Gathering as Design Process: Physical Prototyping for Culturally Sustaining Computational Technologies

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ABSTRACT

To address pressing issues of bias and black boxing embedded in technologies and their underlying computational models, scholars call for inventing and employing design processes that invite participation from those whose lives are shaped by these technologies. In response, we reimagine not only how technologies and their models are designed, but also who designs them. We present our work toward developing the concept of *gathering* as a design process that invites physical prototyping as an important mechanism in developing culturally sustaining technologies. Gathering is inspired by "Hui," an ʻŌlelo Hawaiʻi Hawaiian language word translated as: to band together, assemble, organize. We share our ongoing journey of inventing and engaging in *gathering* and present four characteristics of *gathering* as a design process. Our work has implications for how we design new forms of technology toward more equitable futures, especially by making visible decision making and sensemaking that occurs throughout the design process.

CCS CONCEPTS

• **General and reference** → **Design**; • **Human-centered computing** → *Interaction design theory, concepts and paradigms*; **Participatory design**; • **Computing methodologies** → *Knowledge representation and reasoning*; • **Applied computing** → Education; Media arts.

KEYWORDS

design process; computational models; prototyping; culturally sustaining/revitalizing technology, Indigenous knowledge

1 INTRODUCTION

Innovating with emerging computational technologies – themselves representational artifacts that indiscriminately model the phenomena they encode [1, 18] – requires acknowledging how these technologies are instantiations of cultural systems that privilege particular ways of being and knowing in the world. Further, these technologies perpetuate systemic oppression; a problem that even industry leaders such as Apple, Google, and Microsoft cannot yet resolve [10, 21, 23, 24]. Exploring educational innovations with these technologies without critically understanding the potential historical and cultural damage they can cause risks further disenfranchising minoritized communities. Issues of (mis)representation and lack of representation of minoritized groups not only shape the underlying computational models driving educational "innovation" but also the design processes to build these models, which have both caused deep harm to these groups; particularly Indigenous communities, with whom we work.

We argue that the perpetuation of technological disparities is rooted in (mis)representation and lack of representation of Indigenous culture, education, and computation. Due to the systemic disenfranchisement of Indigenous peoples in STEM [30], present forms of emerging technology do not support or engage Indigenous ways of being and knowing [16]. In fact, many of the historic and current forms of emerging technologies harm, silence, and further traumatize Indigenous peoples. In response and in resistance, scholars push for "technological self-determination and sovereignty" [34]. Building from this stance, we posit that *who designs* matters as it inherently determines the cultural process of design and therefore the product of what is designed. Thus, we seek to (re)engage technologies at their "core" (i.e., their underlying computational model) by fundamentally decolonizing *by whom*, *how*, and *why* these technologies are created in the first place. Moreover, *how* Indigenous knowledge is represented and by whom matters for accurate and appropriate representation of Indigenous peoples.

To address these pressing issues of bias and blackboxing embedded in technologies and their underlying computational models, we join scholars on the journey of inventing and employing design processes that invite participation from those whose lives are shaped by these technologies. It is on this journey that we together discovered the significance of *gathering* as a design approach. Gathering is inspired by "Hui," an ʻŌlelo Hawaiʻi Hawaiian language word translated as: to band together, assemble, organize. Through this

coming together, *gathering* addresses the need to make transparent the blackboxing of technology, especially the underlying algorithms and models driving technology. *Gathering* invites physical prototyping as an important mechanism in developing culturally sustaining technologies. We share our ongoing journey of inventing and engaging in *gathering* and present underlying rhythms of *gathering* as a design process.

2 BACKGROUND

Broadly, our work is shaped by culturally sustaining/revitalizing approaches [20]. Culturally sustaining/revitalizing pedagogy builds on Paris' [26] culturally sustaining pedagogy and focuses on understanding and conceptualizing educational practices specific to Indigenous learners. Connected to the evolution of culturally relevant [12], culturally responsive [11], and culturally disruptive [31] pedagogies, culturally sustaining/revitalizing pedagogies are shaped by a deep recognition of Indigenous sovereignty and need for decolonizing toward sustaining and revitalizing identities of Indigenous designers. Given the systemic biases and inequities that exist in not only emerging technologies but also their design processes, we posit that taking this approach is inherently culturally disruptive, especially for those who identify with the "majority" culture. Culturally disruptive pedagogy seeks to: (1) make visible the socializing of Whiteness, and (2) disrupt hegemonic cultural norms [31]. In this way, we see our efforts toward sustaining and revitalizing Indigenous culture as a productive cultural disruption and opportunity for developing cultural competence, perspective taking, and cultural identities for all designers.

Furthermore, our work in simultaneously inventing and discovering *gathering* as a design approach is heavily inspired by existing approaches of community design and partnership processes. In particular, we are informed by scholarship around community-based design research (CBDR) [3], community participatory action research [4], and research-practice partnerships [6]. This stance recognizes the historical, cultural, and political nature of designing with communities, as well as embraces the needs for inviting diverse participation and addressing systemic challenges. We take these research approaches together alongside a design justice approach [8], which shares the explicit goal of employing community-led processes to challenge structural inequities in the design of technology. This lineage shares important efforts in computer science around the development of critical technical practice [2] through integrating critical and cultural considerations throughout the technology design process.

Collectively, these community-centered and design-focused approaches ground our conceptualization and development of gathering as a design process for narrative technology, computational artifacts that afford creating media to convey or express narrative [cf. 32]. Proposing to use computation in a culturally sustaining/revitalizing way while guided by the above approaches requires critically examining narrative technology at a fundamental level; i.e., at the level of the *computational model of narrative* that drives the technology itself. A computational model is in essence a mathematical function, which structurally describes how an output is computed given a particular input [29]. These models require a precise description of those three elements (input, output, internal

behavior); together, these are the model's *knowledge representation*, formally defined within the field of artificial intelligence or AI [9]. In turn, a computational model of narrative [22] is a computational model whose knowledge representation codifies concepts that matter to model narrative phenomena [35].

2.1 Our Overall Goal: Braiding Cultural, Educational, and Computational Knowledge

Historically, computational models driving new narrative technologies have been designed from Western values and beliefs [18]. For example, consider the video editing software *iMovie* [19]. As a narrative technology, iMovie is representative of a large class of video-based editing software. Like many other software alternatives, the iMovie user interface relies on tacit metaphors that reveal (and privilege) Western ways of knowing and being (as depicted in Figure 1). Notably, this user interface reveals how iMovie's developers conceptualize *time*; i.e., what iMovie's underlying computational narrative model of time *is*: a linearly-structured, forward-directed sequence of events, each represented as time-bound interchangeable chunks of videos no fewer than 0.4 seconds in duration.

While this computational narrative model of time might be adequate in its support for Western-modes of thinking and storytelling, it may induce unnecessary friction for potential storytellers who approach iMovie from within Indigenous epistemologies [13]. Indigenous storytellers may conceptualize time as a natural phenomona (e.g., season, moon phases, movement across place) versus manmade time (e.g., seconds, minutes, hours), but are structurally constrained by iMovie (and many, many others) to shape their thinking as its user interface demands. Thus, while computation holds potential as a tool to facilitate the sharing of stories, we recognize that current narrative technology is not built in a critical or culturally sustaining/revitalizing way [27].

3 METHODS AND CONTEXT

Our team is collectively engaging in critical ethnography [17] through keeping collaborative fieldnotes, documenting design work over time, and collectively reflecting as we continue to move through this journey toward understanding *gathering* as a form of design. In this paper, we present our analysis and ongoing process of how we are working toward building computational narratives in ways that represent Indigenous ways of knowing and being. We present our current reflections of our ongoing design process of what it means to *gather* by drawing on two gathering sessions with one goal of developing a prototype.

3.1 Context of our design team

The members of our design team hold many identities, including Indigenous and Indig-ally, Hawaiian, American Indian, Black, White, Puerto Rican, Japanese, Portuguese, musician, dancer, hiker, explorer, ancestor, learner, teacher, neurodiverse, spiritual, genderqueer, pansexual, Christian, and fun-havers. We have a love of knowledge, learning, teaching, creating, and most importantly sharing. We bring together different background knowledge, including collaborative ways of being, first generation college students, computer science, psychology, learning sciences, game design, law and policy, creative, steward of mother earth, futurist, and more.
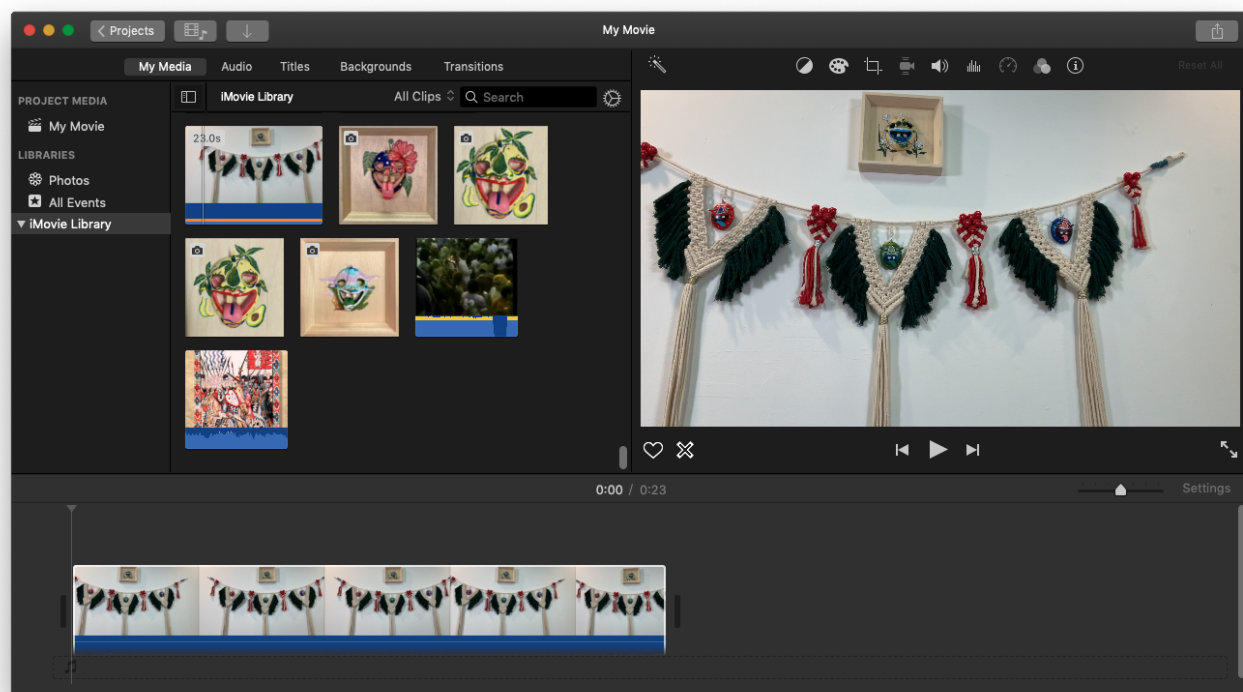
Figure 1: Screenshot of the primary editing interface for iMovie, a software application made by Apple to support video editing and production. The iMovie software tacitly depicts metaphors common to video-based narrative technology; namely, the *Timeline Pane*, which conceptualizes time as linear and always forward-directed, and the *Clip Palette*, which conceptualizes events as time-bound interchangeable chunks of videos no fewer than 0.4 seconds in duration [19].

Our identities and worldviews shape how we approach this work, including our recognition that our work manifests within contexts that invite plurality of meaning and which are embedded within social and political structures.

3.2 Context of design process

The insights we share in this paper are drawn from a collective process of gathering to build technologies that embed Indigenous knowledge rather than Western knowledge. Specifically, our team came together to build a working physical prototype of *Indigenous narrative technology*, a computational artifact we envision that would afford creating media to convey or express Indigenous narratives. The purpose is rooted in an urgent and significant need within our local communities: social studies teachers are not well-equipped to portray Indigenous narratives in their classrooms and Tribal Knowledge Holders cannot practically visit every local social studies classroom in which Indigenous narratives are taught. Our overall goal is to invent new knowledge representations (computational models) that underlie technologies destined to efficaciously support teachers in an accurate and respectful narrative representation of Indigenous peoples and their history.

3.3 Our Prototyping Goal: A Game Design Space Exemplar

Succinctly, we seek to create a computational model that supports the development of a computational narrative technology, which itself supports the creation of narrative artifacts. Given the breadth and depth of this aim, our methodology proceeds in reverse: the prototyping and creation of a single narrative artifact that might be creatable from our envisioned narrative technology, which itself depends on an underlying computational model that we aim to eventually distill. This single narrative artifact ought to serve as a *design space exemplar*. For us, this means that the resulting prototyped artifact captures the essential design properties that reflect intended Indigenous narrative experience goals.

Our prototyping process was guided by a specific Indigenous story that we sought to represent as a playful storygame experience. The story, titled "Why are you running rabbit?," was created by Robert Lewis [14], a citizen and designated storyteller of the Cherokee Nation. "Why are you running rabbit?," tells the story of Rabbit who, in the process of finding water to drink, notices a dust cloud being kicked up by animals who were running nearby. Curious, Rabbit catches up with one of the animals in the group – Turtle – asking them "why are you running?" Turtle responds "I

don't know, I woke up this morning, Squirrel landed on my head, and they took off running. Go ask Squirrel." Rabbit does so, only to find that Squirrel started running because Wolf was running, who was running because Bear was running, who was running because Deer was running. And when Rabbit (with Turtle, Squirrel, Wolf, and Bear) asks Deer "why are you running?," Deer says: "Look ahead!" All the trees in the forest had pulled their roots out! All the trees were running! "Woah," says Rabbit, "that's bad." Everyone catches up to the trees, and when Rabbit asks "Forest, why are you running?" Forest stops and looks at Rabbit, exclaiming "I just felt like running!" To which Rabbit replies: "Run, Forest! Run!" Satisfied, Rabbit returns home to their bed. And the moral of the story is: "just because everybody else does something does not mean that you have to do it too."

Our group experienced this story as a recording of Robert Lewis' storytelling performance during the 2015 edition of *Cherokee Days* [15], a festival organized by the National Museum of the American Indian that features storytelling, films, dance, music, family activities, and demonstrations from citizens of the Cherokee Nation, the Eastern Band of Cherokee, and the United Keetoowah Band of Cherokee. The essential design properties we sought to capture in our game prototype were discovered through our *gathering* design process in the context of this story, as we discuss in the remainder of this paper.

4 INSIGHTS

Together, we've distilled four key characteristics of *gathering* that help us not only define it but also learn how to enact and embody it. Similar to other partnership-based or community-based design processes, insights are meant to transcend the entire design process. Here we present four characteristics of *gathering*: gathering is real, gathering is relational, gathering is rhythmic, and gathering is generative. We experience these characteristics as interdependent, in that, they mutually inform and build on one another over time – and time is viewed as different by our natural ways of being rather than a prescribed deadline or goal.

4.1 Gathering is real: in person physical prototyping

In our own gathering process, our team found that the significance of *gathering* is how the in person, physical prototyping process illuminates all of these often hidden decisions and allows for collective discussion and collaborative decisions.

4.1.1 The importance of being in person. Gathering in person facilitates equitable engagement. It can allow everyone to engage and interact from their own cultural worldview and cultural communication styles, including actions like physical spacing/closeness and eye contact, and is more inclusive of indirect communication styles, allowing someone to indicate when they have something to share, and so on. These ways of being are limited in virtual spaces and those limits were decided upon by the designers of those spaces, which privilege certain ways of being and can silence others. Coming together is essential in Indigenous ways of being. The in person gathering allows for us to bring our whole selves and be fully present. It sets up a different dynamic for the relational by allowing for engaging in culture together, such as starting with

cultural protocols, setting and aligning intentions, and sharing experiences, including meals. It is also easier to align, and at times transfer, energy and flow while physically together. Collectively, we reflected about how important being together in person was for the team and furthered the goals of this work. We would not be as far on our journey if we remained meeting in virtual spaces.

4.1.2 The importance of physical prototyping. While there are a range of digital options for prototyping, gather invites a physical prototyping approach, especially for early stages of the design process. The design process, especially when carried out within a digital system, inherently disinvites participation from people whose participation we often say we want. When work is translated into a digital system, there are hundreds if not thousands of decisions being made by the designers and developers that are not accessible to members of the design team who might not have those expertise. This results in the phenomenon of "blackboxing" [28], which inherently keeps invisible the underlying logic and computational model supporting a digital prototype. When important design decisions are made in these black boxes, it can result in an often unintentional inequitable decision-making process throughout the decision process. Put simply: when designing culturally sustaining/revitalizing technologies, *every design decision matters*. Thus, transparency in decision making through the design process is essential to maintaining equitable participation from all members of the design team. Gathering invites this participation through physical prototyping where real tools are used to making thinking visible. The approach of making thinking visible resonates with theories of learning such as cognitive apprenticeship [7] and constructionism [25], as well as with Native Hawaiian approaches of "ma ka hana ka ike" (learning by doing). We add to this discussion the importance of making thinking visible in a design process, so that decision making is transparent to those who might be novices to design or technology and, thus, allows all team members equitable access to how the design process is shaping the ways in which knowledge is being shared.

4.2 Gathering is relational: centering people over process

We're using familiar tools to prototype together, which does not demand expertise such as programming.

4.2.1 Identifying shared values. We intentionally set aside time to discuss our values, both as values we want to be sure are highlighted in the experience we are designing and in the ways we are engaging. Historically, technologies are viewed as being neutral and holding no values. In reality, we all bring our values and culture into everything we do and every decision we make and, when kept implicit, these become hidden into the design of the technology. As a team we reflected, "stating our shared values, for both the game and our process (though we did not specify that), laid the foundation for centering culture. Often values go unstated and space is not made to discuss them in many places because the goals and values are assumed to be the western ideals. By intentionally starting here, we made space for a process that matched our values, and in our case, was collaborative" (Collective Reflections, Spring 2023).

Our team values and guiding principles are part of our journey and are constantly being shaped. A few examples from our team includes interdependence, relationality, reciprocity, collaboration, natural time + movement, and fun. It is important to continually revisit team values and guiding principles throughout the process. We have a shared values of interdependence and were intentional in designing ways for others to experience interdependence. In reflecting, our team itself is interdependent, as we all bring different knowledge, perspectives, and experiences, and no single member of the team can accomplish the goal of this project.

At times, some values are going to surface as those we need to attend to in a particular situation – like currents. For our team, sometimes these were unstated or not well defined, and allowing for the continual conversation brought us closer as a team. As an example, this came up in identifying the value of collaboration, yet using the term cooperation, in thinking about cooperative play or cooperative games. The further defining of these terms led to a discussion that "cooperation can be towards one person's goal whereas collaboration is always equitable in the goal" (Collective Reflections, Spring 2023) and can further highlight interdependence.

Another reflection was around the value of fun. Energy put into the development is energy that will be experienced in the output. In many Indigenous cultures, it is taught to come to things "with a good heart" and to be thoughtful and aware of the energy you are putting into anything you are making, such as weaving, beading, cultivating plant medicines. An example of this in our work is the enactment of our value of fun, making sure we allow for fun and infuse the work with our humor, which in turn helps ensure that we are designing an experience that values playful learning and that others experience as fun. One design team member reflected that fun helps keep us inspired and a useful tool to engage movement when feeling stuck (Collective Reflections, Winter 2022).

4.2.2 Centering people over process. Rather than centering the goal of producing a product, *gathering* centers the people participating in the process. This means practices such as introductions, cultural protocol, and communing together are just as imperative as the time spent designing. While language around learning often divides "on task" and "off task" work and this frame is often borrowed for other contexts including design, gathering invites us toward a different way of being where there is not "on task" and "off task," but rather collective movement toward building together. In our experience of *gathering*, this movement is propelled with a playful mindset. Working with a playful mindset can be a powerful tool for creativity and problem-solving, as it allows us to engage with our work on a deeper level beyond just our thinking selves. Our team further reflected that, "play can be a secularly spiritual experience that helps us tap into our emotions and intuition. We understand playfulness as a cognitive reframing technique that incorporates emotion and spirit and invites humor" (Collective Reflections, Spring 2023). This mindset not only creates space for inspiration to solve problems and bring new ideas, but also centers the relationality of the work and lays a foundation of trust.

4.3 Gathering is rhythmic: gather requires time and space for (w)holism

Similar to iterative design processes, *gathering* is inherently rhythmic in nature, yet the rhythm of gathering is shaped more by the silences and reflections rather than the ideas and progress. Because the goal of gathering is not driven by a product, it is an inherently personal process that can often result in "productive discomfort" – a shared value we identified (Collective Reflections, Spring 2023. While we value creating a safe space to share our whole selves as humans in the world, we see this as different from valuing comfort. Instead, gathering invites productive discomfort, which can be viewed as disruptive to the flow of the design process or, as we see it, a generative space that spotlights critical areas of *working through* together. Productive discomfort allows time and space to speak and sit in tensions, or key assumptions or design decisions. These moments are pivotal in the design process and in a gathering process are not moved beyond without a (w)holistic resolution. Different from Western iterative design processes that are often driven by deadlines and products with the clock as the timekeeper, gathering instead invites a (w)holistic approach where nature is the timekeeper.

Moreover, when we reflected on the importance of embracing the rhythm of *gathering*, we recalled, "our process allowed for the 'time things take' and for silences, for time where we were able to be and not needing to discuss it, to focus on our other values, such as connection, relationships, and fun!" (Collective Reflection, Spring 2023). This shared insight highlights that centering values early in the design process allows for a (w)holistic form of collective engagement shaped by these values. Revisiting our previous discussion about the dichotomous frames of "off task" vs "on task" behavior, gathering offers a new invitation toward (w)holism. Gathering is a collective movement toward shared values and recognizes that these movements are fluid and constant. This movement resonates with the ways in which our Indigenous team members experience relationality through noticing patterns, responding to rhythms, and moving *with* the currents of nature. Just as we do not control nature, we do not control the process in a production-centered way. Instead, we (our whole selves) are fully present for the experience, in collaboration with the process aligned with natural time.

4.4 Gathering is generative: making design decisions visible allows for important discussions

Because *gathering* opens multiple pathways there are opportunities to have important discussions that might otherwise be missed. Engaging in the real, relational, and rhythmic nature of gathering gives us the tools, trust, and time to explore together. Through this exploration, we are able to engage our productive discomforts and embrace generative spaces of tension. One example of this in our process was how one of our game features appeared to support transactional rather than reciprocal gameplay. One team member reflected, "one of the most memorable moments of our game-making journey was our conversations about reciprocal vs transactional gameplay. These talks helped us reach a consensus on the type of gameplay we wanted to create" (Collective Reflections, Winter 2022). Initially, the game required a certain amount

of resources to obtain a piece of knowledge. This may have given the impression that the game was reinforcing the idea of placing a monetary value on sacredness. It creates a divide where those with more money can essentially buy their way into sacredness, which can be detrimental to our relationships. Ceremonies can help us be who we are by codifying a certain way of being into our practices. The act of giving "hoʻokupu" or an offering should not be about the amount or value of the offering, but rather the act of giving itself, it gives us purpose. By slowing our rhythm and centering our relationships, we were able to work through this significant tension between game elements and cultural integrity to a generative space of respectful integration.

5 SIGNIFICANCE AND NEXT STEPS

Gathering invites a new way, a nature way, of knowing and being a designer through employing a (w)holistic design process. As a form of engaging in design, gathering offers diverse pathways into designing computational tools and digital technology and allows equitable participation by making visible decision making in the design process. This act of making visible what some seek to make invisible (e.g., blackboxing) is inherently culturally disruptive [e.g., 31] to the dominant ways in which technologies are currently designed.

We do not see prototyping to the rhythm of *gathering* as specific to our particular design context or design team. To expand our understanding of gathering across contexts, we invite scholars to consider what this form of being and knowing design might look like with different projects and people, especially when designing with children. The need for equitable pathways to participation in the design process remains significant. Gathering shifts the agency and responsibility of opening up pathways or allowing for participation away from the designers to the collective team. Put simply, *gathering* is not about the designer or researcher pushing to gather, but about the collective team opting into coming together. Fittingly, for Cherokee People, *sgadug* is the community that forms when people gather because of storytelling [33]. Storytelling is not just about the knowledge, but also about the gathering, the people. The stories are living beings and change based on who is a part of the *sgadug*. As we, the design team, gather, we put energy into building the technological foundations to help others *Hui* to form *sgagug* and to learn and collaborate in relationship with the natural world.

We echo the wisdom of Christensen et al. [5, pp. xi]:

> The sharing of knowledge across languages and epistemologies is never a matter of simply exchanging one word for another; it is finding a way to convey accurately the deepest levels of meaning, from one cultural milieu or knowledge tradition to another. Attempts to relate to communities, and particularly to Indigenous communities, too often fall short because academic research remains largely rooted in colonial ways of seeing and knowing (for example, privileging research methods and forms of communication geared towards acquiring information to provide concrete outcomes rather than those aimed at entering open-ended, long-term relationships).

This is why we gather. Huiiii!

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