World-building through techno-scientific creative practice: a case study of workshops as material discursive curatorial tools

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Abstract

This article frames workshops as material discursive curatorial methods drawing on ideas from new media discourses and materialist feminism. It takes as a case study a series of speculative world-building workshops by artists and physicist Libby Heaney delivered to three groups of participants: young people, scientists, and artists, drawing on specific artefacts from the last one. The workshops were commissioned as a material discursive form to unpack the artist's practice and invite audiences to workshop ideas and themes within it. The outcomes demonstrate the capacity of workshop methods in the context of transdisciplinary technoscientific artistic practices for futuring, speculation, and world-building with emerging technologies while generating discourse.

Keywords

Workshops, curatorial methods, speculative, worldbuilding, quantum, artistic practice, transformative methodologies, social practice, transdisciplinary exploration, participatory art

Introduction

The first section of this article surveys the scholarship and thinking around workshops in relation to the history of digital arts and contemporary creative practice more widely. The article considers the workshop as a socio-material curatorial experiment allowing for speculation and knowledge-exchange with publics to unpack and reflect on artistic practice. In the second part of the article, a specific case is considered, *Quantum world (un)shaping* – a series of workshops led by artist Libby Heaney. The paper focuses on a selection of artefacts from one of the workshops in this series, to analyse them as creative outcomes from a speculative exercise with discursive qualities. The text concludes with a discussion of insights emerging from a new materialist reading of the artefacts and a note on the generative potential of workshops within cultural production.

The Workshop as a Site for Artistic Experimentation

If we think of workshops traditionally, their form and function might be the one of an artist atelier or an artist's studio – a creative space for artistic work and experimentation. When using the word "workshop" in a contemporary artistic context, it's most often as a form of programming or audience engagement to accompany presentations of works of art, such as exhibitions, installations, or performances. As such, the workshop has acquired curatorial capacities in so far as it becomes a method of interaction between audiences and artists (and/or artistic objects and practices) by facilitating learning, participation, and exchange.

In the history and tradition of electronic or computational arts, workshops are of particular importance and have been heavily relied on as methods for engaging audiences and introducing them to new technologies and creative experiments. This is evident through the programmes of multiple festivals for art and digital culture, which are one of the primary organisational and institutional frameworks, in which experiments in art and technology are being exhibited and discussed. Some examples of previous and current festivals are Ars Electronica, ISEA, transmediale, FutureEverything, Abandon Normal Devices, DEAF – Dutch Electronic Art Festival, Impakt, Fiber, Pixelache, RIXC, Sonar, MIRA and many more. Festivals have been culturally significant in the history of digital art because of their emphasis on emergent practices and shaping new forms of creativity.[1] The fast-paced, periodic and distributed format is well suited for demonstrating work in progress, emphasising process and inviting feedback.[2] In this sense, workshops sit close to other forms often employed by festivals, such as labs or hackathons, which speak to the same insistence on open-process, engagement, and experimentation.

The relationship between workshops and experimentation, specifically in relation to electronic arts and cross-disciplinary practices, can be traced far back. One example is the artist collective *Jikken Kōbō (Experimental*

Workshop) who were experimenting with new technologies in Tokyo in the 1950s and shared their work in what they called "Experimental Workshop Presentations" (rather than exhibitions) through forms like workshops, performances, concerts, or photographic works for magazines.[3] Institutionally, Ars Electronica as one of the oldest media art festivals and one of the earliest and longest-running institutions of art and technology, was the first festival that piloted a concept for the presentation of art in interaction with technology in the form of multi-media concerts, symposia, and workshops – these were essential for facilitating context for critical engagement and fostering the development of discourse around these emerging creative fields. [4]

Furthermore, in the history of media arts, workshops have been framed and utilised as hybrid methods which achieve skill-sharing and networking, like in the case of Medialab Prado's *interactivos* (workshops) being taken alongside exhibitions to other cities.[5] [6] Importantly, workshops have also been used as democratic tools enabling access to technological skills and counteracting hackerspaces (or by extension hackathons) as male and white-dominated spaces for learning and experimentation in technology by rather facilitating a learning and experimentation space for women.[7]

Crucially, workshop became a verb (not solely in a technologically artistic context) and was neatly used to elaborate the difference between the traditional curatorial role in contemporary art and the necessary changes to curatorial responsibility which arrived with the proliferation of *new media art*: "when you're working with this [new media] you need to go right up to the idea stage and work on how those ideas can be open to the public and how to let the public 'workshop' the ideas in the same way that an artist [in his studio] would workshop the ideas."[8] There is an emphasis here on the importance of allowing audiences into works of art (and by extension practices) especially since digital art is often perceived as difficult to access. This is particularly relevant when thinking about the question of open processes, democratising art and opening it up to new publics.

Despite the prominence of workshops in digital art programmes and their consistent (if infrequent) framing as experimental spaces for exchange between artist and audience, a focused study of their relationship to digital arts is still necessary. While most commonly, in the digital art spaces discussed above, workshops have been associated with hands-on engagement with technology or direct feedback to works in progress, I suggest a more holistic view of the role of workshopping ideas emerging from artistic practice with audiences. This research was not driven strictly by how the workshop facilitates access to emerging technology through hands-on engagement with the

technologies in question, but *how a workshop can be a discursive and speculative exercise* with specific material dimensions opening an artist's practice as a world in itself.

The present research takes the new media scholarship idea of workshops as formats for experimentation, open process and learning and cross-contaminates it with ideas from curatorial practice and materialist feminism to position the workshop as a socio-material curatorial form which allows for public learning, knowledge exchange and the production of discourse around emerging practices.

The Workshop as a Research Framework

Drawing on the scholarship around workshops and digital art presented in the first section of this paper, the workshops presented in this article were approached with the question of: *What does a workshop do as a material discursive curatorial method to generate value through its properties of collaboration, openness, and audience engagement?*

In partnership with the Scotland-based digital arts organisation NEoN, I formulated an artist brief which included devising workshops for audience members to engage with concepts around emerging technology through an artist's practice. In line with themes and approaches in technocritical and technoscientific artistic practices, I was interested in exploring specific dimensions of these practices which guided the selection of the artist to commission. These dimensions were *process, trans-disciplinarity,* and *emerging technology,* meaning I wanted to work with an artist who works in a transdisciplinary way with emerging technologies and is willing to translate their creative process in a workshop format as a response to a commissioning brief. The brief invited the artist to open their practice by facilitating a workshop and working with audiences to explore relevant themes while allowing for speculation and new ideation. Additionally, in line with the programming cycle of the co-commissioning organisation, we were interested in working with feminist methods and approaches and in exploring feminist perspectives in technocritical arts. The brief sought to address issues around digital monoculture through cyberfeminist ideas and practices, including feminist perspectives on emergent technologies and how those might be related to value structures or might subvert dominant narratives. The brief also emphasised the potential for such approaches to develop narratives and world-building tools challenging bias in data and emergent digital technologies and fostering interdependence, plurality, and access.

With the central concern of how artists work with or reshape emerging technology, the obvious choice for emerging technology was artificial intelligence and while there is a large number of artists working in the area, AI was

already significantly visible and widely applied. Rather, the objective of the study was to look at technologies which are still to fully surface, such as quantum computing, which led me to artist Libby Heaney. I wanted to work with Heaney for three reasons. Firstly, she is working with quantum computing. Secondly, her work is transdisciplinary since she began her artistic practice after a successful career as a physicist and combines scientific methods with artistic ones. Thirdly, with the centrality of quantum physics and computing to her practice, her work is deeply materially feminist and strongly drawing on Karen Barad amongst other sociomaterial thinkers, which resonated neatly with the relational lens of the larger research project that this commission sits within and with the commitment of working with feminist methods.

The artist responded to my brief with a proposal to lead multiple speculative, world-building workshops, and instead of extensively focusing on technical details of working with quantum data, to take a more poetic and holistic approach and to work on workshop prompts for imagining a quantum computing future. These prompts would facilitate group work and exchanges between participants to draw on themes and motifs in the artist's practice while creatively speculating on possible technoscientific futures. The workshop materials were developed as a succession to Heaney's major immersive projection work *Ent-* (commissioned by Light Art Space and presented in Berlin) and its subsequent iteration *The Evolution of Ent-: QX,* exhibited in arebyte Gallery in London. There, it was installed within an expanded material world including textile sculptures made in collaboration with Rosie Gibbens, and multiple short video works emulating corporate ads and satirising the entanglement of technology, commerce, and immersive experiences.

In line with the proposal for speculative world-building workshops, Heaney developed a deck of playing cards, from which a set of four (each suggesting a different parameter and guidance for speculation) to be used in various assemblages as prompts for world-building exercises. The four variables or categories of the cards were: quantum computing phenomena, timescale, probability, and physical scale. Divided into groups of 2 and 3, participants engaged in collaborative story-building exercises to speculate on future realities with quantum computing by using their cards as parameters and starting points. After choosing one card from each category, participants were given a worksheet (designed by the artist to resemble a fluid comic grid) and various creative materials such as watercolours, charcoal, and collage materials to represent their quantum world.

The workshops lasted three hours in total each with the artist starting every session with a presentation of her practice and quantum computing, followed by the workshop instructions. The groups spend most of the time in conversation and assembling speculative futures with the artist and curator engaging in conversation and observing the process. At the end of each session, participants assembled to present their world and story and reflect on their approach to thinking, interpreting, and speculating about quantum phenomena.

Following conversations about wanting to involve different kinds of audiences in the project, we decided to organise three workshops – with young people, scientists, and artists to gain different perspectives on emerging technology, scientific theory, and approaches to the themes in Heaney's work from publics with varied familiarity with contemporary art, science and technology. The workshops took place in October 2022 in Scotland with a group of young people in Dundee, scientists from the University of Glasgow, and artists from across Glasgow and Dundee. Because of the different assumed levels of technological and scientific literacy between the groups, we approached every workshop with adapted language to ensure access. Below are the four card categories and respective prompts followed by images of the cards.

Quantum Computing Phenomena (Fig.1)

Quantum Superposition: Future full scale quantum computers show that increasingly bigger objects can be in more than one location at once.

Quantum Entanglement: Future quantum machine learning algorithms show that objects that were once thought of as separate and individual are actually connected in a symbiosis stronger than any correlation we experience in the macroscopic world around us.

Many Worlds Theory: Once thought to be firmly in the realm of metaphysics, future quantum computers realise our universe is one of many separate parallel universes by showing the entropy content of our visible universe is higher than it should be if parallel universes did not exist.

Grover's Search Algorithm: Future quantum computers are coupled with human brains via a new type of microscopic EEG headset and are able to extract long logical trains of thoughts and emotions.

Shor's Factorisation Algorithm: Future quantum computers are able to decrypt all encryption from the early 2020s including the major blockchains. While post-quantum encryption is now in place, companies and governments who own full-scale quantum computers can look back at all RSA/blockchain data that was harvested before then.

Figure 1. Back of card category "Quantum Computing Phenomena".

Figure 2. Back of card category "Timescale".

Timescale (Fig. 2)

5 years: Full scale quantum computers are almost running and the race is on to be the first between two major companies.

10 years: Full scale quantum computers exist but are only in the hands of a few big tech companies and very wealthy governments.

50 years: The world is in a period of radical change due to an explosion of quantum technologies (including quantum computing).

100 years: Quantum technologies have changed all aspects of our lives. The world is now entering a post-quantum future where the technologies are deeply embedded within all aspects of people's lives.
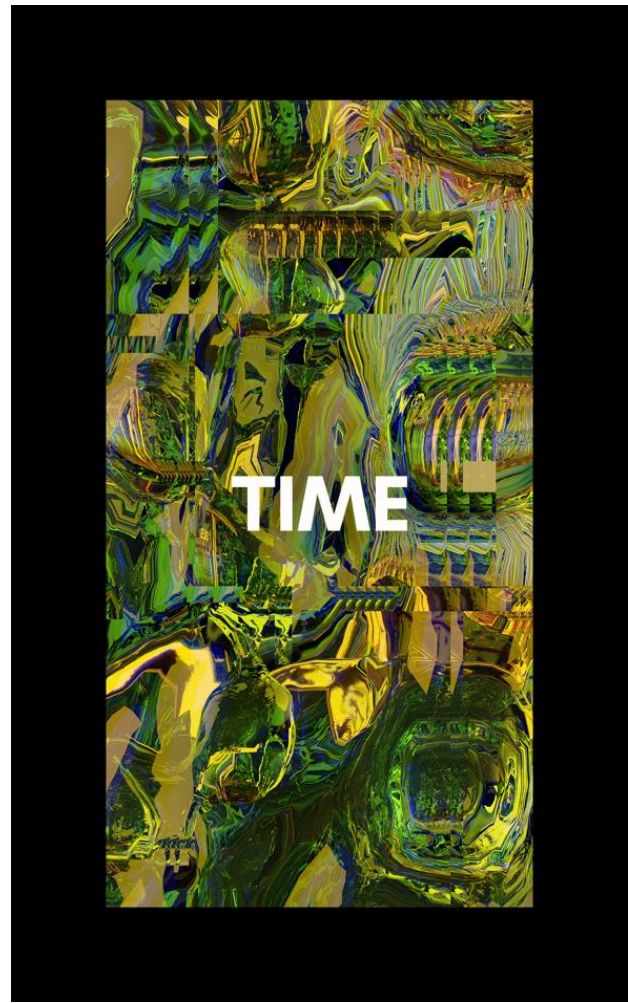
Chance (Fig. 3)

Likely: This type of impact is likely to happen based on past knowledge and current insights.

Plausible: This type of impact may happen - it is not outside the realm of physical and societal possibility.

Science Fiction: This type of impact has a small probability of happening. Like so-called hard science fiction, it is largely grounded in scientific facts, but these have been extrapolated away from current and predicted uses to imagine new tools and worlds.

Fantasy: In a fantasy world everything and anything can happen. Dream your biggest dreams but still try to justify how quantum science plays a significant role.
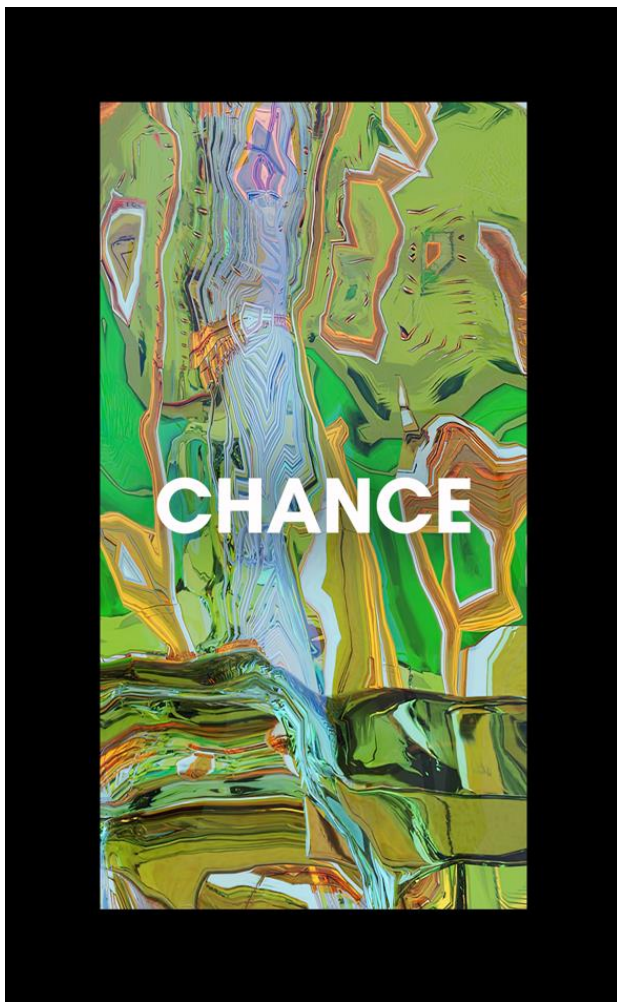
Figure 3. Back of card category "Chance" (or "Probability").

Where (Fig. 4)

Level of bacteria: Quantum physics is a physical theory that describes the microscopic world, how atoms, photons and molecules interact. A bacteria is at least 1000 times bigger than the realm of quantum physics.

Human body: How might your quantum computing phenomena impact individual humans or groups of humans, either physically or collectively (societally, bio-politically, economically). Keep relating your world building back to human bodies themselves.

In the home: Our homes are domestic spaces, where we often interact with technology to make our lives (supposedly) easier, personalised and more efficient. Personal assistants like Amazon's Alexa respond to our voice commands and smart objects like washing machines and door CCTV are controlled by our phones. How might future quantum technologies permeate our homes?

Urban environment: Our cities are already thronged with technology from public space CCTV to congestion monitors to myriad advertising screens. How might the future city be altered by your quantum technology?

Nation state: A nation state is a large group of people who inhabit a specific sovereign territory and are connected by history, culture, or other commonalities. How might future quantum technologies reinforce or deconstruct the idea of a nation state?

Planet: The Earth is home to all known life. It is a web of geological, ecological, and cultural systems. However, these are changing fast due to climate change and widespread ecological destruction. How might future quantum technologies support or oppose the Earth's natural systems?
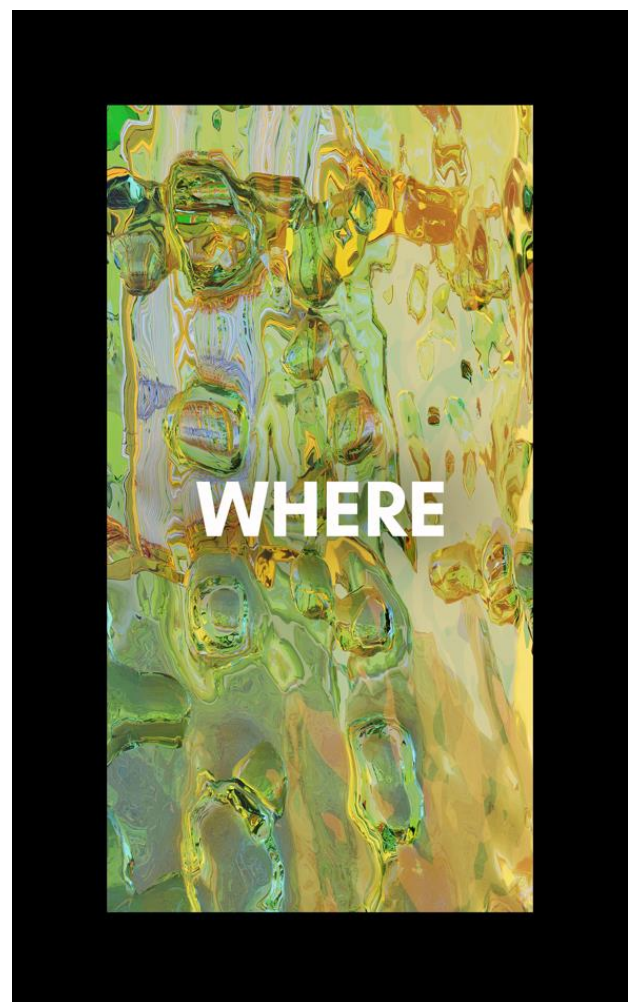

Figure 4. Back of card category "Where" (or "Scale").

The Workshop as a Space for Technoscientific Speculation

As an instance of curatorial research and an art-based method involving a group creative activity, the workshops were means to evoke and/or explore affect and emergent capacities related to the research question i.e., how is the workshop generating value through its material discursive properties? This question was conditioned further by the speculative nature of the workshop, particularly in facilitating world-building exercises on technoscientific developments in quantum computing and their possible impact on both social and material realities.

This section begins with an evaluation of how the different participants (young people, scientists, artists) engaged with the workshop activities based on their varying degrees of knowledge in contemporary art, technological innovation, physics, computation, or philosophy. Then, it moves onto a presentation and reading of some of the artefacts produced during the workshop with artists. Comparing and evaluating all three workshops fully is beyond the scope of this paper and instead, it keys in on one of the workshops to evaluate the ways in which the workshop generated value in response to the research question under these particular conditions. The section concludes with a summary of insights and an indicative note of potential applications of workshops as curatorial methods in relation to cultural production.

By a combination of observation, transcripts of conversations, and artifact analysis, the paper gives an overview of the different ways in which participants engaged in the workshops based on their participant group. The intention of working with young people, scientists and artists in different contexts was to experience engagement and ideation around themes from the artist's practice from people with various degrees of familiarity with the core themes. To this end, the engagement in the workshops was relatively predictable, and the three groups exhibited expected responses to the workshop conditions.

While young people and artists embraced imagination and storytelling with attention to the non-human and narratives and approaches less bound by normative world rules, scientists often struggled to detach their approach to scientific phenomena from the established research norms they usually work withing and found it challenging to engage with creative methods and "let go." Interestingly, both the scientific and young people groups produced narratives which were, if not strictly technophobic, at least adjacent to neo-luddism. The scientific researchers produced some dark techno-dystopian futures, if delivered somewhat humorously, but also with notably less earnestness than the other two groups. At the same time, the

group of young people unexpectedly imagined an end to computational technology and a new joyous world order of togetherness.

While scientists were less challenged by the scientific and philosophical context of quantum physics and quantum computing, they found it difficult to approach with an entirely creative speculative lens, which is not bound by scientific methods and approaches. While they enjoyed getting to use creative materials to speculate on impossible scientific scenarios, they were more keenly interested in finding out the practical applications of how the artist uses quantum data in her digital artworks, and less so in adopting artistic methods themselves to explore a subject matter they're familiar with from a new perspective. Their speculations were bound to traditional narrative structures and focused on story as driven by events, which stood in a stark contrast with the artist group who insistently tried to avoid traditional narrative structures and rather focused on exploration of ideas.

The artistic group tackled their tasks with an expected measure of criticality and non-conformity to the parameters and instructions of the workshops. Predisposed to collaboration and crossing creative disciplines, these participants freely experimented with both themes and forms to build the worlds they imagined prompted by the cards in the workshop. This group's distinctly experimental approach to responding to the prompts resulted in artefacts exploring new perspectives on narrative structure and speculating on new directions for future applications of emerging technologies, with sensitivity to both opportunities and risks. As such, it was the workshop with artists which produced the most value reaching beyond the situatedness of the specific workshop. In the following section, I present some of the artefacts which emerged in this context along with some of the themes they explored.

Workshop with Artists

In this text, workshops are framed as spaces for experimentation and collaborative methodologies, which take the shape of an assemblage, in which the artist, participants and curator are different socio-material elements with dynamic boundaries, engaged in a process of reterritorialisation in different dimensions. For example, the material conditions of the workshop space (in an artist-run gallery in Glasgow available at the time of the workshop), the material conditions of the workshop prompts infinitely reconfiguring until the performance of *agential cuts* in the form of a beginning (or a card selection); or the social conditions of artistic backgrounds and disciplines affecting the connections which are established between people, matter and ideas. In the current reading of the case study workshop, my approach to socio-material analysis is

influenced by Latour[9] but mostly in line with Karen Barad[10][11] and Donna Haraway.[12][13] Therefore, this reading is founded in the claim that discourse and materiality are ontologically inseparable.

Contributions of both material and discursive agencies in the context of the workshop form socio-material assemblages. Crucially, such kinds of material-discursive practices signal a move away from discourse as strictly linguistic and instead consider discourse as always expressed materially too. In this sense, the workshop becomes a socio-material assemblage or apparatus, which performs realities and values through *agential cuts,* therefore framing the workshop apparatus as a performative theoretical lens which facilitates articulations and manifestations of different phenomena in practice. Within this framework, the material outcomes of the speculative workshop exercises perform *agential cuts* which enact and materialise certain realities – what Barad calls "material enactments of differentiating/entangling."[14] These are the collective outcomes and artefacts of the workshop participants as both matter and meaning.

In this way, this socio-material relational analysis frames the participants' contributions (and the outcomes of their worldbuilding) as material discursive artefacts, which represent their speculative energies and reveal relations between the material, discursive, social, and other realities of the workshop's conditions and the material, cultural, social, and other realities of the participating artists, the facilitating artists, the observing researcher/curator and other social and material conditions entangled in this moment. Ultimately, the workshop outcomes become socio-material artefacts representing the complex entanglement of ideas, instructions, workshop materials, gallery conditions, artistic practices, and social relation which come together (or apart) in the workshop as an intra-action. In the following section, I present selected outcomes which emerged in the workshop with artists elaborating on the realities they projected.

Workshop Artefacts

Resource Cube

Prompts: Many Worlds Theory / Likely / Planet / Hundred Years

A 3D model of parallel universes assembled from two separate worksheets, this artefact represented a source cube, drawing on the Many Worlds Theory (Fig. 5). The two participants imagined a scenario of multiple different parallel universes, all exchanging resources between one another. The participants finished two of the narrative arcs and one of them begins with the discovery that this universe can take from other universes and they do so. They accumulate abstract cube objects and later discover other universes can also take from them which causes panic and leads to the first universe ending up with almost nothing. The second parallel universe (or timeline) starts with a huge accumulation of resources but in the end, they have nothing, and another universe comes in and gives them one resource cube.
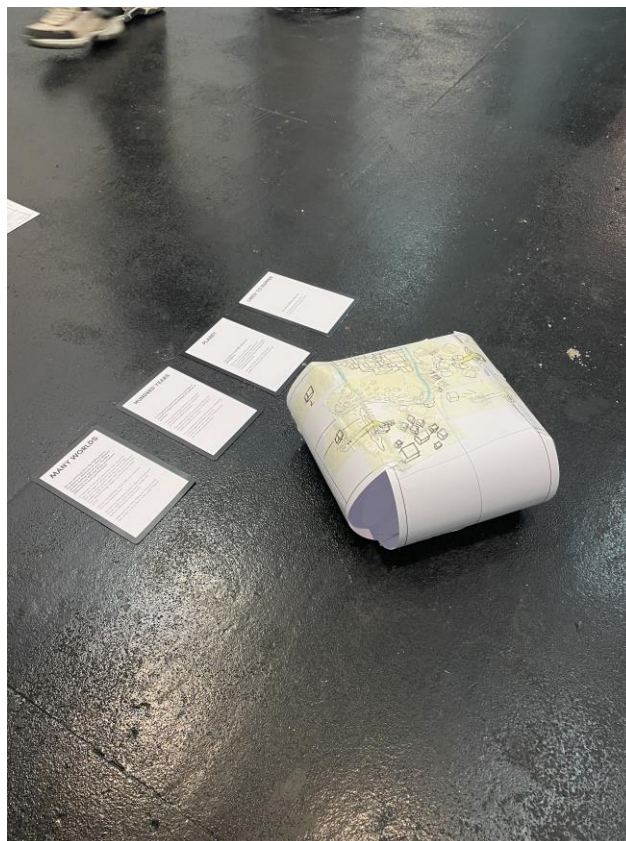

Figure 5. Workshop artefact "Resource Cube".

This artefact surfaced extractivist themes, the narrative revolving around the extraction and exchange of resources, suggesting more traditional dystopian sci-fi outcomes. Participants chose to focus on extractive resource-based narrative since they interpreted the prompt that "scientists didn't realise matter could move between universes" as a critical piece which suggested interaction between universes or worlds. The world evolves into a meta self-referential narrative as the 3D shape of the artifact mirrors the shape of the resource cube central to the story, which mirrors the structure of a quantum computer. The probability of "Likely to Happen" had suggested a sense of danger or "worst-case scenario" in the context of extraction and exchange.

Patrick Moore

Prompts: Shor's Algorithm / Fantasy / Bacteria & Cells / 5 Years

An interactive puzzle-like artifact with multiple entangled elements, non-linear timeline, and multiple possible interpretations, depending on the way in which one interacts with it, with no prescribed central narrative (Fig. 6). The story lays itself differently narratively, depending on the way in which the tiles are moved around and replaced. All elements are and aren't part of the story at the same time. The different elements are folding over the story, and they are entangled in a certain way, but we can never know all the ways in which they are. It reflects the exponential possibilities within a quantum computer and poses a question about the possibilities which exist within it depending on the person who engages with it. In a sense, this modular interactive game performs as a small-scale quantum computer.
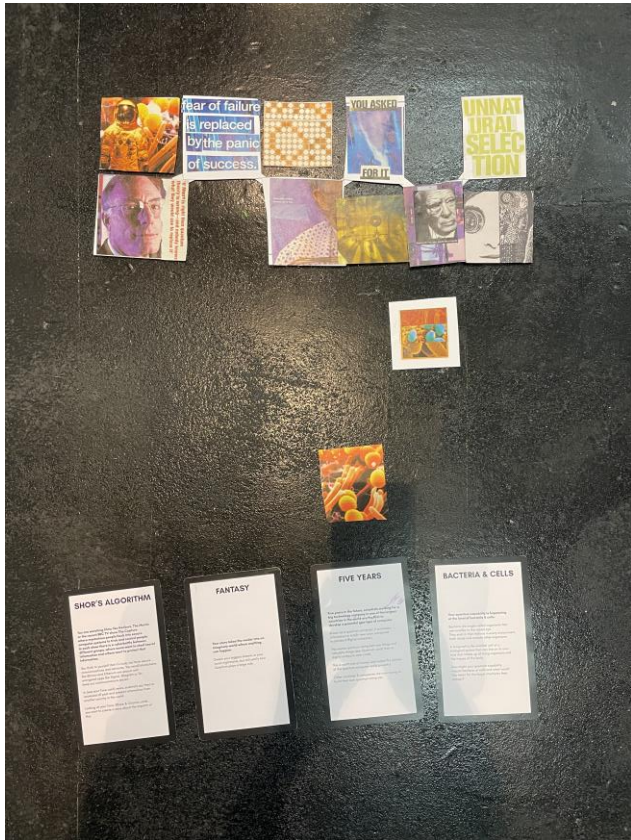

Figure 6. Workshop artefact "Patrick Moore".

While the participants were creating it, they developed a sort of narrative themselves, while at the same time trying to stay away from traditional narrativisation in an attempt to resist linear thinking. Originally, they were planning on creating a linear story, which to break apart after to

disconnect it, so it could be assembled differently, in a way "played" by others and be participator. Eventually, they decided this would create a predetermined form in itself and will be difficult to get away from, so they decided to break it up for the process to begin with. There's no beginning and end because the artefact could not exist in that way.

Participants were focused on not having a linear story, they wanted to give independent snippets or fractions, glimpses into something which could be assembled in various ways, rather than a time-based story. The artefact represented an interdependent network of possibilities. Despite the lack of traditional narrative, there was a human figure which emerged, and the participants spent significant time creating – Patrick Moore. Everyone in this non-realised narrative is Patrick Moore, the only character, and all characters at the same time. Everything is happening to him and also as a result of him.

Void Area

Prompts: Superposition / Likely / Home / 100 Years

Two separate narratives superimposed onto each other, exploring quantum superposition and symbiosis. Participants began by exploring the concept of something existing in two spaces at once. They decided to meta-narratively split and work independently to come up with two separate narratives to then superimpose (Fig. 7).

Drawing on ideas of simulation, they speculated on quantum superposition and the idea of something existing in two places at one time but also existing in all time simultaneously. Participants reflected on the perpetual continuation of the universe and the end communicating to the beginning. This outcome is particularly challenging to represent because in this paper the outcomes are still presented into a linear textual form, which contradicts their original form. The participants also reflected on the challenge of working in two opposite linear and non-linear directions and looking for what one doesn't understand – the artefact represented two becoming one.

They were imagining the relationship with oneself through a quantum lens as a way to communicate between past and future in a nonlinear way. A key part was the presence of a gap, or a void area, indicating they don't really know themselves or how they got there. They began to ask themselves about the end, the apocalypse, and the impossibility to conceive a beginning and an end. A struggle of communicating with the past, while trying to fight the future. In a way, a collapse of past and future, or of time itself.

The artefact reflected on circularity, time, and communication between past and future in a non-linear way to challenge traditional notions of storytelling. The artefact imagines two selves within one person and reflects moments of cognitive dissonance and the entanglement of the conscious and the unconscious mind but also represent the mind trying to push back into linearity.
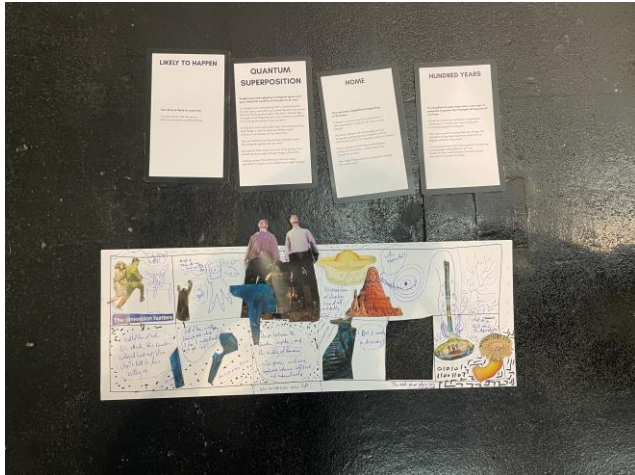

Figure 7. Workshop artefact "Void Area".

Brain Spider

Prompts: Grover's Algorithm / Maybe Likely / Cities / 50 Years

Paper sculpture of a Mobius strip made by tearing and reassembling the provided worksheet strip (Fig. 8). The starting point was having mind control in 50 years as a likely scenario. The world began with a reality where quantum computers are available but only to select few. At the same time, the ideas and concepts of state, country and nationhood have dissolved, and companies have taken over as the superstructures governing life.

The role of quantum computing in this world is as a predicting machine – doing calculations, almost divination, because it can compute so many different possibilities and can produce accurate statements about the future. This means it can do predictions on the ecological and climate crisis and yearly it needs to fulfil a quota of killings to preserve enough resources for the world to survive. These ideas of eco-fascism are cross-contaminated with ideas of eugenics, where the computer performs calculations on the most fit individuals for the state.

The participants reflected on the implications of mind control and the pointlessness this would bring, when there is full control. Participants elaborated on another strand of their world in which a powerful quantum computer had been

built in another reality which had the parameters of the Big Bang which created our planet. This world was a simulation to determine whether it was feasible, and whether they wanted to recreate this event based on our planet and they decided against it. Humorously, the participants also described the presence of the brain spider, which is a supercomputer able to manipulate the biochemical soup around it in a quantum mechanical way.
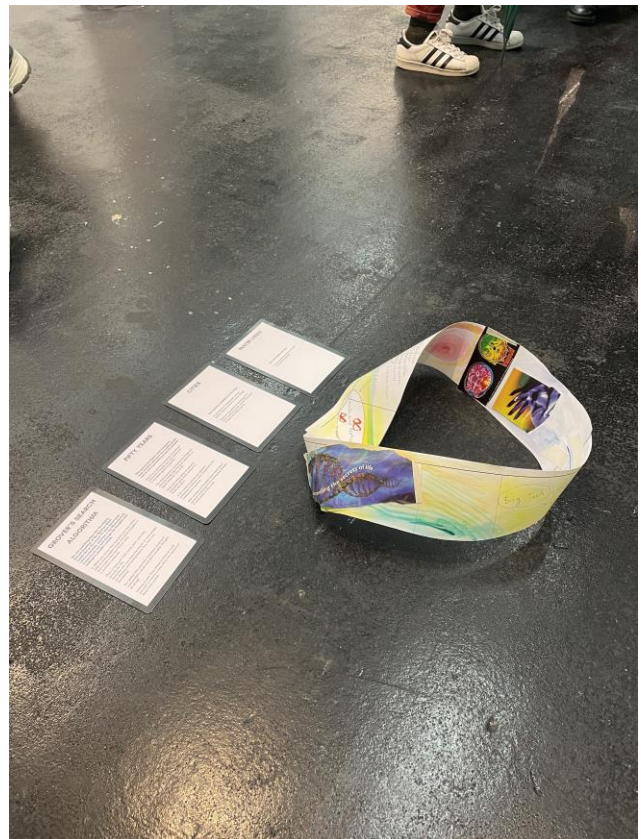

Figure 8. Workshop artefact "Brain Spider".

This artefact represented a narrative involving eco-fascism, rebirth, destruction, circularity, and statehood being taken over by corporate entities. Explored intense reliance on predictions, calculations, a kind of divination through data. It was a hybrid object drawing on organic and technological entanglements.

Discussion & Insights

The material artifacts of the workshops were fundamentally discursive in nature and represented complex outcomes of intra-active relations to one another, enacting and reshaping material objects, and encounters. Each of these brief sketches (of what were in actuality critical speculative probes on the future of an emerging technology widely

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unfamiliar to most publics) are only partial and momentary stabilisations, actions in motion rather than fixed results. Rather than arriving at strict research findings, this experiment in framing workshops through a material discursive paradigm reveals the potential for considering them as generative curatorial models. This is particularly charged when working with complex transdisciplinary practices and emerging technological concepts since it allows for a holistic view of relationships between meaning and matter which doesn't advocate for totality but rather for a speculative potential which is always in flux. The cards and prompts in themselves are a representation of multiple possibilities existing at the same time; while the workshop setting in itself is an expression potential realised through the collaboration between participants. The workshop is an intra-action in itself.

The theme of parallel universes exchanging resources draws on interconnectedness and resource dynamics and reveals the performativity of phenomena as it enacts feminist-material concepts like multiplicity. The narrative that reality is contingent on relational interactions. The artefacts acknowledge the impossibility of capturing or representing quantum phenomena linearly through their attempt to manifest complex multi-dimensional realities via a limiting two-dimensional form.

In synthesising a reading of the four artefacts through a socio-material lens, several common threads and insights could be outlined. Through all artefacts, participants engage in reconfiguration and restructuring to challenge linear narratives as a manifestation of Newtonian physics, or the traditional ontological rules we're used to being bound to. The artefacts enact multiple possible futures at the same time and blur the boundaries between imagination, personal (and collective) experience and histories. In all instances of world-building, the participants speculated on the multiplicity of reality through engagement with a complicated intra-action of technological, ecological, and power crises. In these experimental collaborations, participants create narratives and worlds in which they strive to challenge established cultural dichotomies and binaries and instead emphasise the complexity and multiplicity of reality.

There's a distinct gesture towards material possibility and the interconnectedness and interdependence of human and other-than-human agencies. This performativity of phenomena is wrapped in another layer of contextual meaning by the very performance of the artefacts materially but also discursively by the participants – the material expression of the entangled social, cultural, material, personal contexts to shape the speculative narratives.

Participants imagine worlds where traditional notions of temporality, linearity and the self are all deconstructed or reassembled to emphasise gaps or empty spaces as holding potential for realisation or revelation. Explorations of identity and selfhood in relation to others draws on tensions between past and future and the challenge of understanding the multitudes of oneself.

The analysis of the artifacts reveals the presence of concepts and ideas from feminist materialism in line with the theorists and ontological frameworks set out in this paper. Namely, the notions of entanglement and multiplicity while critically reconsidering ideas of technology, ecology, power, and selfhood. This reading of the outcomes of the workshop has multiple implications along various directions. Firstly, it serves as an expanded view of the facilitating artists Libby Heaney's practice, as the workshop conditions and prompts emerged from her artistic work to date. As such, this exercise is not only a tool for audience engagement but also a way to expand the world of an artist's practice and allow it to be workshopped by audiences. Secondly, in line with feminist materialism and wider socio-material understandings of relations, we can talk about the emergence of situated knowledge as a result of the specific cultural, artistic, social, material, and political contexts of each group of participants, who worked on the same artifact. The partial and multiple perspectives which informed each outcome contribute to a fractured understanding of the particular perspectives, speculations, and imaginations of the participants which produced it. Thirdly, the workshop as a method and a context, creates synergy between knowledge sharing and creation (via collaboration), production of discourse (via openness) and public and collective learning (via audience engagement). As a generative form, it facilitates a rich and complex socio-material context for the exploration of values, particularly in relation to multi-disciplinary discourses and practices and for speculation into techno-scientific social and political realities.

Speaking in more strictly practical terms within cultural production, workshops as discursive-material curatorial methods could be valuable tools for mediating between practices, publics, and meaning. As a generative strategy, such workshop approaches could be particularly illuminating in facilitating participation, evaluating creative projects, or as a commissioning framework for new artistic work.

Conclusion

This text explored the capacity of workshops as discursive-material curatorial tools to expand complex techno-scientific ideas and concepts emerging at the intersection of artistic work and scientific innovation. Via a new materialist reading, the paper suggests that such experimental and open forms hold potential for generating situated knowledge(s) and revealing relations which otherwise might remain

concealed. Importantly, as a curatorial experiment, the cases presented here suggest a generative loop of knowledge creation, emergence of discourse and collective learning at the intersection of world-building, audience engagement and expanded artistic practice.

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