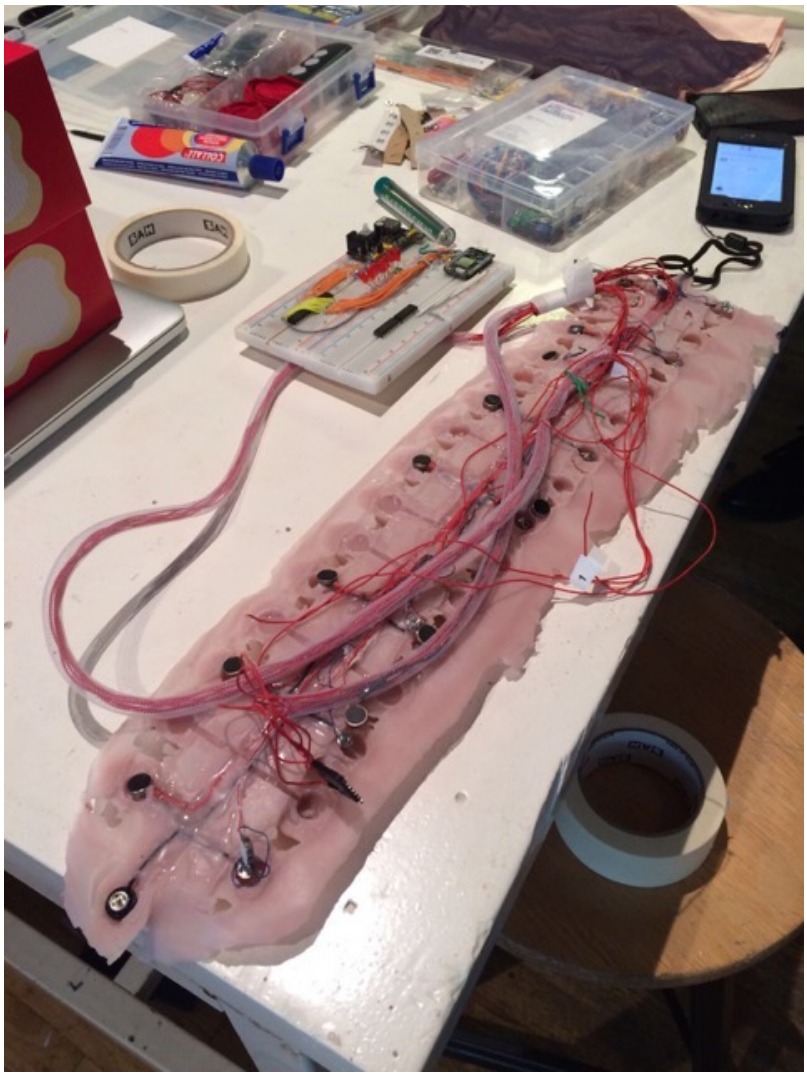
To test this hypothesis, we set up a controlled experiment to test whether Haplós could reduce the frequency and strength of chocolate cravings. We chose chocolate as the subject of the cravings because it is a common food craving that can be induced in the lab {Andrade et al., 2012}. Our study tested the effects of the application of short, carefully designed patterns of vibrotactile stimuli reduced the frequency of intrusive food-related thoughts with statistical significance. To test the strength and frequency of cravings, we used the Cravings Experience Questionnaire (CEQ) {Andrade et al., 2012}. Sixty-six participants took part, with thirty-eight of them belonging in the experimental condition. The results of the study show significant results between the experimental group and the control group for the CEQ frequency scores, suggesting that those who wore the body vest with the motors in experienced a lower frequency of chocolate cravings. We are now in the process of submitting the study for review and publication.

2.3.2.2. Bisensorial: Multisensory biofeedback and artificial intelligence for shaping mental states

Bisensorial {Maranan, et al., 2016} was a fully working proof-of-concept of a technology that was based on the Haplós technology. Its aim was to induce desired mental states using touch and sound that evolved in response to EEG readings. A genetic algorithm generated patterns of auditory stimuli and tactile stimuli down a user's back, based on readings provided by an EEG headset. The result is intended to be a personalised soundscape and 'touchscape' that adjusts to the user to construct the most efficient bisensorial stimuli for inducing a desired mental state. In order to both structurally encourage skin contact and freedom of motion we produced a spine structure cast in platinum prosthetic silicone that would provide a casing for the electronic components. This electronic spine is skin-like to touch and sculpturally mimics the anatomy of the vertebrae, giving the structure a visual reference regarding its function: as a sensorial device for the spinal column. The spine was integrated into a bespoke dress designed to maximise skin contact as well as provide torso support in order to relax the extensor muscles and make the tactile stimuli more perceptible. I developed Bisensorial with a team of artists and designers during Hack the Brain 2016 hackathon in Amsterdam over three days, from 24 to 26 June 2016. It won first place, besting eleven other teams {CogNovo, 2016}.

The images below show aspects of Bisensorial.[13]

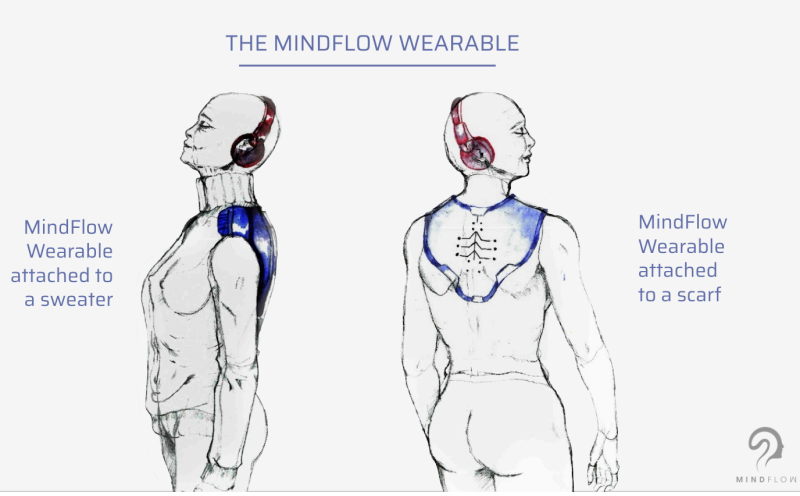
[13] From http://www.diegomaranan.com/?p=3635

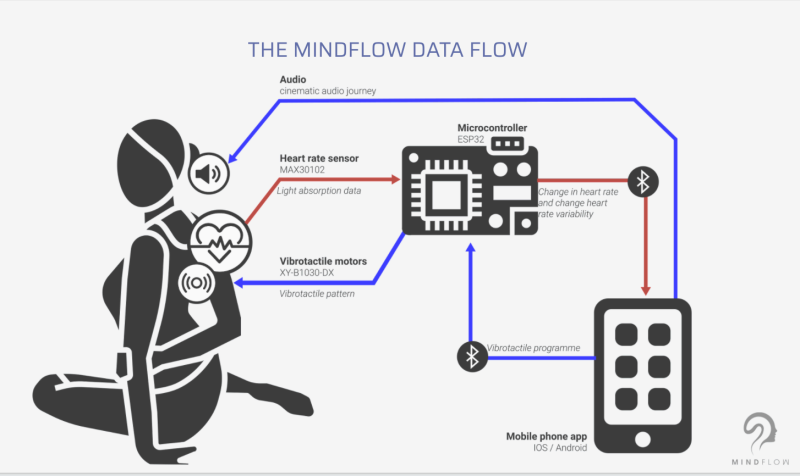


2.3.2.3. Mindflow: Multisensory biofeedback for anxiety reduction

MindFlow was a prototype for a personalized wearable system designed to provide the user with calming, restorative audio and tactile experiences through an innovative use of their real-time physiological data. It was awarded a Data Prototype grant from the UK's South West Creative Technology Network (SWCTN). MindFlow builds on Haplós and Bisensorial, but additionally builds on neurobiological theories of emotion {Koelsch et. al. 2015} that explain thebiophysical basis for emotional states. The Mindflow team—which included two of my former PhD supervisors, artist John Matthias and scientist Sue Denham—worked with people with Dementia during the SWCTN R&D period alongside partners Age UK in order to produce a prototype which will provide data-driven anxiety reducing experiences {Mindflow, 2021}.

Images below are from the original pitch to SWCTN.



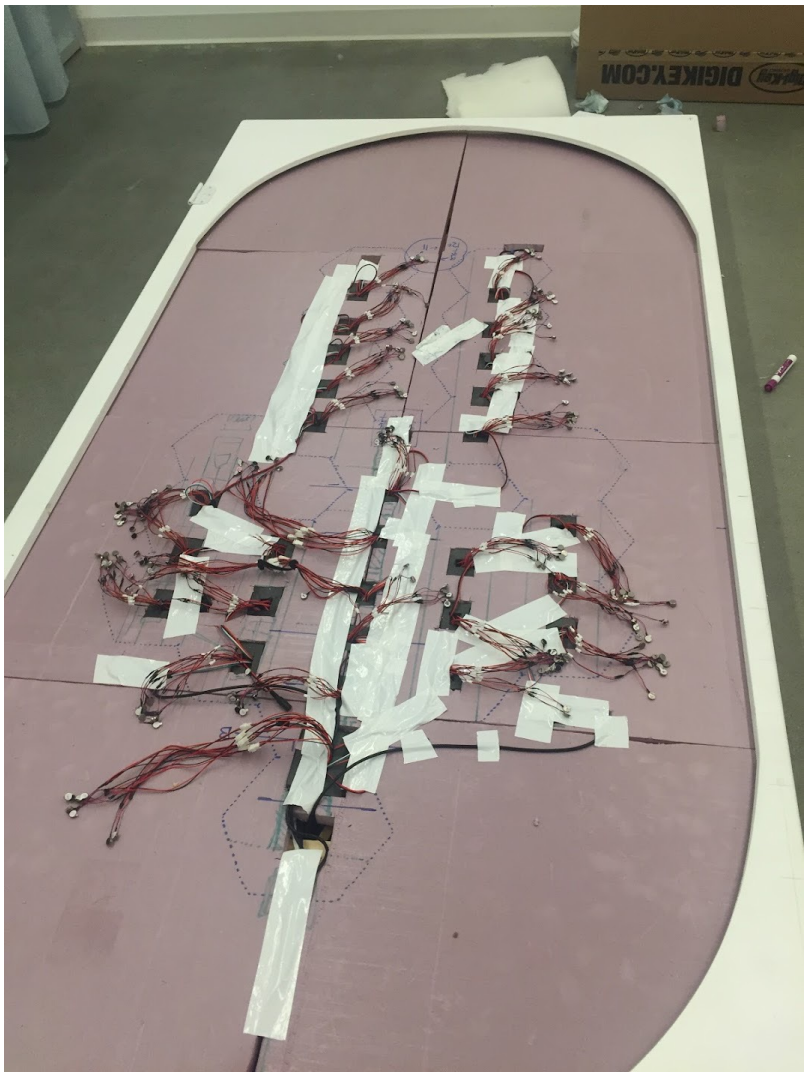


2.3.2.4. RE/ME: Creative reshaping of bodily self-perception through full-body immersive experiences

Building on Bisensorial (but foregoing its biofeedback component) RE/ME is an interactive installation based on Haplós and which I subsequently developed by along with speculative designer Agi Haines, composer Sean Clarke, and computer scientist Frank Loesche. The team was formed out of the CogNovo program and was selected for the award out of approximately 25 other teams

that were formed during a series of EU-funded events called Hack the Brain held in 2016 and 2017. RE/ME was one of five projects pitched at Art, Science & Technology Collaborations in Europe, a symposium on how the arts can be a catalyst for innovations that seek to address today's challenges. RE/ME won the pitch and was chosen to be further developed at DART 17, a test laboratory in San Francisco, USA, with the help of a 10,000-euro grant. The RE/ME team joined DART 17 in San Francisco in July and August, 2018. During our residency, we created an interactive installation using a custom-made cradle and a version Haplós using hundreds motors to create a full-body, immersive, tactile experience. RE/ME incorporated the use of music and sound to the carefully designed patterns of touch provided by Haplós. However, RE/ME can be further used to transform the user's experience of their body's size and shape in imaginative and novel ways. Using RE/ME, users can sculpt their perception of their body's shape and size {Maranan et al., 2018; Maranan et al., 2019}.

RE/ME is an immersive experience that involves lying down in a custom-designed surface with embedded motors and built-in speakers, as shown in the images below.



2.3.2.5. Dama: Multimodal stimulation for sensorimotor rehabilitation

Haplós has the potential to be used in sensorimotor rehabilitation, such as in post-stroke recovery. Vibration has been used to cancel muscular tremors in early studies and prototypes of devices for people with essential tremor {Curay, 2016; Pathak et al., 2014}. Vibrotactile stimulus has been used as an information cue for rehabilitating gait in hemiplegic subjects {Afzal et al., 2015; Jaffe et al., 2004; Ma et al., 2018} as well as upper limb rehabilitation {Kapur et al., 2009; Karime et al.,

2011}, as well as providing haptic feedback in serious games for post-stroke rehabilitation {Alamri et al., 2010}. One study found that the remote application of vibrotactile noise improves fingertip tactile sensation with potential to enhance dexterity for stroke survivors (Enders et al., 2013). Hussain et al. {2015} designed and invested the use of a wearable robotic extra finger used by chronic stroke patients to compensate for the missing hand functions of the paretic limb. I suggest that Haplós' possible effect of intervening in the sensorimotor loop and creating greater tactile sensitivity can help with stroke rehabilitation. For instance, Haplós can be incorporated as part of mirror therapy by heightening the illusion through the same principle as the rubber hand illusion {Barnsley et al., 2011; Botvinick & Cohen, 1998}, perhaps with the addition of visual stimuli such as LEDs that light in synchrony and in the same location as the vibrotactile stimuli. In addition, Haplós could also be used as part of interactive intervention for improving the gait of people with neurological diseases, such as Parkinson's patients, who have been shown to respond well to a music therapy technique called rhythmic auditory stimulation {Hove et al., 2012}.

I supervised Mariel Francesca Reyes an undergraduate student at UPOU's Bachelor of Arts in Multimedia Studies program who put together Dama (pictured below), a prototype of a glove that uses the Haplós technology {Reyes & Maranan, 2019}.

2.3.3. To infinity and beyond: space science and space exploration though the arts and humanities

In the interest of brevity, this review of CogNovo-enabled projects was a partial one and focused only on the Haplós project and its subsequent outcomes and spin-offs. I postpone discussion of other recent artscience collaborative work in which I have engaged, including a series of projects integrating arts- and humanities-led inquiry with space science and space exploration, including the following:

- Clinical Trials in Interplanetary Mission (CTIM), a series of projects that uses speculative and critical design, imagined scenarios, props, imagery, diegetic prototypes and science fiction writing to innovate on clinical trial methodologies of the future {Nasser et al., 2020; Nasser et al., 2021a}. This speculative approach might be used to train individuals to find new

processes and methods for unprecedented situations where a quick response is needed.

- Critical writing on Seeker,[14] a series of art projects where members of local communities design, build, and performatively inhabit an interstellar starship in a museum setting, which can help space scientists diversify the concept of astronautical analogue missions {Nasser et al., 2021b};
- Ēngines of Ēternity, a series of projects by SEADS that started from the creation and launching of a series of artworks into the International Space Station in collaboration with a team of space scientists;[15] and
- The RITCS 2022 Winter School Workshop on Climate Change and the Space Race, in which art and performance students are asked to develop multisensory expressions and imaginations beyond what we can ordinarily see, in order to address our lack of connection with nature and the universe.[16]

I hope to summarize and reflect on these other projects at another venue.

Seeker

[14] https://seads.network/hyperproject/seeker
[15] https://seads.network/hyperproject/engines-of-eternity
[16] https://seads.network/project/ritcs-winter-school-2022

Ēngines of Ēternity: Galing

Ēngines of Ēternity: Data Monument

3. Science By Way of Art: Exploring the current state of artscience in the Philippines

While artscience is well-established and well-documented in the Global North, to what extent the same can be said in the Philippines—and how it works—is currently unknown. *Science By Way of Art* (SBWA) is a qualitative study that examined exemplars of artscience activities undertaken by Filipinos in order to arrive at a first approximation of this gap in the literature. While there have been initial efforts to map activity affined with artscience in the Philippines, such as new media art (see section 3.3.1.3.1.1), SBWA is to the best of our knowledge the first systematic attempt to map artscience practices and art-science collaborations in the country.[17]

3.1. Background

In this section, we discuss initial attempts to characterize artscience in the Philippines through a review of published literature. (For a review of other theoretically relevant concepts, see section 2.)

3.1.1. Artscience as a discourse in the Philippine context

To identify contemporary artscience initiatives and activities by Filipino artists or scientists of which our research team may not have been aware, I conducted a search on the abstract and citation database Scopus[18] using combinations of keywords. The search was conducted on all available metadata

[17] For SBWA, UPOU provided additional support by hosting the website and providing research administration services, including review and vetting of our data collection and informed consent policy and helping disseminate the call through its institutional networks and partners. See the Appendices section

[18] Website: https://www.scopus.com

fields. The goal was to find peer-reviewed research that actively uses keywords such as ”artscience” or “sciart” in a Philippine context, and consistent with the definition of artscience laid out in section 2.2.2.2.2.1 (i.e., as an active engagement between arts and humanities with fundamental and applied scientific research that lead to shared or convergent approaches, topics, or concerns). However, these series of searches yielded little, as shown in Table 1.

Keyword	**Additional keyword (“AND”)**	**Number of hits**
sciart	-	105
artscience	-	201
sciart	Philippines	1
artscience	Filipino	0
sciart	Philippines	0
artscience	Filipino	0

Table 1. Number of hits on Scopus for keywords in columns 1 and 2; search done on all fields

The single hit on ”sciart + Philippines” was a false positive: the resulting article was part of a collection of writings that covered art in the Philippines and artscience in general, but as separate articles.

I also conducted a search of publications in Leonardo, a particularly well-regarded journal in artscience published by the MIT Press, for mentions of the Philippines or Filipinos. This yielded the following results:

- Lasay, F. (2006). The Philippine Triad and Western Dichotomous Philosophies: A Contest of Traditions in Three Audio-Performance Projects. Leonardo, 39(1), 59–65. (https://doi.org/10.1162/002409406775452131)
- Modirzadeh, H. (2009). Musical Compost, Consorts and Collapsing Pyramids: On the Disintegration of Traditional Performance Practices to Raise a Sound Society. Leonardo, 42(3), 252–258. (https://doi.org/10.1162/leon.2009.42.3.252)

However, the first article did not meet our criteria for artscience in that we did

not see a sharing or convergence of approaches, topics, or concerns between the arts and the sciences, while the second article (authored by a non-Filipino researcher) takes up Filipino/Philippine-related concepts only in passing. I also note that no citations for either of these two articles were found using Google Scholar's citation lookup feature. All in all, the research literature on artscience practices in the Philippines appears to be sparse.

However, this does not mean that these practices don't exist. For example, Trial & Error is an "art & science collective" based in the Philippines that has produced works such as *Dynamic Elements*, "an artistic take on the periodic table" {Reyes, n.d.}. The collective asks questions that resonate with artscience topics described in section 2.2.2, although the focus appears to focus on science communication specifically:

> Can art and science co-exist? Can science be beautiful? Can art be scientific? Trial & Error: Art and Science Collective is a group of artists and scientists with a shared passion to create art that makes science fun and accessible. {Reyes, n.d.}

During the course of the study, we realized that the relationship between in the arts and the sciences figures heavily in the discourse around one of the most well-accepted symbols of Filipino national identity: nationalist and polymath Jose Rizal (1861-1896). Rizal made significant contributions not only to literature but also to the sciences {Bantug, 1961}. To this extent, discourse around Rizal has often portrayed him as a "Renaissance man" {Angeles, 2013; Curaming, 2017; Anwar, 1995}. Reyes {2013} interestingly argues that Rizal's Novel, El Filibusterismo, Rizal could be productively understood as a kind of a science fictionist through both subtle and overt references to science, critical thinking, and technology. We discuss how of this particular way of framing artscience in the Philippines might motivate future work in section 4.

3.1.2. New media and digital art: artscience's kissing cousins in the Philippines

In the field of Philippine contemporary art, the practice most closely related to artscience is new media art, by which I mean art forms that are "produced, modified, … [and/or] transmitted by means of new media/digital technologies or, in a broader sense, make use of 'new' and emerging technologies that originate from a scientific, military, or industrial context" {Grau, 2016}. Contemporary new media art owes much to earlier forms of media technologies, such as sound recording and cinema {Manovich, 2001}, and their subsequent encounters with data processing, which "changed the identity of the media as much as that of the computer, transformed from simple calculator into a 'media processor'" {Quaranta, 2013}. It has become increasingly difficult to capture the wide range of actors in the new media art landscape particularly given not only the current ubiquity of digital authoring tools but also the emergence of computational technologies that are disrupting art practices and markets, such as non-fungible tokens (NFTs) {Dubner, 2021}.

A range of new media art practices and platforms in the Philippines exist—see Yraola {2013} and Yraola {2020} for a review, and Sandico {2017} for an example of the type of smaller festivals that are perhaps prevalent but underreported in the research literature. Although Ermitaño has suggested that "technophobia" {Ermitaño, 2020} runs through arts and culture policy and practice in the Philippines, there are indications of growing interest in digital art in the Philippines {Alpad, 2018; Soliman, 2021}.

3.1.3. STEAM Education in the Philippines

Another area of activity in which artscience might have figured more systematically and consistently in the Philippines is in the domain of education, and specifically in the discussion around STEAM education {Anito & Morales, 2019; Commission on Higher Education, 2017}. However, in my experience as an educator and researcher in a post-secondary institution, I have yet to come across a STEAM educational framework or implementation in which the arts and

humanities are seriously taken as contributing in equal measure as the sciences. My perception is reinforced by the published research on STEAM education in the Philippines, in which the of "Arts" in the STEAM acronym has been replaced with another term such as "Agri/fisheries" {Morales et al., 2019; Anito & Morales, 2019; Tabios, 2018; Aristorenas & Monterola, 2019; Commission on Higher Education, 2017}. One Philippine educational institution has an institutional webpage that lists its STEAM experts,[19] though does not list any details on how the various fields are linked; none of the faculty listed appear to have a formal background in the arts, the humanities, or in pluridisciplinary research or practice. More telling still are instances in which STEAM (with "A" = "arts") is referenced, but no mention of the arts is made at all {Ayuste & Sarmiento, 2019}. This is despite a wealth of research discussed in section 2 on the fascinating relationships between the arts and the sciences, or even simply on how the arts can contribute to science education {Braund and Reiss, 2019}. In sum, what available literature on STEAM education in the Philippines does not elaborate on precisely *how* the arts might interact with, integrate with, interrogate, or otherwise relate to science, technology, engineering and math.

3.2. Research questions

What does artscience in the Philippines currently look like? Three secondary questions, each associated with a specific topic of inquiry, are subsumed by this main research question:[20]

1. What does meaningful engagement between the arts and the sciences mean for Filipino artscience practitioners? (Conceptual framing of art-science relations)
2. Why do Filipino artscience practitioners pursue the work that they do? (Motivators and kickstarters)

[19] https://www.mc.edu.ph/experts/topics/steam-education

[20] The last question was included in our research as the members of our research team work in one capacity or another in tertiary-level education.

3. What factors enable and hinder the work of Filipino artscience practitioners? (Enablers and hindrances)

3.3. Methodology

To answer these questions, we used grounded theory {Glaser and Strauss, 1967} and incorporated elements of narrative inquiry {Creswell and Poth, 2018, p. 70} as the basis for our approach. Our choices were predicated on the assumption that we were studying a nascent, loosely organized (at best) community of practice that has been sparsely documented.

We attempted to capture and analyze the practices and personal histories of individuals who self-identify as Filipinos (or individuals embedded in the Philippine context) working between or across the arts and the sciences (hereafter referred to as "Filipino artscience practitioners") through a series of interviews. We aimed to elicit personal narratives of life histories as well as thoughtful reflections of projects they undertook in the past, were conducting at the time, or planned to carry out in the future. That is to say, we studied *individuals* (who self-identify with artscience) in part by examining their *activities* (in the way of artscience projects).

3.3.1. Sampling and data gathering

Grounded theory features theoretical sampling and requires incremental and continuous adjustments to the sampling techniques, data gathering instruments, and theoretical frameworks. As such, we used a two-stage sampling process:

1. Convenience sampling via an Open Call for participation of individuals who identified with the notion artscience.
2. Purposive sampling from Open Call respondents, adapting grounded

theory's approach of theoretical sampling {Qureshi and Unlu, 2020}. The figure shows the sampling and data gathering process leading up to the analysis.

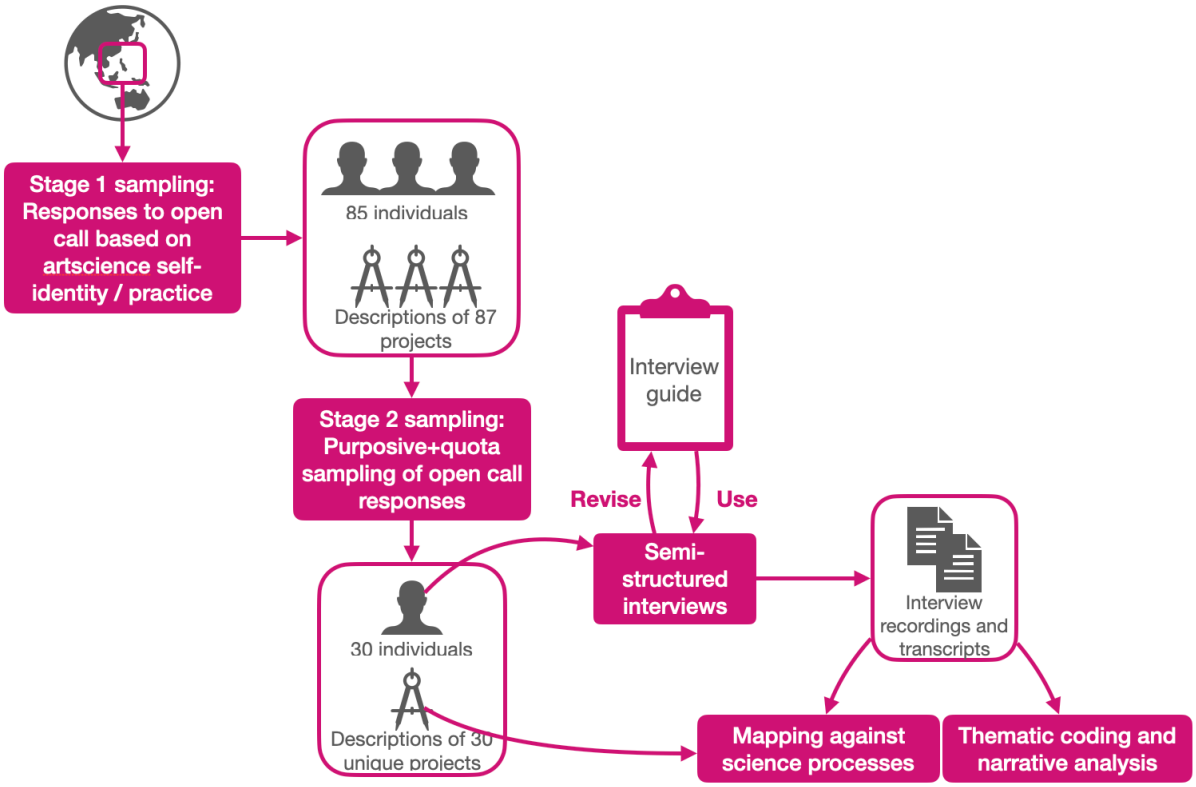


Figure 2. Sampling and data gathering process.

3.3.1.1. Stage 1 sampling: Open Call

Interviews participants were identified through an Open Call (see section 5.5.1) for examples of artscience initiatives. The call was disseminated through different social media channels, picked up by a few mainstream media platforms,[21] and disseminated through other SEADS' and UPOU's public outreach communication channels.

[21] See https://www.scoutmag.ph/68754/science-by-way-of-art-reseach-project-open-call/ and http://baguiomidlandcourier.com.ph/health.asp?mode=archives/2021/june/6-13-2021/health6-Art-and-science-fusion.txt

The Open Call invited the following individuals to submit information about themselves and a previous project they had worked on if they meet any of the following conditions:

- They identify as an artist in the Philippines who
  - collaborates or has collaborated with science and technology researchers and practitioners,
  - incorporates scientific and technological research into their artistic or creative work, *or*
  - is involved in other kinds of art-science collaborative projects.
- They identify as a scientist in the Philippines who
  - collaborates or has collaborated with artists when conducting research projects;
  - uses scientific methodologies for research in or practice involving the arts and humanities; *or*
  - is involved in other kinds of science-art collaborative projects.
- They have a background in the arts and humanities but engages in work in the Philippines which has an impact on scientific knowledge or practice.

That is to say, stage 1 sampling was a convenience sampling of participants who engaged with the notion of artscience as form of "identification" {Cajilig, 2013}.

All participants were required to be of legal age. Participants were not provided with any incentives to submit an entry to the Open Call. However, we communicated the purpose of the research on the SBWA website:[22]

> This open call is for artists, scientists, philosophers, designers, inventors, engineers, and other researchers who work in the arts and humanities or in the science and technology R&D sector. We would love to hear more about your work so we can build a clearer picture of the state of art-science collaborations in the country.

[22] See https://ph.science.bywayof.art

3.3.1.2. Stage 2 sampling: Purposive sampling from Open Call responses

Stage 2 sampling adapts GT's approach of theoretical sampling , which means that complete inclusion-exclusion criteria necessarily cannot be specified completely in advance without having completed the Open Call first. As we proceeded with our stage 1 sampling, we began to better understand what we were looking for, leading to formalized inclusion/exclusion criteria which we now refer to us our *teleological*, *impact*, and *notability* criteria sets.

The *teleological inclusion criteria set* takes into account the primary aims and questions of this study. It seeks to address the question, "Does this case potentially answer the confirmatory, exploratory, or action-oriented research questions of this project?" This criteria set is composed of the following subcriteria:

- *Confirmatory*: Does this open call submission confirm that transformative/ radical sci-art projects are happening in the Philippines?
- *Exploratory*: Does this open call submission help us understand the qualitative nature of art-science relationships in projects across the Philippines?
- Action-oriented: To what extent would the project or individual represented in the open call submission contribute to building a community or practice that would could facilitate the bringing together of existing projects, individuals, organizations, or communities to create transformative and inspiring outcomes in the future?

The *impact inclusion criteria set* refers to the extent to which the submission had the potential for scientific, economic, educational, and other impacts. We selected projects or individuals that demonstrate potential for the following:

- *Scientific impact*: To what extent does this open call submission represent actual or potential scientific or science policy impact?
- *Economic impact*: To what extent does this open call submission represent actual or potential economic or economic policy impact, and at what scale?

- *Educational impact*: To what extent does this open call submission represent actual or potential impact on education or education policy?
- *Other impact* (community-building impact, capacity-building impact, etc.): To what extent does this open call submission represent actual or potential social or cultural impact?

The *notability inclusion criteria set* asks whether the open call response is notable in one or more of the following ways:

- *Sophistication*: Is there a complexity and depth in the project reported in the open call submission?
- *(Global) Novelty*: Does the project feature aspects that are unusual, such as a unique combination of disciplines?
- *(Local) Uniqueness*: Is the project one of its kind in reference to other submissions in the open call?[23]

The research team used these three criteria set evaluating which 30 respondents will be selected for an interview, through a multi-stage, investigator-triangulated {Creswell & Poth, 2019, p. 251} selection process. As an example of how these criteria set were mobilized, we note that despite the affinity that new media art has on artscience (as discussed in section 3.3.1.3.1.2), we excluded for deeper study artistic practices which merely uses technology as an authoring tool, unless the contents and the themes of the work signalled a potential for arts-based contributions to science activities.

3.3.1.3. Semi-structured interviews

Research participants who passed through the Stage 2 sampling were invited to participate in 1.5-hour online interview, which were recorded and transcribed. At least two people from the research team present – a main interviewer and a notetaker. I acted as the main interviewer for all but three of the interviews. At the start of the interview, the researchers verified whether the participant had

[23] This is effectively quota sampling as a substrategy of the more general purposive sampling strategy.

read, filled out, and sent back the informed consent form. Participants were asked for a verbal confirmation that they consent to being part of the study. Participants were compensated for their time.

Interviews were conducted using an interview guide. As per GT principles, the interview guide evolved as we conducted more interviews, gathered more data, and began to evolve our theoretical frameworks. It became clear to us after the first few interviews that there were certainly artscience engagements of value occurring in the Philippines, particularly considering the response that we got from the Open Call. After conducting the first few interviews, for instance, we included in the interview guide a line of questioning that we had not originally described in the proposal. See section 5.5.2 for the final version of the interview guide that we had used. Table 2 relates interview questions with the study's research questions and themes.

In addition to following the interview guide, interviewers asked additional follow

Themes	*Conceptual framing of art-science relations*	*Enablers and hindrances*	*Motivators and kickstarters*
Research questions	*What does meaningful engagement between the arts and the sciences mean for Filipino artscience practitioners?*	*What factors enable and hinder the work of Filipino artscience practitioners?*	*Why do Filipino artscience practitioners pursue the work that they do?*
Interview questions			
In relation to your project / practice, can you give us a brief background of your practice - can you identify milestones leading up to that?	X	X	X

With everything that you've shared with us, where or how do you currently locate your practice? Do you consider yourself an art-science practitioner or something else? What do you self-identify as? When people ask you what you do, what do you tell them?	X		
What are the current challenges you have faced or currently face in your line of work / field / with these projects that you do?		X	
What do you think needs to be done to overcome challenges?			
What do you think needs to be changed in our educational system?		X	
Do you think the kind of work that you do could potentially have financial benefit to you or economic impact to others		X	
On a scale of 1-10, how much more varied do you think your interests are compared to other people? 1 = your interests are very much less varied than the other people's, 10 = your interests are very much more varied than other people's	X		
What kinds of activities/ projects do you have planned in the future?	X		

Thinking about everything you've discussed, if you could get the resources to support any art-science project you wanted to pursue, what would you do? By resources, I mean funding, time, and personnel or collaborators, influence.	X		
What you do consider a successful outcome of that project? Or that consider a successful outcome of the project?	X	X	
Do you have examples of the kinds of projects that excite you?	X		
How would you redesign education?		X	
Where do you get your inspiration?			X
For you, what the relationship between the arts and the sciences?			
How would you define creativity? (e.g., what counts as a "creative project" or a "creative research project")	X		X
To what extent do you think it would be possible to produce the next Marie Curie, Stephen Jay Gould, Richard Feynman, Chandrasekhar, Einstein, Newton?		X	

Table 2. SBWA themes, research questions, and interview questions

3.3.2. Analysis

Interview recordings and transcriptions have been subj ected to an initial coding using a hybrid deductive and inductive approach. Pre-established codes were based on the four topics of inquiry discussed in section 3.3.2. A line-by-line coding will be conducted after submission of this report in preparation for submission to publication venues. Coding was done using NVivo 12. Data collection and analysis were conducted in parallel, consistent with grounded theory. To minimize coding bias, coding will be done by the PI but will be reviewed by the Research Associate as a form of investigator triangulation {Cresswell & Poth, 2018}.

3.4. Results and Analysis

In this section, we present a summary of our current results and analysis of responses. In the interests of brevity, we postpone a more detailed discussion of results and analysis for later publications.

The Open Call resulted in 89 submitted projects from 85 individuals representing wide range practices. They reported acting either independently, in small collaborative groups, or as part of an institution.[24] After the stage 2 sampling, we identified 30 individuals and invited them for the online interview. All invitations were accepted. Interviews were conducted from 14 August 2021 to 13 September 2021.

The participants invited for interviews pursued diverse occupations. They included (though were not limited to) the following:

- An archaeologist and professional explorer
- A children's book illustrator
- A philosopher of science
- New media artists

[24] Raw data from the Open Call is not submitted as part of this report, but can be made available at a later time after redaction of confidential and protected information, and subject to review by data privacy and research ethics experts.

- A neuroeconomics researcher
- Chemists who work in cultural heritage
- Designers
- Cultural workers
- Poets
- Science fiction writers
- Environmental scientists
- Visual artists

We note that these labels often were used by the participants to identify themselves to other people or within a particular professional network, but would not necessarily be the labels they would use for themselves or within other professional networks.

We note as well the relative abundance of submissions from certain fields (poetry, visual arts, science communication, and chemistry) and the absence of submission from certain other fields (e.g., dance).

In the following sections, we present our analysis of the data taken from SBWA interviews. We use codes to refer to the interviewees for the time being. Many interesting (and sometimes unexpected) themes emerged during the interviews. We present for the time being only the ones that are aligned with the four topics covered by our main research question. Participants are referenced using their initials as identifying codes.

3.4.1. Conceptual framing of art-science relations

We found it striking that for many of the research participants we interviewed, artscience was part of their practice of working towards sociocultural, environmental, or political awareness or change. This ethos was reflected in various ways, such as through the use of visual design or storytelling to communicate science or science policy (RJS, NI, CPF), advocating for the use of local natural resources (PKM), critiquing power through provocative conceptual art pieces (CL), creative positive experiences for senior citizens

through interactive technology design (VK), translating science more effectively into public policy (VKB), encouraging more Filipinos to engage with agriculture (JCJ, NPF), or raising awareness of climate change through co-creating art interactive in local communities (RL). One particularly interesting thread we picked up was the idea that engaging in artscience in the Philippine context was a strategy for decolonizing received ideas around natural and cultural heritage (WFT, LDC, MSR) or technology (JCJ). MJR had proposed an entirely different term for the genre of science fiction he is writing, "islandpunk", as a response to science fiction genres like steampunk from the West.

On the one hand, these affinities unsurprising given that this research is situated in the Global South, where individuals often advocate for social change because conditions compel them to. On the other hand, this politicization was not so obvious given that there does not appear to be anything inherently political about the relationship between the arts and the sciences, at least at first glance. However, it is interesting to note that when C.P. Snow proposed his notion of two cultures during his seminal 1959 talk, he did so by relating it to the discussion on pressing problems of his time, including global wealth inequality. Similarly, among the SBWA study participants, very few explicitly related art and science as a field of pure ideas exchange, and even if they did, their practice in neuroeconomics (MBG) or weather disturbances (MO) ultimately references topics of wider social concern: decision-making and climate change. For many SBWA participants, art and science were often inseparable from social, environmental, and political advocacy, resonating with the stance that many other artscience projects make {Paterson et al., 2020}.

We received a sizeable number of science communication entries during the Open Call, but selected only a few science communicators for the interview stage in order to get a broader diversity of practices. Nevertheless, science communication still accounted for roughly 50% of the interviews we conducted. While science communication featured prominently in our interviews, other forms of public engagement (e.g., through public art exhibits) were notably absent, with the notable exception of projects such as *LigtasPAD* by RL, which engaged local communities in the issue of climate change and climate adaptation

through participatory and technology-enhanced arts creation. Another exception, *Explore My Ili* by LDC, involved the production of DIY explorer kits for children, which was seen by its creator as something that primarily benefits the community, but could also conceivably be framed as a public engagament activity for the geography or exploration.

Most participants expressed the belief that the arts and science were related in one of the four ways:

- **As disciplines that are loosely connected but connected nonetheless.** Few could described precisely what how those connections are configured and how they emerge, but many would give anecdotal insights or example to illustrate their ideas. One participant explicitly talks about culture as the defining bridge:

  RA: Nu'ng una, nu'ng nag-aaral pa ako ng Physics...actually parang wala siyang relationship. Ngayon nang nag-study na ako, noong meron na akong research about Ethnoculture, sa kultura, parang magkadikit talaga sila.

- **As separate disciplines that can or should interact with each other.** For instance, "science informs art and vice versa" (TJD). Science communication and other related activites involving the use of the arts in "evoking emotion and intuition to trigger stronger motivations for change" {Paterson et al., 2020} falls under this. In this view, the sciences are about facts (as opposed to questions) external to human experience. Science is associated with the natural, while art deals with the human (WFT).
- **As related fields of practice that intersect with each other.** This was most common for those participants who brought up the possibility of a "fusion" (MSR) of the arts and the sciences, or for one to "be infused" (RJM) with another. This (in)fusion, however, was mostly conceived as as an instrumental kind of engagement that was largely multidiscplinarity or interdisciplinary in nature (as opposed to a transdisciplinary one; refer to section 2.2.2.2.2.3 for a discussion on pluridisciplinarity approaches). One participant's framing captures this instrumentality:

MJR: The distancing of science has become problematic. Art's function in this sense is to provide some sort of relatability or accessibility to make science more communicable and to portray it in a way that matters to people.

- **As activities of inquiry and practice that were motivated by similar approaches, methods, or values.** This view was by far the most rare but the most boundary-melting of them all. VKB, a philosopher, was eloquent on this point:

VKB: You cannot be exceptionalist about art and science. If I wanted to add to that, I would say that sometimes they employ the same methods. That's one way to say that there's an interface that art and science employs the same methods. For example, in the arts, it usually springs from someone's creativity kasi art is a creative enterprise… However, you could also argue that there's also scientific creativity wherein imagination, working creative juices of the scientists becomes important in scientific investigation. The example for this is with the known theoretical physicist, Einstein himself. Einstein purportedly thought of the general and special theory of relativity through a dream. Einstein dreamt of imagining falling into space and he also imagined cows running past the speed of light. There's an account like that wherein Einstein dreamt of these things. Those dreams of Einstein's apparently, according to the account, informed his general and special theory of relativity.

Indeed, creativity as a bridge between arts and the sciences was frequently mentioned by interviewees (e.g., VKB, TJD, RJS, NI). While this is not entirely surprising, it was interesting to see it emerge from the data, and we attempted to avoid priming or biasing participants with the concept too much. For example, we did not reveal to participants the name of the larger project ("The Creative Turn in the Sciences") of which SBWA is part. We also intentionally refrained using words such as "creative" or "creativity" in our interview guide, with the exception of one question towards the end of the interview ("How would you define creativity? What counts as a 'creative project' or a 'creative research project'?"). We added this question after conducting a few interviews and we began to pick up on interviewees' usage of the term, and so we decided to probe research participants' definitions of creativity to explore if they have developed. For some (e.g., MJR, RJM, MO), creativity remains in the domain of the arts, and

the role of the arts in an artscience engagement is largely about communicating or being "infused with" (RJM) science. Others, such as materials engineer LJD, acknowledges a link between artisic and scientific creativity but tends to assigns a different word—innovation—when it refers to science.

> **Interviewer:** Would you consider yourself a creative person?
>
> **LJD:** No, I don't know. I don't think I am creative. I'm not artistic. Well, I don't know their equivalent. When in terms of looking for ways and strategies to which we need to respond and innovate on our side of materials, ako, mahilig ako mag-explore kumbaga magkaroon ng iba't ibang trials na theoretically-based on what we know about our materials. In terms of creative na marunong akong mag-communicate, marunong akong mag-present so that I could get attention? Medyo hindi ako confident doon sa part na 'yun.
>
> **Interviewer:** So you associate creativity with artistic creativity?
>
> **LJD:** That's one aspect that I strongly associate it with aside dun sa sinabi ko sa creativity na meron kami from the technical perspective na we try to look at other ways and means to be able to adjust, innovate on our... creativity also is really innovation, right?

What is also interesting are the words that did *not* appear as frequently as I had expected them to, namely *curiosity*, *imagination*, and *exploration*, as these are traits I often associate with creative behavior common to the the sciences and the arts.

One theme that cropped up in a few but very notable subset of the interviewees was the notion of queerness in their practice and its relationship to artscience. KL, a poet who works for a environmental science organization, has written poems that employ "a lens of queerness when [applied to] environmental concerns". MBL is a neuroscientist who also writes poetry, and the way he relates queerness to his scientific and artistic practices is worth quoting in full:

> **Interviewer:** What extent is your work as a scientist make its way into your poetry?
>
> **MBG:** It's where the neuroscience comes in. My work in neuroscience focused on perception. I'm also interested in areas of embodied cognition, so what's the relationship between the eye and the body, basically. In neuroscience, conceptually, that's a given framework that we deal when we look into behavior. There is a sort of behavior that we

observe. At the same time, we know that there are these processes that we really don't understand particularly well. That's why, to begin with, at least what neuroscientists in general are looking into, we are particularly interested into these neural correlates associated with behavior, largely because we know somehow that there is a relationship to behavior with some neural processing, but we still don't know what that neural processing is. Where somehow it runs parallel with my poetry is because of this idea of displacement. In a way, it was almost very much a given for me. It was so easy to settle in for me to think about, how do you call this, this dissociation between the eye and the body. I thought whether my conception or at least my interest in that area is just because of my gender dysphoria or maybe because of displacement. It turns out, all of those things somehow intersect. In a way, neuroscience provided me that language to really step into those topics. In a way, that's where my scientific pursuits became also very personal, in the sense that I already have a template to look into these questions or these problems into my poems.

While the impact of queerness and queer theory on the arts is well established, ”queering” {Roberson, 2021} as a strategy in the sciences to ”drive research by offering perspectives that others in a lab group or collaboration might not have considered” {Byrne, 2021} is a more recent phenomenon {Letts, 1995}. As an LGBTQ creative practitioner and researcher myself, I have often made the association between living outside the boundaries of heteronormativity with a transdisciplinarity ethos, and to see this echoed by the some of the interviewees was a pleasant surprise.

We found that the philosophers in our group made the strongest conceptual links between the arts and the sciences. For instance, VKB talks about the necessity of philosopy (specifically philosophical accounts of confirmation) in order to understand and contribute to “scientific success”.

VKB: What's the aim of science? Is the aim of science truth? Is the aim of science predictability? Is the aim of science just empirical adequacy? These are actually competing accounts. If you say that the aim of science is truth, then science as successful to you, it produces true theories. If you believe that science aims at predictability, then science is successful if it produces scientific theories that predicts things. If you say that science aims at empirical adequacy, then science is successful if it produces theories that are empirically adequate.

VKB also brought to our attention how the humanities can create a link between science research and policy-making, citing the case of UK's What Works Network of organisations in the UK which propose policies based on scientific research. Interstingly, one of the current or previous heads of the network was a

philosopher. The arts and humanities might be able to provide novel and crucial perspectives in policy formulation.[25]

3.4.2. Motivators and kickstarters

In attempting to understand proximate and distal causal factors contributing to the emergence of artscience practice in the research participants, we note three themes that emerged: turning points {Denzin, cited in Creswell and Poth, 2018, p. 72}, accidental and serendipitous encounters, and early exposure to fascinating experiences.

Explaining how she entered the Royal College of Arts' summer program and eventually became a visual artist, CL relates this turning point:

> **CL:** My course was human biology … I didn't go to med school, but I finished the pre-med. […] . One of my professors [in a class in multimedia arts] saw my portfolio because we had a class. We just had to pass plates. I never thought of becoming an exhibiting artist or studying contemporary art, but she saw it and then she was like, "I'll enter your portfolio."

Another respondent (now a National Geographic explorer) also started off in medical school and then quit, explaining that as a graduate of the Philippine Science High School, she was contractually obligated to pursue a science career but would have preferred history or the social sciences. She settled instead for a disciplinal compromise of sorts—archaeology:

> **LDC:** I liked history. I liked culture. I liked going to museums which was very lucky for me na I could do that. My dad used to teach in [the College of Social Science and Psychology at UP Diliman]. I was exposed to those types of things. Frustrating for me na our history is highlighted by three things: the Spanish period, the American period, and the Japanese period. You don't really learn much about what goes before. Archaeology lets you dig that.

[25] Here we note that one of the former Chancellors of the UPOU, Dr. Grace Alfonso, is a practising artist. It would be interesting to study how being an artist might have influenced her approach to governance and policy of a public institution.

Interestingly, it appears that most of the turning points were accidental or serendipitous in nature. LDC further recounted how the met one of the artist she now collaborates with:

> **LDC:** It's artists who appeared magically. The guy who's doing the sheets right now… He was doing a project in El Nido and I was in El Nido at that time. He was sleeping over at the house of the tourism officer and I was also sleeping over at the house of the tourism officer.

That is to say, while many of the participants reported a kind of a turning point in their career or practice, few appeared to have made the decision to make the turn out of some kind of ”pure” volition.

> **NPF:** My degree is BA Communication Arts. To tell you all, I also have a background in information technologies. I earned 95 units in computer science [but] I transferred to UPLB mainly because nawalan ako ng scholarship in [my previous university]… I accidentally entered this educational background of mine. It's not that I want to pursue it but because I'm into it, I managed to see the silver lining of what can, what if people have this ability to have their left and right brains activated, and still have this passion, this longing for the both of the fields.

In the case of BMJ, a theatre performer and professor who completed her MFA in the US, the turn towards the sciences occured over a long period of time but was precipitated by a personal tragedy that occurred several years in the past. That event has led her to now explore how theater performance techniques can be used in the context of clinical psychology.

The field of chemistry came up surprisingly often. Admittedly, three of the interviewees that we selected (RJM, GR, JMC) worked in the field of chemistry (two of who do chemistry research for cultural heritage). But in addition, one had shown interest in chemistry at university (KL); two described how chemistry functions as conduit for interdisciplinarity among the sciences (LDJ, NPF); and finally two others (JI, RA) talked about transformative experiences they had with chemistry when they were children.

> **JI:** Six years old pa lang ako nung tinanong ng: “when I grow up, I want to be a...” Lahat

lawyer, doctor, pagdating sa akin sabi ko: “I want to be a chemist.” May idea na ako na cool siya. I grew up na nakita ko iyong chemistry; iyong nagiging purple siya ganun. Naging dream ko siya. Come to think of it, it's also about beauty kasi nakikita ko nag-iiba iba yung kulay. Cool siya, parang hindi ko naman inisip noong bata ako kasi I want to cure cancer. Hindi ko naman siya naisip noon.

RA: Maganda ang ano natin noon sa Elementary, compared sa ngayon kasi ang Elementary ngayon, pagawan mo ng project na basket, hindi marunong kasi iba ang curriculum…

Interviewer: So naging interesado ka sa Science dahil sa mga ginagawa mo'ng activities?

RA: Yeah, mga physical activities na ginagawa.

Interviewer: Bakit 'yung mga activities na iyon, na-engage ka doon? Ano 'yung naka-attract sa iyo?

RA: ‘Yung mag-gawa ng mga experiment. Tapos sabihin mo kung ano 'yung resulta sa nagawa doon. Sa Chemistry. Lalo na 'yung, I remember, 'yung nagche-change 'yung kulay sa Chemistry namin na subject noon. '

The notion of material transformation is referenced in another concept that came up: magic. Three of the participants had used the word “magic” or “magical” to describe some aspect of their engagement with artsci to mean either inspiring (CL), as a reference to the spiritual (BV), or accidental or serendipitous (LDC).

Indeed, serendipity was a recurring theme and figures in one topic that caught our attention: access to encyclopedias and other media in childhood. Seven participants mentioned encyclopedias as having made an impact on them.

Interviewer*:* Thanks. I wanted to ask a little bit about your early childhood […] What kinds of activities did you like to do?

MJR: I was definitely known as the nerd, no doubt… [I] can distinctly remember printing out the Mars 2020 Rover which is now the Perseverance rover on Mars. When I was a kid growing up, I would print out the schematics for that.

Interviewer*:* What do you think the interest in these themes come from?

MJR: Honestly, there's no specific one-point genesis that I can point to you. I could say that my parents bought a lot of encyclopedias and when I turned the pages, I stopped at the space section. The colors that I saw in the space section, I gravitated towards [it].

Interviewer: Can we know any books that have influenced you or what type of books you read the most?

TJC: Specific works of science fiction that I have kept to heart and carried with me are Frank Herbert's Dune and Einstein's Dreams ni Alan Lightman. ‘Yung Dune, interestingly enough, I came to it not by the novels themselves, but by an accompanying work. Long story short, sobrang detailed nung world-building na ginawa ni Frank Herbert doon. I think in early '80s, mayroon gumawa, although it wasn't officially endorsed by the author, this Dune Encyclopedia. It was written as an in-world encyclopedia with all of the characters and all of the animals and technologies of that world.

Interviewer: How old were you when you encountered this encyclopedia?

TJC: Ah, 10, 13? Between 10 and 13 years old.

Interviewer: How did you feel reading all of these materials that [your parents] would give you? The encyclopedias, the GED.

KL: The encyclopedias were entertaining, in part, because there are a lot of images that supplement or support the facts that I will be reading. When it came to those technical, like GED, I didn't put my attention on them. I had more of my time in the encyclopedias, I put my nose very deep in that because they had a more entertaining presence or value to them.

Interviewer: Ano'ng klaseng mga libro yung binabasa mo?

MO: Mapa. Dictionary binasa ko rin 'yon. Pero kaya ko lang naman binabasa 'yung mga dictionary noon kasi may mga illustration sa gilid. Alam n'yo yung Groliers, kasi may illustration sa gilid. Iyon lang yung tinitingnan ko. Mga ganoon. Tapos sa mga encyclopedia, is yung mga illustrative na encyclopedia.

NI: I think one of the early beginnings… My parents also bought a lot of books, I'm not sure, yung A Child's First Library of Learning. It's this whole collection of science picture books na binebenta door to door. We had the whole collection of that. Now it's nice to see na some groups are trying to revive that kind of literature na popular science. I actually just ordered online.

We see different that encyclopedias afforded serendipitous discovery ("when I turned the pages, I stopped at the space section"), entry points, entertainment, and/or immersion.

Aside from encyclopedias, science fiction books and movies were also referenced as interests that the interviewees associated with their current interest in artscience, serving as inspirational or aspirational touchpoints. KL, for example, describes how wanting to be an astronaut was "a most common thing, at least sa mga nakikita ko on cartoons when I was a kid, ang daming mga batang gusto maging astronaut, ako rin, isa rin ako sa mga batang iyon." NI describes how science fiction films inspired her to become a science communicator:

> **NI:** I think one of the early beginnings, it's going to sound a little funny, pero I got started on Alien films. I grew up on the whole Alien franchise, the Predator franchise. I forgot ano pa bang Sci-Fi films growing up, some Sci-Fi and even horror. I was heavily into films. I actually took up TV and film production track under my comms major in Ateneo. I think it was really just Sci-Fi films.

Whether these individuals ended up affining themselves to artscience because of early exposure to encyclopedias and science fiction, or whether they displayed interest in these topics because of some innate propensity for such material, is an open question. However, one thing that appears to be common to many the respondents who reported interest in these topics as children is that they had supportive families who nourished these interests, facilitating early exposure to fascinating ideas.

This was not always the case, though. Some of our respondents recounted how they chose to pursue the sciences at university (instead of working in the social sciences, the arts, or the humanities) because of expectations placed on them by their family or by themselves; however, at some point down the line, they would reach a turning point in their career and then pursue a different career track. For the respondents of this research, their educational experience all along their life continuum played an important role in shaping who they are now. Education served variably as motivator, enabler, frustration, and hindrance

for our participants. We had previously mentioned how LDC (who is an alumna of the Philippine Science High School) was compelled to pursue a science oriented course when she would have rather studied history instead. Her experience of being pressured to pursue the sciences is echoed by other participants, including MJR:

> **Interviewer:** What are the challenges that you've faced in the past or currently face?
>
> **MJR:** From a family level, I faced a lot. My parents were bankers, as I mentioned. That's why I took up management. They saw commerce as the most immediate way to have a sustainable livelihood. I had to convince them so many times just to get into creative writing. I had a lot of straining family relationships after I graduated because I wanted to pursue a writing career very seriously. The Palanca, it lent credence to my career.

MJR's mention of the Palanca links to another topic: awards, scholarships, prizes, and other forms as recognitions as motivator and enabler for some of our participants (KL, MBG), which sometimes served as a strategy for legitimizing their practice (MJR) or for building interest within their target community (RJS).

After the first few interviews, it struck me that the participants we were interviewing held (somewhat unsurprisingly) a great number of interests. We thus added a question to the interview guide on how they compared the variety of their interests with reference to the population at large:

> On a scale of 1-10, how much more varied do you think your interests are compared to other people? 1 = your interests are very much less varied than the other people's, 10 = your interests are very much more varied than other people's.

While a few of the respondents rated themselves being between 5 and 7, many more rated themselves between 8 and 10, with a few stating that the scale could not even capture the diversity of interests they held. Being self-ratings, these data should be treated with some caution in what they actually signify. Neverthelesss, I speculate that perhaps a significant number individuals who self-identify with artscience as a field of practice may also possess to an enhanced degree certain cognitive abilities or traits such as cognitive flexibility {Ionescu,

2017}; divergent thinking ability {Runco & Acar, 2012}; convergent thinking ability {Cropley, 2006}; and/or openness to experience {McCrae, 1993; Smillie, 2017}, one of the "Big Five" constructs in psychology {John, et al., 2012} which appears to have cross-cultural robustness {Rolland, 2002}, including in Filipino psychology {Church, 2002}. These traits are typically associated with psychological constructs of creativity {Weiner, 2012}. I touch on these topics again in section 4.

3.4.3. Enablers and hindrances

Unsurprisingly, access to funding was one of the most commonly mentioned barriers to the interviewees' artscience practices. What we want to highlight in this report is what funding can actually enables, inspired by evidence we gathered during the interviews.

Access to funding can create longer and more regular contact between artists and scientists, which (it is hoped) could lubricate social relations and facilitate disciplinal openness. Anecdotal accounts from some of our participants and personal experiences that our research team has accumulated suggest that while the "two cultures" can commingle in informal social settings, they do not mix as well when engaging formally in a disciplinal way, except through very limited engagements such as 1-on-1 collaborations or mentoring (e.g., WFT). Debates over terminology and nomenclature are common. Scientific activities that engage the arts and humanities often do so only in very limited parts of the process—usually towards the end, limiting the role that the arts and humanities can play in setting science research agenda. For example, one of the projects reported by a participant was involvement of illustrators and visual artists in the preparation of a major government report about a topic that relied to a certain degree on speculative imagining of the future based on science research (TJD). The artists were asked to create visual representations of these imagined futures, but the resulting collaboration seemed fraught from what we gathered of the experience. In addition, the artists came in during the tail-end of the project, when much of

the scientific conceptualization had already been crystallized, leaving little room for equitable collaboration. We suggest that it is *prolonged* contact—or finding new areas of contact—between disciplines that creates interesting and potentially transformative artscience work.

In another example of how the sciences might be enriched by the arts through new areas of contact, we present the example of LJD, a materials engineer professor who helped create a novel fabric that could be used for personal protection equipment. Originally developed as a biofilter, the fabric was repurposed as a new material for a face mask, whose shape was created by industrial designers. That was the extent of the collaboration, which is typical for many industrial design projects. However, LJD seemed pleasantly surprised when I proposed to her other possible systems of engagement, wherein artists are not simply commissioned to execute work that scientists have thought of in advance:

> **Interviewer:** What do you think might happen if you were able to produce this material, open this up to the general public say artists and designers and say "Listen we have this material. This is what it can do. Come up with interesting uses for it." What do you think about that idea?
>
> **LJD**: It's an interesting idea kasi actually parang hindi, ako personally hindi ko naisip yan. Hindi namin... Parang ang mindset namin is parang kami 'yung parating nagpu-push nung application; kami 'yung laging nnaghahanap kung saan ba s'ya puwedeng magamit. … Well, wala kaming ganyang activity right now. Actually, maganda nga syang i-explore. Like for example, these are the properties of this material. Okay, these are the properties kunwari lang nung clothing tech, do something about this o kaya industrial design look for other applications for this. Hindi pa namin nagagawa 'yan, hindi rin namin naisip. I think it's a good suggestion, it can be a welcome activity between our colleges and our specializations in the university. Students may have a lot of different ideas that they can put together to be solutions to whatever problems they're exposed to. Wala kaming ganyang engagement.

Access to funding enables exploration and risk-taking. Through informal observation, we suspect that artscience practitioners who have easier access to financial capital are those that subsequently had the capacity to explore topics or develop creative or research projects which have the utility or value in the long-run. The absence of financial capital does not mean that such exploration is

impossible, however; actors simply need to have access to other forms of capital {Bourdieu, 1986}, such as cultural or social capital {Talisayon, 2008} that can afford risk-taking, particularly social risk-taking, since compared to other types of risk-taking behavior (e.g., financial, health and safety, ethical, recreational), social risk-taking is the one most associated with creative behavior {Tyagi et al., 2017}. The question then really is: how can we enable disciplinal risk-taking that can come with pluridisciplinary work?

The range of insitutions providing structural and financial support enabling the research participants to carry out their work was varied, but the number of American, European, and UK actors was noticeable. In future reports on this project, we will attempt to map institutional engagements. We did notice a few interesting clusters centered around the UK, Los Baños, and UP Diliman. For example, one of the cultural heritage chemists (GR) is about to pursue a graduate program in textile design at the University of Glasgow; CL participated in the Royal College of Art's summer program; neuroeconomist MBG is based in London. Los Baños, on the other hand, is home to both a thriving scientific research community as well as arts organizations such as Philipine High School for the Arts. However, the apparent presence of such clusters could be an issue of confirmation bias and/or an artifact of our sampling methods. What is clear however is that there is little if any ringfenced funding for artscience engagements from typical arts or science funding institutions in the Philippines (and here we have in mind government agencies such as NCCA and DOST) except in very limited ways.

Many of the participants expressed difficulty in finding like-minded individuals with whom they could talk about their interest in artscience. We had previously mentioned Trial & Error, an artscience collective in the Philippines. However, their Facebook group appears to be down and we have heard through informal channels that the collective is currently inactive, suggesting that sustaining a community of artscience practice is difficult; this has certainly been our experience.

3.5. Discussion and future work

Through the Open Call and the interviews we have conducted, we find widespread interest and practice in artscience through inter- and multidisciplinary engagements. The breadth, scope, and depth of the conceptualization, implementation, and theorisation of the relationship between the arts and the sciences are somewhat limited if compared to programmes and projects discussed in section 2. However, we suggest that they are only limited in so much as that opportunities for training, professional development, serendipitous discoveries, informal social interaction, mentorship, prolonged disciplinal contact, recruitment, and risk-taking are limited.

In section 4, we link our analysis of this study to a wider set of policy recomendations. In the meantime, we conclude ths discussion of the SWBA study with further resesarch directions which could be pursued. We defer until the next section a discussion about what the impact of the study is on our own personal and professional practices as cultural workers, public servants, scientists, and artists.

The SBWA study is an initial step towards more broadly understanding the state of the confluences between the arts and sciences in the Philippines. Future research could cover a deeper exploration of the topics we have surfaced in this report. We also see gaps that our study has not yet been able to fill in, such as the following:

- **Actor Mapping:** Given the scope of the interview guide, the current corpus of interview texts could be analyzed using different analytical frameworks and methods to answer different research questions. For example, we suspect that there is a ”small world network” {Auber et al., 2003} of actors who would be more inclined to actively support existing (or develop new) artscience initiatives if they brought into more active contact with like-minded individuals, institutions, and enablers. Actor mapping would allow for a deliberate exploration of the different kinds of relationships and collaborations developed between individuals and institutions in order to better understand who the best enablers are. As a starting point, the data we have already collected through the Open Call

and the interviews could be mined and reanalyzed with an actor-mapping goal in mind.

- **Artscience in the margins**: While we never formally probed our research participants' socioeconomic profiles, we note that most of interviewees were university-educated and had enough access to the Internet to have received the Open Call and respond to it. We suspect a whole subculture of inventors, thinkers, tinkerers, and creatives who might resonate with the ntion artscience should they have had access to higher education opportunities, as well as certain flows of capital and influence.Future research—which could very well be participatory in nature—is needed to figure out how to systematically identify and access such individuals.
- **Queering artscience:** As disscussed in the section on the SBWA study, queerness appeared as a theme in a few of the interviewees, particularly the male participants. It would be interesting to return to our original respondents and pursue a line of questioning around the relationship between queerness and transdisciplinarity in artscience.
- **Polymathy, giftedness, and multipotentiality**: A line of inquiry that we were not able to pursue during the interviews but is worth studying for future research is association between interest and ability in artscience and with giftedness {Winner, 2000}, polymathy {Araki, 2018}, or multipotentiality, although the opinion among psychologists around multipotentiality as a construct appears to have soured {Achter et al., 1996; Araki, 2018}.
- **Creative Industries:** We note that while this study identifies strengths and opportunities in art-science collaborations in the Philippines and proposes weaknesses in the relationships between artistic and scientific establishments, practitioners, and researchers, this study is not a competitive analysis. Future work that could be done in this regard include SWOT {Gkarane & Vassiliadis, 2020; Helms & Nixon, 2010}, Five Forces {Porter, 1979}, cost/benefit (Mishan & Quah, 1976), or risk/benefit analyses.
- **Participatory research:** In this study, our research team consciously took

on a role as outsiders probing the lives of the study participants using traditions borrowed from ethnography and experimental psychology. However, as cultural workers, science communciators, and artists ourselves, we see tremendous potential in engaging with this population in a participatory way to build shared areas of inquiry and experimentation. We intend to reach out to our participants as part of the member-checking process as we prepare to submit our findings for peer review; after this is done, we invite them to engage in further dialogue, which many of the participants expressed interest in. We speculate that if these individuals have the opportunity to learn about each other's views and practices and opportunities for regular and prolonged contact are provided, interesting—even magical—outcomes might emerge in due course.

4. Conclusion and moving forward

To what extent the arts and humanities can contribute to transformative science research in the Philippines? In this report, we outlined an argument for the need to uncover and explore existing, potential, under-utilized, or under-described collaborations between artists, designers, scientists, and inventors that advance not only artistic practice and humanities research but also basic science and technology research (hereafter referred to as art-science collaborations) in the Philippines as a way to expand and reframe our understanding of the value of the Philippines' creative sectors.

To conclude this report, I introduce the SHARES framework as one possible answer strategy to develop art-science collaborations for transformative science.

4.1. The SHARES Framework

SHARES stands for *Support from the Humanities and the Arts for Radical Engagement with the Sciences.* We use "radical" (from the Latin "radix", meaning root) in all its multiple connotations: rooted, fundamental, grounded, transformative, disruptive. In its current iteration, SHARES can be simply summarized as thus: *through mutual agreement between disciplinal stakeholders, the arts and humanities can interface at any point with scientific processes because creativity is a common well from which all disciplines can draw.* A visual representation of SHARES is roughly shown in Figure 5, which is not meant to be an exact representation of the framework but rather an evocative explanation of what we hope to convey, namely that there are many areas in which the arts and humanities can interrogate, inspire, and other interface with various types of scientific processes, such as (but not limited to) the ones that were discussed in section 2.2.1. The thickness of the lines suggests the degree of potential engagement that might be possible. To see how this is reflected in our SBWA study, please refer to the webpage https://aspiring-fang-3f3.notion.site/SHARES-as-applied-to-SBWA-case-studies-d81bf56fe2e74b91a993667458b013ad

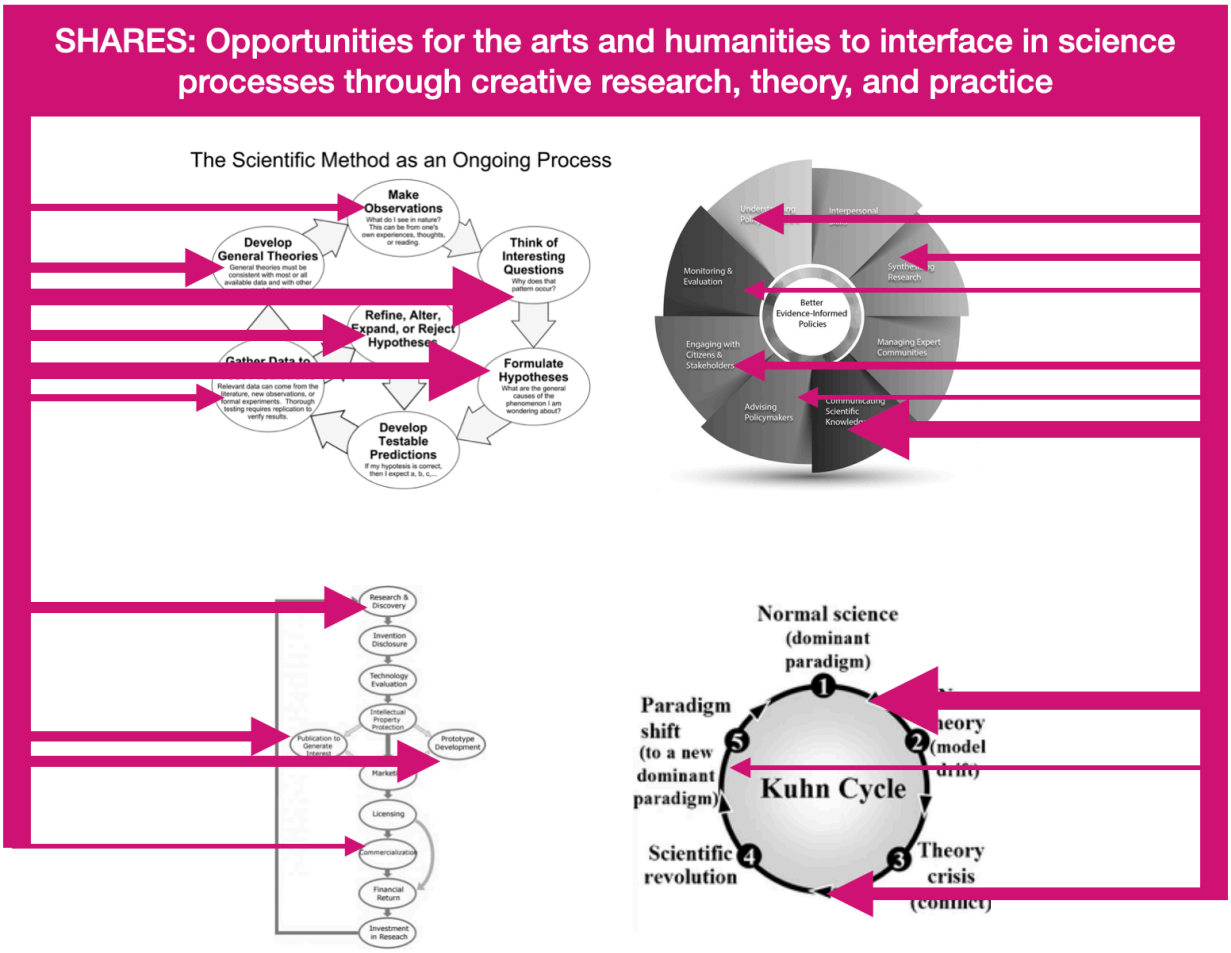


Figure 5: Evocative visualization of the SHARES Framework

The SHARES framework is predicated on the following assumptions:

- The arts and humanities can lead to transformative and creative science processes and outcomes; we argued for this in section 2.
- There is a nascent artscience community of practice in the Philippines (as revealed through the SBWA study discussed in section 2) that could benefit from support.
- Creativity can be the bridge between disciplines, but first, different disciplines need to have a dialogue about how they view creativity and acknowledge areas of common ground before such disciplinal bridges can be built.

The last point needs elaboration through examples. Writing from the perspective of computer science and artificial intelligence research, Boden {1999} offers a typology of creativity: historical, psychological, exploratory, and transformational creativity. (An example of the transformational creativity is Kuhnian scientific paradigm shifts.) Morales {2017} offers via the field of Filipino psychology a take on creativity as operationalized through the notion of "diskarte". Western psychology offers ways of formalizing and studying creativity (as discussed in section 3.3.4) through constructs such as cognitive flexibility, divergent thinking, convergent thinking, and openness to experience. Cohen {2011} proposes a continuum of creative behaviors:

- Level 1: Universal Creativity (in all people from infancy; also when learning something totally new)
- Level 2: Rare Compared to Peers (the child or adult creates unusual perspectives, actions, products, questions)
- Level 3: Developing Talents (expertise acquisition of knowledge and skills)
- Level 4: Developing Heuristics (expertise acquisition of strategies and ways of doing things)
- Level 5: Producing Information (shift from adapting to a field to beginning to add information to it)
- Level 6: Creating by Extending a Field (linear trajectory)
- Level 7: Transforming or Revolutionizing a Field (network trajectory)

Other fields will have different ways of engaging with the notion of creativity. Consensus is not the goal of cross-disciplinary dialogue on creativity; mere openness to conversation and the possibility of convergence is enough.

4.1.1. Anticipating criticism of SHARES

A criticism of SHARES might be that it amounts to no more than a mere instrumentalisation of the arts. Our response is threefold: First, SHARES does not

assert that the arts *only* has value when it engages with the sciences, but that it *can* have value and that this value should be recognized and supported. Second, further development and testing of the SHARES framework should be done by individuals and institutions who truly understand how pluridisciplinary engagements between the arts and the sciences can be mutually beneficial for all. SHARES may be an instrumentalisation of the arts, but it should be one formulated *by* the arts community. Third, by nurturing collaborative ties between different disciplines, SHARES is likely to create value to the art and humanities as well.

4.1.2. SHARES enabling mechanisms

In this section, we provide general recommendations appropriate for policymakers, funders, public research organizations, and educational institutions so that SHARES becomes an acceptable and impactful framework for artsscience engagement.

4.1.2.1. Educators

4.1.2.1.1. Keep (or include) the Arts in the ST(R)EAM acronym

The STEAM discourse in the Philippines glosses over the arts, as discussed in section 3.3.1.3.1.3. While there are systemic barriers that hinder the flourishing of basic science and technology research in the Philippines, the sciences are legitimized in Philippine policy in a way that the arts are not. By way of illustration, it is worth noting that the Philippines has a “Balik Scientist” {Ancho

& Park, 2018} program, but not a "Balik Artist" one. Nevertheless, science research in the Philippines is limited in a fundamental way especially at the graduate level {Kachchhap & Mishika, 2015; UP Open University, 2019}, with "blue skies" research particularly underfunded {Ilano, 2017}. There needs to be concerted efforts by educators and education researchers to keep the Arts in STEAM, perhaps even offering new buzzwords that can further reinforce the role of the humanities in education, such as STREAM (STEAM + Reading) {Nuangchalerm et al., 2020}.

4.1.2.1.2. Retrofit existing programs to include discussion on and practice in artscience

Given that the creation of brand new degree programs can be a prolonged and arduous process (especially in state universities and colleges), creating new programs of study is not always a viable strategy. However, educational institutions could provide support for cross-disciplinary educational opportunities. For example, additional support could be given to those who want to pursue double major degrees featuring unusual disciplinal combinations, and track their professional progress over a long period of time. Support could come in the form of funding, an extended maximum residency, recognition, or tracks within existing major programs that provide a cross-disciplinary specialization (e.g., a multimedia computing track within a computer science program), so we can nurtury pluridsciplinary interest and expertise early on.

In addition, existing undergradaute courses in sciences and the arts could specifically include discussion on the relationships between the arts, humanities, science, and technology. For example, STS 1 (Science Technology and Society) and ARTS 1 (Critical Perspectives in the Arts) are existing General Education courses at the University of the Philippines, and are required for courses for their entire undergraduate student body—all 33,000 them. In section 4.4.2 we mention plans on how we might take advantage of this opportunity at UPOU.

4.1.2.1.3. Create opportunities for internships and real-world alternative learning activities

Educational administrators might consider actively developing internship and alternative learning activities for their advanced undergraduate and graduate students in the arts and humanities. For example, the Bachelor of Arts in Multimedia Studies program at UPOU has organized placements for its students with the Philippines Space Agency. Managed carefully, these engagements might encourage public institutions and private companies to later consider developing an artist-in-residence or designer-in-residence program. These embedded artists or designers can play a layered role in the activities of the company. They can provide alternative, playful, critical, and even potentially disruptive (in the multiple senses of the word) perspectives that can drive institutional; develop artistic outputs that can engage the public on issues that

The development of such programs should be done carefully and critically, and perhaps under the supervision of experienced artscience facilitators.

4.1.2.2. Funders

4.1.2.2.1. Ringfence funding for artscience collaborations

Funders who support work in the arts, humanities, sciences, and engineering should consider creating funding tracks that explicitly call for collaborative ventures between the arts and the sciences. A review of UK's Wellcome Trust artscience funding programme (1996-2006) found that ringfenced funding for artscience projects "achieved high-level impacts" especially for the arts

{Glinkowski & Bamford, 2009}:

> Undoubtedly, an enormous capacity for generating new artwork and for fostering interdisciplinary collaboration would have been lost had the artscience scheme not occurred. The evaluation showed that considerable innovations, new explorative processes and methods of working, and interesting outcomes had occurred that had attracted high levels of public and media interest. Many of these would not have been possible without some dedicated funding to sow the seeds of research and collaboration. While many people felt that, in its original guise, artscience had served its purpose and had been appropriately wound down, there was felt still to be a vital need for an innovative and flexible funding scheme that would support artists and scientists to work together. In summary, artscience had generated a strong brand name and had enabled innovative, creative practice to flourish, often with high-quality outcomes.

With respect to the British Council Philippine's programme of activities, we suggest that the British Council review the Wellcome Trust's artscience funding programme and consider its applicability and potential impact to its activities in the Philippines.

4.1.2.2.2. Provide mechanisms for long-term monitoring and evaluation

We suggest that the success of artscience in general and of the SHARES framework in particular needs to be evaluated over a period that is best measured in years or decades, not months. This is a challenge given that both arts and sciences research in the Philippines appears to lack support for long-term evaluation research (e.g., longitudinal or tracker studies).

4.1.2.2.3. Consider new forms of cultural work and new models for patronage

It may be worth consider new models for patronage in order to facilitate artscience partnerships, which may then result in new forms of cultural work in the Philippines. An example of an interesting model can be found in Les Nouveaux Commanditaires (New Patrons), a French nonprofit that facilitates the commissioning of artworks that are seen as "actor(s) of public life".[26] One of the roles that New Patrons has played in the past is as a matchmaker who identifies artists and connects them with potential commissioning patrons. New Patrons was responsible for connecting a community of "expert composters" in the Belgian town of Willebroek to artist Angelo Vermeulen, resulting in the award-winning public artscience installation Biodiversity Tower {Vermeulen & Maranan, 2019}.

4.1.2.3. Professional research organizations: Establish coordinating actors and provide opportunities for serendipitous interactions

4.1.2.3.1. Take the lead as coordinators and mentors

We suggest that there is a need for professional research organizations to facilitate dialogue between arts, humanities, and science institutions in order build communities of practice, curate networks of networks of artscience practitioners. One important role that such coordinating actor can take is identifying strategies for mentorship and supervision. Potential resources that can be tapped for mentoring expertise could be mined from the networks

[26] Organization website: http://www.nouveauxcommanditaires.eu

revealed from this study—e.g., alumni of pluridisciplinary research training programs like University of Plymouth's CogNovo program {Torre et al., 2020}—and in subsequent actor-mapping studies. Mentorship is crucial in trying to braid these two cultures together, as the potential for conflict and misunderstanding is high. Callard and Fitzgerald {2015, p. 36} urge caution in this regard:

> Try to design an interdisciplinary experiment that puts together the empirical rigour of neuroimaging and the conceptual openness of the humanities, and there is a good chance that you will be condemned by neuroscientists for your ambiguity, and by humanities scholars and/or interpretive social scientists for your empiricism.

4.1.2.3.2. Provide opportunities for both formal disciplinal dialogue and serendipitous interactions

In order to galvanize the nascent community of artscience practice, professional research organizations should organize formal opportunities for cross-disciplinary dialogue. Several forms of engagement are possible, ranging from merely introducing them to each other in informal settings (e.g., coffee meet-and-greets, brown bag lunch presentations), organizing more structured knowledge-exchange events (e.g., conferences and symposia), to active collaborations on research and creative projects.

Professional research organizations should also provide opportunities for serendipitous interactions between different disciplines. Creative hubs are good foundation for such environments, but other environments are possible in different institutional settings (e.g., social spaces in public research organizations such as universities) and can be designed according to a range of principles {Thoring et al., 2019}. given that innovations often arise in part through coincidence {Wasserman, 2021} and—as the SWBA study shows—through chance encounters.

4.1.2.3.3. Strike while the iron is hot

Based on the strength of the responses we achived during the *SBWA* study, anecdotal accounts from *SBWA* study participants accounts of the increase of interest in artscience activities particular during the pandemic, current partnerships that my colleagues and I are currently forming with arts and science communities in the Philippines, I believe that the country is entering a window of opportunity during whith it would ideal time to launch programmes supporting artscience (or other similarly radically interdisciplinary intiatives) in the Philippines.

Professional organizations should strike while the iron is hot. Opportunity has a limited duration and that funders, researchers, and other actors need to start preparing for when this window opens to take full advantage of this opportunity. UK-based researchers Felicity Callard and Des Fitzgerald point to the temporality of pluridisciplinary networks across the social sciences and neurosciences across the world {Callard and Des Fitzgerald, 2015}:

> These networks represent a definite moment, in which there was a sense of flux around the relationship between the neurosciences and social sciences. The specificity of that moment is also evidenced by the emergence of a series of groups, coalitions, and interdisciplinary research arenas during roughly the same period… We conjecture that that moment is no longer alive in quite the same way. It is certainly not that the avenues for interdisciplinary research have suddenly narrowed, but rather that the horizon of interdisciplinary possibility … [T]here is a temporality, as well as a momentum, of openness and closure around specific interdisciplinary fields.

4.2. Research dissemination and public engagement strategy

This report was structured as a rough outline for more substantial narratives that I wish to set down in the near future through a series of conference

presentations, journal articles, and public engagement events, which I eventually intend to bring together to form the manuscript for a book proposal.

This report will be refined further and shared with the research participants. After that, it will edited to make it more appropriate for public consumption and then uploaded to the UPOU institutional repository as a preprint. Afterwards, we will use various portions of the report for IEC materials, publications, and shareable reports, as described in Table 3.

Dissemination channel	Audience	Audience size	Content	Projected date
Virtual talk[27]	Attendees at the UPIS Art Fair Vernissage	35	Presentation of early draft	
Virtual talk[28]	Members of the international SEADS Network	12	Presentation of initial draft of artscience Engagement Framework for Science Excellence	Done

[27] Slides available on https://repository.upou.edu.ph/items/4d707124-f176-4075-a012-f2fb7313c441

[28] Presentation notes available on https://aspiring-fang-3f3.notion.site/SEADS-Presentation-c859294df0bc4b60b94815270a84e629

Virtual Talk[29]	Attendees of the Living Labs Inaugural Symposium, York St John University	10	Presentation of artscience Engagement Framework for Science Excellence	
Virtual talk	Philippine Space Agency	4	Presentation of initial	Done
Publicly accessible Open Educational Resources (OERs) appropriate for undergraduate courses	Higher education institutions in general; undergraduate students at the University of the Philippines in particular	~350 students every year at the UP Open University campus alone	Content from this report will be adapted into learning material that will be incorporated in this course which I teach every year. The learning material will also be made available to other UP campuses offering ARTS 1, which is a required course for *all* undergraduate students in the UP system.	February 2022

[29] Slides available on https://repository.upou.edu.ph/items/de202571-1e1c-4e91-9049-96dcfa2e99dd

ARTS 1	Undergraduate students at the University of the Philippines Open University (UPOU) ~300 students every year at UPOU alone Content from this report will be adapted into learning material that will be incorporated in this course which I teach every year. The learning material will also be made available	~300 students every year at UPOU alone		2022 1Q

MMS 194: New Media Art		~100 students every year	Content from this report will be adapted into learning material that will be incorporated in this course	2022 1Q
Journal publication in AVANT (Scopus-indexed journal on interdisciplinary studies)	International research community		Section 2, *Artscience: Divergences and convergences in the sciences and the arts*	2022 4Q
Journal publication in Leonardo (Scopus-indexed journal on artscience)	International research community		Section 3, *Science By Way of Art: Exploring the current state of artscience in the Philippines*	2022 4Q

Sharing a whitepaper-version of this report our contacts at the DOST, DTI, CHED, DepEd, and other relevant government agencies	Philippine government agenecies		All sections	2022 2Q

Table 3: Dissemination strategy

5. Appendices

5.1. SBWA Open Call form

The original version of this form was available on https://ph.science.bywayof.art/contact

Thank you for your interest in the Science by way of Art Open Call, which is part of The Creative Turn in the Sciences, a project that aims to explore existing, potential, under-utilized, or under-described collaborations between the arts and the sciences in the Philippines.

This call is for artists, scientists, philosophers, designers, inventors, and other people who work in the arts and humanities or in the science and technology research sector. We would love to learn more about you and your work.

For more information about the project and the research team, please visit https://ph.science.bywayof.art. This project is supported by the Connections Through Culture programme of the British Council. Additional support has been provided by the University of the Philippines Open University and SEADS.

Data Collection Policy and Informed Consent Policy

The Creative Turn in the Sciences team respects and values your privacy. As such, your personal information will be protected in accordance with the Philippine Data Privacy Act of 2012, its implementing rules and regulations, as well as related issuances from the National Privacy Commission. This Data Collection Policy describes how The Creative Turn in the Sciences team collects and will use any personal information obtained when you fill out this form. Information outlined in this Data Collection Policy will be supplemented by an informed consent form when you become a participant of this study.

TYPES OF INFORMATION COLLECTED

When you fill out this form, personal information such as your name, email address, gender, contact details, occupation, institutional affiliation, and information related to your art-science collaborative research experience may be collected.

PURPOSES

The information you provide through this online form will only be used and processed by The Creative Turn in the Sciences team so that the researchers may contact you about further information on the study. For the purposes stated above, your personal information shall not be collected through any other means other than this form. If The Creative Turn in the Sciences team wishes to use the information you provide through this form in ways other than for contacting you, your consent will first be obtained.

RETENTION OF PERSONAL DATA

Your personal information will be retained or stored for as long as the purposes for which they are being processed have not been satisfied. The Creative Turn in the Sciences team will retain and use your personal information as necessary to comply with its legal obligations, resolve disputes, and enforce its agreements.

DATA USE

As the data subject, you have the following rights:

- The right to access personal information;
- The right to make corrections to personal information;
- The right to object to the processing of personal information;
- The right to erasure or blocking of personal information;
- The right to be informed of the existence of processing of personal information;
- The right to damages;
- The right to lodge a complaint before the NPC; and
- The right to withdraw any other data you contribute.

This consent form may be updated from time to time. The data subject will be notified whenever there are any updates that will significantly affect his/her rights. In case of complaints, concerns, or questions regarding the processing of your personal information, or if you wish to exercise your data subject rights, you may address them to:

The Data Protection Officer
University of the Philippines Open University
UPOU Headquarters
Los Baños, Laguna
dpo.upou@up.edu.ph
63-49 5366001 to 6005 loc. 299

By proceeding with this form, you consent to being contacted by The Creative Turn in the Sciences team should you be selected as a participant of the study.

Personal Information

Please tell us about yourself.

- Name
- Email address
- Gender/Sex
    - Female
    - Male
    - Prefer not to say
    - Other (please specify)
- What would you say your occupation was? How would you describe your line of work?
- Institutional Affiliation (if any)
- (Optional) Your mobile number
- (Optional) Link(s) to your website or social media profiles
- Where did you hear about the Science By Way of Art ?

Tell us about your work

In this section, please recall a project of which you were part and which involved an active and fruitful collaboration between practice, methods, or experts from the arts, humanities, sciences, or engineering. If you have been involved in multiple projects that fit that description, please choose one in which you feel that the arts contributed the most towards achieving science-based outcomes. Please share only information that you have the authority to disclose.

- Name of the project
- When did the project happen?
- Please briefly describe the project. What was the focus of the project? Who was involved? What were the outcomes? How did the art and science collaboration happen in this project?
- Referring to the same project, to what extent would you say that arts- or humanities-based approaches advanced scientific research aims, methods, knowledge, or other outcomes during the course of the project?
- (Optional) You can upload any files that you have permission to share with us that can give us a better idea of either the specific project you discussed or your work in general.

5.2. Interviewer's guide during the SBWA interviews

1. Introduction (8 min)

- Greetings
- Check for consent form.
- Explain who is on the call
- Explain the livestreaming portion. You might notice that it says that this call is being livestreamed. We're not livestreaming to the public, we are just sending audio to software that we will automatically transcribe the

audio. Is that ok?

- For this project, we are trying to map out and understand art-science projects and practices in the Philippines. And so this interview is about getting to know you, your background, your practice, art-science activities that have you planned for the future, and your thoughts about the relationship between the arts and the science,
- Do you have any questions?

2. Present part 1 (20 min)

- Just for the record, could you state your name?
- We just also wanted to confirm details from open call submission (their entry should be open so we can quote from it directly)
- You currently work as _____ with _____ (instiutution) , correct?
- How did you hear about the Open Call?
- Why did you respond to the Open Call?
- The project you shared with us is called_____ and is about _____, is this correct?
- We read your entry, which is why we've invited you for this interview, but could quickly you tell us more about this? If you have any additional material you wanted to share? (researcher can inject any detail which interviewee can jump off from)
- (ask them to explicitly identify where the art part is and where the science part is)
- (Open questions)

3. Past (10-20mins mins)

- In relation to your project / practice, can you give us a brief background of your practice - can you identify milestones leading up to that? Could be courses you've taken, people you've met, organizations you've worked with, books you've read / films you've seen etc, places you've traveled to, that may have influenced your trajectory.

4. Present part 2 (10min-15mins)

- With everything that you've shared with us, where or how do you currently locate your practice? do you consider yourself an art-science practitioner or something else? what do you self-identify as? How would you describe ? When people ask you what you do, what do you tell them?
- What are the current challenges you have faced or currently face in your line of work / field / with these projects that you do? (trying to tease out what kind of support they need - could be institutional support and financial thingz — pwede ring mas social /emotional support pala— either way could point us to the gaps and needs of the sector, kahit anecdotal lang ang data)
- What do you think needs to be done to overcome challenges?
- What do you think needs to be changed in our educational system?
- In the future, do you think the kind of work that you do could potentially have financial benefit to you or economic impact to others? (How?)
- On a scale of 1-10, how much more varied do you think your interests are compared to other people? 1 = your interests are very much less varied than the other people's, 10 = your interests are very much more varied than other people's

5. Future (10mins)

- Now I'd like to talk about future plans you might have.
- Prompt for speculative question: thinking about everything you've discussed, if you could get the resources to support any art-science project you wanted to pursue, what would you do? By resources, I mean funding, time, and personnel or collaborators, influence.[Trying to get at what the ideal artscience engagement for them is. What is the highest form of artscience engagement for them? Although we didn't really get this from this question. Too many confounding variables (e.g., they may have peresonal ambitious they wish to meet, or institutional goals)]
- How would you redesign education?
- What kinds of activities/projects do you have planned in the future?

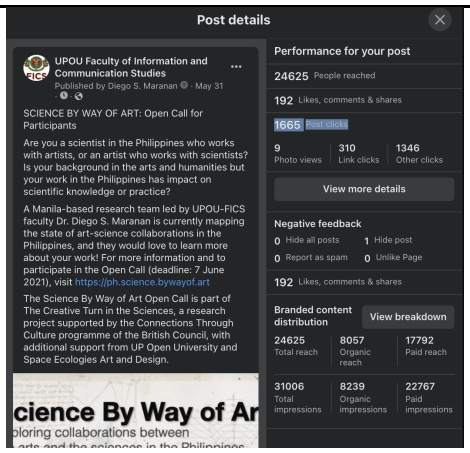
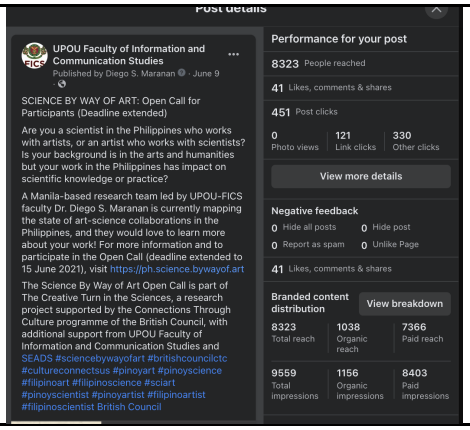
- Ask for answer to speculative question
- What you do consider a successful outcome of that project? Or that consider a successful outcome of the project?
- Do you have examples of the kinds of projects that excite you?
- Where do you get your inspiration?
- For you, what the relationship between the arts and the sciences?
- How would you define creativity? (e.g., what counts as a "creative project" or a "creative research project")

6. Closing

- Thank you for your participation! This ends the formal part of the interview, and I'd like to just have a conversations right now. We can tell you more about this project, but before you do, do you have any questions for us?
- Kilala mo ba si _____
- Ok lang ba if we mention you as a participant in the future if we think may kilala ka?
- To what extent do you think it would be possible to produce the next Marie Curie, Stephen Jay Gould, Richard Feynman, Chandrasekhar, Einstein, Newton?

5.3. Facebook metrics on public engagement with SBWA Open Call

Call		**People reached**	**Likes, comments & shares**	**Post clicks**

First call[30]		24625	192	1665
Extension of the open call[31]		8423	41	451
Totals		**33,048**	**233**	**2116**

5.4. SBWA Data Collection Policy and Informed Consent Policy

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[30] See https://www.facebook.com/upoufics/posts/6243836145642679

[31] See https://www.facebook.com/upoufics/posts/6289003334459293

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- The right to object to the processing of personal information;
- The right to erasure or blocking of personal information;
- The right to be informed of the existence of processing of personal information;
- The right to damages;
- The right to lodge a complaint before the NPC; and
- The right to withdraw any other data you contribute.

This consent form may be updated from time to time. The data subject will be notified whenever there are any updates that will significantly affect his/her rights. In case of complaints, concerns, or questions regarding the processing of your personal information, or if you wish to exercise your data subject rights, you may address them to:

The Data Protection Officer
University of the Philippines Open University
UPOU Headquarters
Los Baños, Laguna

dpo.upou@up.edu.ph
63-49 5366001 to 6005 loc. 299

By proceeding with this form, you consent to being contacted by The Creative Turn in the Sciences team should you be selected as a participant of the study.

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