

# **Pluralizing RRI pedagogy: “Cachando” tactical lessons towards critical resistance for Responsible Research and Innovation Learning**

Martín Perez Comisso§, Ben Gansky\*, and Lindsay A. Smith\*

§ *Universidad de Chile, School of Chemistry and Pharmaceutical Sciences*

\* *Arizona State University, School for the Future of Innovation in Society*

Opening up RRI to values and ways of knowing and doing beyond its European and Anglophone origins has become a focal area for scholars and practitioners. This article addresses the role of RRI pedagogy within the broader scope of this transformation, an under-examined topic in the literature. Drawing on the theoretical framework of critical resistance, we explore how RRI pedagogy might offer engaged scholars and educators opportunities to ‘risk themselves’ by intentionally destabilizing their authority as knowers. We offer a case study of a multinational, multilingual, multi-institutional learning initiative drawing from decolonial thinking to resist Anglophone epistemic hegemony in responsible research education. Our case study points to tactics for unsettling pedagogical habits by working across language differences, centering learners’ contexts, attending to the labor of teaching itself, and ‘searching for decoloniality’ (Lyons et al. 2017).

RRI pedagogy, decoloniality, epistemic pluralism, critical resistance, multilingual learning

## **1. Introduction**

Gone are the days when researchers and innovators work in isolation without public accountability for their productivity, relevance, or impact. Diverse communities are catalyzing transformations in knowledge systems, pushing for a more fair, diverse, open, participative, and accountable science. Responsible Research and Innovation scholars and practitioners (RRI) have

become essential in this shift, assembling a critical community of makers and thinkers supporting and enabling more transparent and responsible knowledge practices. As this community transforms research and innovation practices, we might anticipate concomitant shifts in how science and technology are learned and taught.

RRI began as an explicitly European project to foster innovation aligned with European values. More recently, RRI has been increasingly taken up outside of Europe, leading scholars and practitioners to question the degree to which its values, politics, and innovation frameworks embed European perspectives (Wong 2016). Pluralism across and within RRI communities has, then, become a focal issue for the field (e.g., Ludwig and Macnaghten 2020; Macnaghten et al. 2014; Reyes-Galindo, Monteiro, and Macnaghten 2019). We understand pluralism expansively as the coexistence of diverse identities, values, and epistemologies enacted by participants in shared reflexive and deliberative processes, each capable of ‘knowing and doing’ in their style. The question of how to globalize and pluralize RRI is critical to its utility in new and (politically, epistemically, and culturally) diverse settings. In these contexts, we need to reflexively reexamine not just lingering Eurocentricity in RRI practices and values but in its pedagogy, too. In this paper, we illustrate a pedagogical approach that self-reflexively attends to this question, drawing from the concept of critical resistance to explore ways RRI educators can, in deep collaboration with students, pluralize RRI learning in alignment with its emergent global profile.

The following section reviews the existing literature on RRI pedagogy. Despite the inclusion of pedagogy as a proposed topic in the initiatory editorial of this journal (Guston et al. 2014), the literature on RRI pedagogy remains underdeveloped and has not foregrounded critical self-reflexivity. However, literature in science and technology studies (STS) critically reflecting on the role of teachers and the nature of teaching has grown significantly in recent years. We

briefly describe some recent developments in STS critical pedagogical research relevant to teachers of RRI. Pedagogical practice offers engaged scholars an opportunity to both *teach* and perform critique, specifically by calling into question their research methods and epistemic authority in collaboration with students. We frame our discussion of this potential in terms of critical resistance.

Our third section presents as a case study [CACHO, a transnational, bilingual course and toolkit focused on science, innovation, and cross-cultural knowledge practices](#). CACHO is an online bilingual pedagogical intervention that critically resisted Anglophone hegemony in science and technology and RRI by creating a toolkit and project-based learning syllabus to support bilingual teaching, engaged methods, and transnational research collaborations. Central to this intervention was the displacement of English as our primary language of engagement, fostering transnational and intercultural dialogue about the role of place in responsible innovation and scientific practice. This paper analyzes the CACHO pedagogical intervention through the lens of critical resistance, suggesting its pedagogical potential for reflexive RRI teaching and learning. We use the concept of critical resistance to examine how scholars, activists, and advocates have mobilized reflexivity to generate situations with new sets of possibilities for working across differences. CACHO foregrounds the productivity of engaging with differences in values, knowledge, and practices across contexts in the Americas, focusing on decolonial thinking to transform science practices (cf. Escobar 2007; 2014). An analysis of CACHO offers lessons for RRI Pedagogy to engage with different value systems in scientific education and to interrogate diverse paradigms of open, responsible, and inclusive research and innovation.

We conclude with a reflection on the tensions at play in RRI today: between the struggle to achieve disciplinary and political coherence on the one hand and, on the other, to accommodate epistemic and axiological differences in research practices, particularly differences across extreme inequality and histories of violence. No one strategy for negotiating this tension will be sufficient. Here, we suggest ways CACHO might provide inspiration and lessons for contingent, partial, and local navigation of these tensions with integrity and transparency.

## **2. Critical pedagogy in RRI and STS**

### ***2.1 Examining the RRI literature on pedagogy***

Despite this journal's founding editors' intentions to foreground research on RRI pedagogy (Guston et al. 2014) and undergraduate and graduate courses and workshops offer training in aspects of RRI (cf. Conley, Tabas, and York 2022), there are surprisingly few analyses in the RRI literature focusing on pedagogy.

Within this journal, scholars have framed their pedagogical goals for RRI as a need for 'the integration of RRI in education' (Bardone, Burget, and Pedaste 2023, 3). RRI pedagogy is represented as a pedagogical disposition or set of methods/tools rather than a substantive subject in its own right: RRI pedagogy is a '*way of teaching*' (Bardone, Burget, and Pedaste 2023, 4). Several authors emphasize the relevance of RRI training for scientists and engineers (Conley, Tabas, and York 2022; Eggleson and Berry 2015; Sunderland et al. 2014; Tomblin and Mogul 2020), others identify a strong need for trainings and practice support for all stakeholder groups' (Marschalek et al. 2017, 2), including policy-makers, future educators, civil society organizations, and K-12 learners (Bardone, Burget, and Pedaste 2023; Marschalek et al. 2017; Richter, Hale, and Archambault 2019).

Scholars emphasize the use of interdisciplinary and intersectoral dialogue (Marschalek et al. 2017; Sunderland et al. 2014), problem-based learning (Conley, Tabas, and York 2022; Tomblin and Mogul 2020), futures literacy (Conley, Tabas, and York 2022), narrative and interactive media (Eggleson and Berry 2015; Richter, Hale, and Archambault 2019), physical and social teaching techniques such as those adapted from the work of Augusto Boal (Marschalek et al. 2017; Tomblin and Mogul 2020; cf. Boal 1993; 1998), and design fiction and critical making laboratories (Conley, Tabas, and York 2022; cf. Ratto 2011), as furthering the state of the art in RRI pedagogy.

As Bardone et al. put it, '[e]ducation is acknowledged as playing an important role in promoting the ideals behind RRI' (Bardone, Burget, and Pedaste 2023, 2). Revealed in this framing is a conceptualization of RRI pedagogy as a vehicle for disseminating fundamentally unproblematic and already-coherent theory and methods. However, Marschalek et al. acknowledge the need to situate teaching methods within distinct communities and how they "avoided preaching about RRI but rather focused on actively encouraging a lively discussion that would allow for constructive criticism of RRI" (2017, 308). While Sunderland et al. (2014) posit the normative value of transferring ethics 'from the margins to the center,' the authors spend almost no time discussing what, or rather whose, ethics would be brought to the center. When scholars frame RRI as a 'way of teaching,' scholars implicitly (and explicitly in some surveyed articles) aspire to codify RRI as a pedagogical method. As RRI scholars have come to a broad consensus that a core value of RRI is reflexivity, a naturalization of ethics elides the generative and normatively significant potential for RRI pedagogy to shape spaces of possibility for critical self-reflection. In light of recent RRI scholarship calling for and demonstrating the generativity of more epistemically and ideologically plural approaches that go beyond RRI's historical roots

in European values, institutions, and ways of knowing (Ludwig and Macnaghten 2020; Monteleone 2020; Reyes-Galindo, Monteiro, and Macnaghten 2019; Wong 2016), a critically reflexive turn towards globally nuanced RRI pedagogical scholarship is due.

To reframe the potential of RRI pedagogy as a space of radical possibility for self-reflexivity and (self) critique, we turn to recent treatments of pedagogy within engaged STS (cf. Tomblin and Mogul 2020).

## ***2.2 STS approaches to critical pedagogy***

As a research community, STS scholars have traditionally been committed to critically examining sites and processes of knowledge formation (Brady and Fricker 2016; Clarke and Fujimura 1992; Hale 2019; Knorr-Cetina 1999; Latour, Woolgar, and Salk 1986; R. Lave 2012). Perhaps it was only a matter of time for STS scholars to direct their analytic focus self-reflexively at their pedagogical practices. Feminist science studies scholars have developed a multi-faceted analysis of learning processes as situated, social, embodied, partial, and constantly subject to reconfiguration (Barad 2000; Braidotti et al. 2018; Giordano 2017; Haraway 1988; Harding 2008; J. Lave 1988; Nieusma and Malazita 2016). These and other STS scholars have written extensively on the affective and practical difficulties that can accompany sustained programs of critical self-reflexivity and ‘staying with the trouble’ (Conley et al. in press; Haraway 2017), a subject we explore in greater depth below.

As STS scholar-pedagogues have sought to align their teaching practice with this scholarship, they have developed a wide variety of strategies, tactics, and insights, seeking to cultivate values that reflect RRI’s cardinal virtues of anticipation, inclusivity, reflexivity, and responsiveness (Lezaun, Marres, and Tironi 2016; York 2018; cf. Stilgoe, Owen, and Macnaghten 2013). These developments include pedagogical uses of prototyping and critical

making (Downey and Zuiderent-Jerak 2021; Kenny, Liboiron, and Wylie 2019), situated curricula, disability-forward approaches to inclusivity (Lee, Olson, and Shew 2022), and performative and speculative practices as ways to approach critical pedagogy with epistemically and culturally diverse groups of learners at undergraduate and graduate levels. As participants in a 2021 workshop on critical STS pedagogies expressed in a collectively-authored article, pedagogical work is an opportunity to ‘center critique, question arrangements of power and authority, and encourage actors to conscientiously reflect on their assumptions and biases while questioning, unpacking, and deconstructing practices of knowledge production—including STS practices of knowledge production’ (Conley et al. in press). We next address this understanding of the critical potential for RRI of pedagogical space as opportunities for performative critique or critical resistance at the precise sites of the field’s reproduction and diffusion.

### ***2.3 Critical potential of pedagogical practice for RRI: critical resistance***

Critical resistance is an approach that puts ideas into action, assessing and reacting to the inequities and violences of the current social reality. It is closely related to the concept of praxis (see Feenberg 2014). Initially, anti-carceral and abolitionist movements in North America adopted the term critical resistance to characterize anti-racist actions and the fight against police brutality (Dilts 2019). In the humanities, scholars have articulated critical resistance as a form of ‘post-critique’ (see Couzens Hoy 2005) to discuss the process of self-criticism and disassembling, questioning one’s being, or as Butler (2001) evocatively described it, ‘risking oneself.’ Critical resistance is the creation of alternative possibilities made available through the enacted critique of current systems, starting, but certainly not ending, with oneself.

The concept of critical resistance has already permeated learning spaces that use emancipatory paradigms to reconfigure the underlying relations between pedagogy and power

(Oladimeji 2018; Clark 2020). For instance, Waller, Wethers, and da Costa (2017) examined critical praxis as a catalyst of reflexivity in English language learning and proposed principles to act with it in the classroom. Critical resistance as an educational strategy involves both rational and affective reflection on existing practices with the intent of purposeful reconfiguration (Foucault, 2022). This is sympathetic to RRI's critical disposition towards hegemonic ways of knowing and doing, with an additional explicit focus on the liberation of people (Couzens Hoy 2005, 234).

Agre's (1997) framing of critical technical practice speaks to the necessity and vulnerability of risking professional identity in self-reflexive praxis, encouraging practitioners to 'embrace the impossibility of foundations... [through] a continually unfolding awareness of [their] own workings as a historically specific practice... [to] make further inquiry into the practice ... an integral part of the practice itself. [To] accept that this reflexive inquiry places all of its concepts and methods at risk. And [to] regard this risk positively, not as a threat to rationality but as the promise of better ways of doing things' (1997, 23).

### **3. Critical Resistance as Research Pedagogy**

In this section, we focus on the CACHO learning toolkit and course as a case to reflect on models for pluralizing RRI pedagogy through practices of critical resistance. We offer our experiences of co-creating and conducting CACHO and its design principles as a suggestive entry point for a praxis-based critique of RRI pedagogy.

STS learning contexts in multiple institutions worldwide are enacting critical didactic tactics. To give some illustrative examples: Max Liboiron's leadership of the CLEAR Lab in Canada (see, e.g. Yanchapaxi et al. 2022) privileges community expertise and leverages participatory collective data collection and analysis to understand and confront plastic pollution

in Northern Canada. The Making and Doing program of 4S, the annual conference of the Society for Social Studies of Science (Downey and Zuiderent-Jerak 2016; 2021), collects and places into conversation a broad diversity of pedagogical experiments, such as critical making practices in Brazilian DIY communities (Barbosa e Silva and Blikstein 2021), inspired by the work of Brazilian philosopher of science and technology Alvaro Vieira Pinto (Pinto 1969). Making and Doing also hosted Pavel Vasilyev and colleagues' "Medical Archive," a project in which an interdisciplinary group of students 'described, annotated, and digitized the archive of [a Moscow] psychiatric hospital, with a special emphasis on the collection of historical photographs'; through this project, students grappled with 'the opportunities and challenges of translating the social history of psychiatry' in the context of an ongoing dialogue on the ethics of archival research (Vasilyev, Yakovenko, and Pogorelov 2023). Making and Doing has also created an environment for exchange and collaboration towards an emerging field of critical transnational pedagogy, with 'global classroom' experiments aiming towards 'transformative, co-production of theory and methods bringing students, faculty, and interlocutors together across diverse sites of interests and obligations' shaping explicitly decolonial responses to 'intertwined crises of education, environment, and epistemic injustice' (Ferguson et al. 2023).

In this precise vein, we now focus on the experience of CACHO.

### ***3.1 CACHO as pedagogical critical resistance***

CACHO, begun in 2019, is a learning initiative created by a research collaborative of scholars working and teaching in Argentina, Chile, Mexico, and the United States. CACHO interrogates the epistemic politics reproduced by research methods pedagogy focused on the writing, work, and theories of the Global North (Smith et al. 2021). We designed the course in explicit dialogue with models of teaching innovation based on RRI by offering students an online, transnational,

synchronous learning experience with a critical focus on innovation in Science and Technology in the Americas. The course was fully bilingual (Spanish and English) and practice based. The CACHO group also produced a toolkit with exercises to support other courses seeking to address histories of epistemic exclusion in the field.

One of the central conceptual fulcrums for CACHO is critical attention to the relations between language and knowledge; as we will explore below, we believe the connections between language and knowledge hegemonies in educational settings to be under-explored in the RRI literature. Critical language studies scholars have documented how ‘[c]ontemporary English language teaching stems from long histories of global empire and capitalist conquest’ (Hsu 2017, 112). One aspect of the politics of English-language hegemony turns on questions of differential access to English-language learning. This access then mediates individuals’ and communities’ access to labor markets, including in higher education, scientific research, and innovation (cf. Marques and Baruki-Fonseca 2022). Critical pedagogy scholars have also focused on how the typically unchallenged teaching of English as the lingua franca of business, education, and science serves to ‘other,’ marginalize, and racialize non-White populations, structuring hierarchies of knowledge and belonging (Macedo, Dendrinos, and Gounari 2004; Ferguson et al. 2023; Hsu 2017).

Instruction language, then, is a salient matter for RRI educators insofar as RRI is concerned with inclusion (since language mediates who can access and participate in RRI education) and reflexivity (since unthinking reliance on English as the language of RRI pedagogy may inadvertently reproduce colonial dynamics of exclusion and racialized hierarchies). Postcolonial scholarship has focused on language as an overdetermined space for the construction and reinforcement of colonial practices (Fanon 1991; Heller and McElhinny

2017; Said 1994) and coloniality—the infrastructural and subjective structuring power created by colonialism (Mignolo 2007; Maldonado-Torres 2007; Quijano 2007). In CACHO, we hypothesized that linguistic diversity might also bring epistemic diversity to our learning spaces, allowing students to articulate plural ideas, approaches, and impacts of innovations. Conversely, Anglophone dominance limits epistemic pluralism and situatedness (Bansal 2022; Hwang 2005; Rodriguez Medina 2019).

Our case highlights the potential for increasing RRI pedagogy’s inclusivity and reflexivity through multi-lingual, transnational learning experiences. Typically, transnational learning experiences have responded to challenges of multilingualism by a) limiting their collaborations to institutions that exchange knowledge only in English or b) focusing their learning objectives primarily on non-English (foreign) language acquisition. CACHO intentionally subverted these assumptions. English-speaking students, particularly in American universities, are typically not expected to engage with knowledge produced in other languages, unlike college students from non-English speaking countries (particularly those part of the Global South), who are expected to read English in addition to their local language. This leads to a reliance on English as the *de facto* language of knowledge exchange within and beyond the classroom (see, e.g. Pérez and Johnson, Jr. 2020). From the fine arts to mathematics to natural and social sciences, most prestigious journals and conferences exchange ideas in English (Hamel 2007).

These scholarly ways of understanding and producing knowledge are being rightfully interrogated (cf. Hsu 2017). English-speaking academia’s exposure to, and increasingly, collaborations with knowledge producers in Global South(s) have made evident the epistemic and axiological assumptions underlying the practices that have dominated academia since at least

the 20th century. Disciplinary, individual, a-critical, universalist, and disinterested research molded how English-speaking Global North academic knowledge systems were designed. These principles aren't just partial perspectives on scientific endeavors but, given historical practitioners' insistence on their sufficiency (e.g. Polanyi 1962), fundamentally problematic for intellectual endeavors (Harding 2011).

CACHO's objectives emerged in dialogue with RRI scholarship as a framework that could interrogate and rework 'standard' ideas about innovation, globalization, and justice; the title under which the course was offered to students is 'Global Innovation in Latin America.' The course's learning objective was to develop multilingual and multidisciplinary skills for team-based, effective, and ethical intercultural science and technology research and communication, using multimedia open resources that facilitate engagement and dialogue. This multifaceted objective reflects the current challenges and demands of reflexive academic research.

Current movements for open, decolonial, situated, reproducible, and problem-centered research demand new ways of knowledge production that are more sustainable, plural, engaged, and transparent (e.g. Escobar 2018; Mohamed, Png, and Isaac 2020; Pollock and Subramaniam 2016). Here, we encounter the dilemma that motivated the design of CACHO in the first place and which resonates with the challenges for RRI outlined above: How can we prepare our students for a world that demands transformed practices of knowledge production if we, as teachers, are still struggling to transform ourselves? How can we support students in developing a workably coherent understanding of the specificities of RRI theory and practice while we commit to unsettling and destabilizing our understanding of the field? Tuhiwai Smith (2012), in her pathbreaking book *Decolonizing Methodologies*, offers both epistemological and practical shifts in research praxis to help Indigenous practitioners and other readers address embedded

colonial perspectives and hierarchies in knowledge generation. Through CACHO, we don't naively offer approaches to decolonize RRI pedagogy, suspicious of easy calls to reduce or conflate the complex and necessary work of the return and redistribution of land with a broadening of pedagogical and epistemological approaches (Shahjahan et al. 2022; Tuck and Yang 2012; Peñuela 2010; Peters 2009). We also take seriously the critique from scholars in Latin America that postcolonial theory in the Global North can, when not accompanied by epistemic shifts, reproduce the global inequities it aims to address (Contreras 2011). Here, we focus on critical resistance as an intervention that centers reflexivity and an analysis of power in the Latin American tradition of pedagogy of the oppressed (Bazán 2017; Streck 2017; Freire 2018; Da Silva 1997).

CACHO, as a pedagogical collective of researchers across the Americas, took an intentionally slow approach to designing the course, committing to six months of weekly meetings to do the work of critical resistance: to identify the dominant axes of inequality, locate ourselves within these, and to design novel pedagogical engagements focused on system change. In our design phase, CACHO members described their previous experiences of transnational research and teaching marked by global inequalities that privileged the authority and power of scholars in the Global North. Given these structural inequalities, we understood critical resistance as a powerful praxis to develop alternative RRI pedagogies that allowed us to reflect on the sources of geographic and epistemic inequalities and work collaboratively to develop humble and partial interventions. The most mundane aspect of our collaboration laid the most important groundwork for critical resistance: holding over a year of weekly meetings where we developed trust, interrogated the hierarchies in our group, read each other's work and regional canons, developed potential case studies, and reached beyond our collective to local

collaborations in each country. We gave ourselves and the process the time needed to build trust, learn from each other, and turn that shared reflexive insight into a pedagogical intervention.

This work led to five design principles for transnational critical pedagogy (see Figure 3). The principles were based on the practices we had developed as a working group and hoped to offer participants in our courses. We designed a bilingual syllabus and a series of classroom exercises that concretized these principles. For example, we developed specific bilingual strategies to foster symmetrical exchange and co-design, such as providing all class communication in both languages and requiring student responses to be bilingual. We also formed small groups, so each had at least two comfortably bilingual speakers to pair with students less familiar with a second language. We also designed the course to allow students to get to know each other over extended periods through virtual city walks, coffees, and research site visits. Based on the CACHO collective's experience, symmetry, and co-design first required trust and meaningful cultural connections as a basis for the subsequent careful work of collaborative transnational research.

Figure 3: CACHO principles

**Symmetrical exchange and co-design:** Exchange is based on openness and epistemic humility, allowing for critique, iterative creation, failure, and multiplicity. This principle also seeks to resist the traditional paradigm of international education where learning is created for and oriented to the dominant partner's needs.

**Inverted Syllabus:** The privileging of bilingual and interdisciplinary sources and authors to include a range of texts often excluded from the intellectual canon. Through inversion, we go beyond the simple diversification of the syllabus to privilege authors and ideas that have been traditionally excluded.

**Safe, challenging learning space:** Participants are encouraged to interrogate and share their backgrounds within a safe environment. Affective reactions to the learning materials and research projects are encouraged and facilitated to produce memorable learning experiences in a respectful and caring exchange. Bilingualism is safe, and mistakes are appreciated.

**Learning by trying together:** Collective exploration from all team participants across cultural and linguistic differences to catalyze intellectual exchange.

**Research-oriented towards meaningful outcomes:** Participants design products meaningful to their context and the communities they serve. We offer knowledge mobilization strategies and examples to facilitate the design of bilingual transformative engagements, making learning oriented to public action.

### ***3.2 Implementation of CACHO***

The course was designed to last seven weeks and was conducted from March to May 2020 and October to December 2021. In our first iteration, 85 students enrolled, 61 completed the experience; in our second version, 37 enrolled, and 31 completed the course.

During the course, we organized students into approximately six-person transnational teams designed to group learners with aligned topics of interest and realize our cultural, linguistic, and intellectual diversity goals within each group. All the course readings and the work the students produced were bilingual. Students supplemented their expertise with digital tools and peer language mentors to help them engage meaningfully in both languages. They also met together in and outside of class (via group chat and video-conferencing apps) to complete a group design research project on a science and technology problem affecting the countries of all the participating institutions. For example, one group examined agricultural innovation, and another looked at gender disparities in academic production during the pandemic. The goal was for each learner to study their context and to contribute to a transnational understanding of the problem: embedded learning in context to understand global innovation. We purposely asked students to research their own context and then share that with others in the group who had each studied their local context, focusing on exchange rather than the traditional international exchange model, which brings foreign students to study local ‘others.’

Although this course might be expected to be limited to bilingual learners, we had many monolingual students, both English- and Spanish-speakers. The design principles and course assignments were structured to guide students gently and effectively into a bilingual exchange, allowing for a new kind of intercultural dialogue. Our most effective intervention was to dispense with the correct/incorrect approach to language learning (the experience that had dominated their secondary education) and instead create an environment for students to practice what Rodriguez-Medina calls ‘hermeneutic humility, that is, the attitude of looking for meaning harder, of an empathetic search for what the other wants to express... to momentarily take language as a tool for communication, regardless of its cultural and geopolitical imbrications’ (2019, 3). Our design commitment to a safe but challenging learning space was essential to overcoming everyone’s fear of speaking a second language badly or shaming themselves. By making the course fully bilingual, everyone from the teaching staff engaged in this same risky language work focused on communication rather than correctness, further cementing the bonds of trust and symmetry between the research groups.

CACHO offers one approach to global engagement around science and technology guided by critical resistance pedagogies. We sought to destabilize the dominance and over-representation of English speakers in venues of knowledge production and research cultures globally. Directly engaging with, rather than ignoring, linguistic and cultural barriers made these frictions generative, leading students to engage with ideas they have been cultured to ignore. Unmarked Anglophone pedagogy naturalizes knowledge hierarchies. This over-representation of scholarship from wealthy contexts shapes collective norms, expectations, and meanings of knowledge, obscuring the diversity of epistemic values.

By choosing local examples of global S&T innovation challenges, we were able to build on the epistemic work of bilingualism by allowing global groups to engage in primary research to critically resist hegemonic narratives of innovation. For example, one group studied GMO soy production in each context. They found that when they focused on the genetic modification of the plants, the United States was the apparent center of innovation, but when focusing on agricultural practices like sowing seed, harvesting, storing grain, and shipping, Argentina emerged as a center of innovation. Mexico, in contrast, was shown to be a center for innovation in resistance practices, particularly with the legal protections afforded to corn, which affected soy adoption. This nuanced work complicated unidimensional narratives of innovation and responsibility, helping students better understand innovation trajectories and how contexts and values shape technological change. We do not offer CACHO as a perfect model but rather as an illustrative example of critical pedagogical resistance in practice and how RRI educators can mobilize pedagogical design principles to address an often-unchallenged epistemic inequality in RRI.<sup>1</sup>

#### **4. What RRI pedagogy can learn from CACHO**

Reflexivity includes situating the self, explicitly acknowledging and creating space for a plurality of values and epistemologies and foregrounding the significance of context. These practices demand humility from structurally privileged actors and an active commitment to unsettle one's sense of epistemic security as individuals and as participants in institutions whose habitual practices perpetuate inequities and preclude possibilities for equal exchange across differences. We view the CACHO design principles and toolkit as one humble piece of the much

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<sup>1</sup> For a more detailed account we offer the website <https://tinyurl.com/CACHO2020> for further exploration.

bigger work of restructuring academic practice towards a more global and just knowledge system.

The group's name, CACHO, derives from the word Ka'ach, the Yucatec Mayan verb meaning to break, separate, or fracture, and from the Spanish word *cacho* (a problem or a small piece). In Chilean slang, it can mean a wicked problem; we see embedded epistemic inequities as a *cacho* for higher education. We draw from the CACHO experiences four tactical lessons for critically resisting hegemonically Anglophone RRI pedagogy, summarized in Figure 2.

The first lesson is cautionary, and it is this: beware of conflating problematization and critical reflection on coloniality with the practical work of decolonization (cf. Tuck and Yang 2012). In other words, do not over-claim: the work of diversifying voices and examining embedded epistemic and structural inequalities is essential but insufficient. Critical resistance as a disposition and practice offers a possible avenue for decolonial action in so far as it addresses the epistemic legacies of colonialism. However, as RRI scholars and practitioners situated within the Global North seeking to pluralize 'responsibility,' 'research,' and 'innovation' by referencing, collaborating with, and thinking from the perspectives of scholars and activists from the majority world (Alam 2008), we must be aware that this work risks being appropriative (Lyons et al. 2017). While CACHO set out explicitly to 'decolonize' research on science and technology issues, we do not claim that this course is doing the work of decolonization. The course offers intellectual strategies and an infrastructure for knowledge exchange through which to problematize coloniality rather than colonization (Mignolo 2007).

Our second tactical lesson is the value of challenging learners to engage with non-Anglophone texts, even (especially) if this is outside their comfort zone. New translation tools and a pragmatic approach to 'good-enough' cross-language communication can enable learning

across contexts and cultures. This approach undoubtedly has its limits. But the goal for CACHO was to unsettle teachers' and students' reliance on a canon of English texts and the unmarked assumption of English as the language of knowledge, to surface the politics of Anglophone hegemony in research, and to shift the attention of teachers and students together towards new questions and new modes of practice. In our 'search for decoloniality' (Lyons et al. 2017, 42), we must remain aware of how certain authors, texts, values, and practices are valorized, and others are left on the 'wrong side' of a language barrier. The often identity-destabilizing challenge of working across languages is forced upon many non-English speakers, particularly those working in academia. We argue that it is essential for Anglophone scholars to engage in these challenges.

Our third tactic is to leverage context for learning. Decoloniality will necessarily appear differently and imply different forms of thought and action across diverse locations: 'What might be decolonizing research in Argentina could diverge importantly with that same project in Mexico, which we saw explicitly in practice in the course. Through an iterative co-creation process, the teaching team can come to both shared ideas about power and education and create a meaningful space for learning (Smith et al. 2021). We extend this commitment to contextual specificity further by foregrounding modes of research output or knowledge mobilization (Bennet et al. 2007; Levin 2008; Skipper and Pepler 2021) that encourage students to engage with issues they care about in their local communities while drawing connections to the presence of related issues in other places, enacted in ways both similar and distinct. This can mean redirecting attention away from the familiar objects of RRI (often emerging technologies) towards maintenance, diffusion, and repair projects. Exploring how 'innovation' is articulated in these contexts will involve critically examining the concept of innovation itself.

Our final lesson from the CACHO experience is that critical resistance in this form is time-consuming and often challenging. Transforming knowledge practices requires deep commitment, and, to refer once more to Judith Butler’s memorable phrase, it involves ‘risking oneself’ (2001). For teachers whose professional identities reside in their facility with Anglophone knowledge practices, the risks of appearing and feeling out of one’s depth are real. Moreover, the institutional and logistical coordination required to actualize multilingual, multinational, and multimodal collaboration (particularly with a normative commitment to non-hierarchical organization) is substantial. Such labor is often ‘invisible’ and frequently gendered (e.g. Star 2016; Suchman 1993). The necessity of anticipating, honoring, and accounting for such coordinating and affective labor and its differential distribution across team members shaped by their intersectional identities and social locations is a crucial lesson from CACHO for RRI pedagogy. Compensation for this labor should be factored into project planning; compensation can mean many things, including recognition and visibility within and across institutions, payment, and agency, depending on context. Explicitly addressing the distribution and compensation of labor is necessary, particularly in multi-institutional partnerships across Global North-Global South contexts – precisely the kind of partnerships that may be necessary if RRI is to extend globally.

Figure 4: Tactical Lessons for RRI

1. Critical resistance pedagogies allow students to **deconstruct and question coloniality** (the structuring epistemic and affective legacies of colonialism).
2. Frictions of **reading and learning across language differences** are both generative and surmountable with the aid of digital technologies and an understanding of language as communication.
3. **Embed learners in their national, regional, and individual contexts** to pluralize our understandings of scientific production and its values.

4. **Anticipate, value, and reward the time-consuming and intensive work of collaboration** by creating meaningful value for all partners (e.g., publications, funding, local systems of recognition, etc).

One of the virtues of the profusion of ad hoc methods for real-time and asynchronous language translation used in CACHO was its foregrounding of the messiness of exchange across differences. Lest we forget: tidiness and efficiency are not culturally neutral values (Okun and Jones 2000). We suggest that the design principles of CACHO offer RRI pedagogy a set of ways through which to actualize the ‘self-risking’ work of bringing the field’s pedagogy into line with its diversity of practice. These tactical lessons, some seemingly mundane, none particularly original, nevertheless suggest methods for embedding context, plurality, and the deconstruction of hegemonic assumptions into course design, pedagogical care, and intellectual nurture.

## 5. Conclusion

Our normative argument is that we should encourage differences to make a difference in our knowledge systems from the beginning. RRI Pedagogy is a worthy site for enacting diverse values through different ways of knowing and doing in various sociocultural contexts. And within those contexts, there will still be further differentiations based on local conditions. If we are to enable pluralist approaches to RRI, the environments and practices involved in reproducing the field are an essential site for self-reflexivity. Opening the field up to participation by diverse actors is not only a normative good in itself; nurturing pluralism in an epistemic community also supports geographic, linguistic, cultural, and disciplinary translations of RRI: in other words, its extension and elaboration (Ghosh et al. 2021). Working across values and epistemic differences also means an ultimately more robust set of understandings and methods for RRI, drawing on diverse actors' insights and situated knowledge (e.g. Stirling 2008). Critical Resistance takes time, slow collaboration, and in the case of CACHO linguistic and

geographic shifts. However, we suggest that through pedagogy, we can reinvigorate our interrogation of the epistemological commitments that enable RRI to function as a corrective to unreflective scientific and technological endeavors. We offer CACHO as one approach that might allow RRI educators to embrace discomfort and resist the familiar hierarchies of the canon, the classroom, and the English language. Nurturing RRI learners worldwide— particularly across bridging Global North - Global South divides – is vitally necessary to RRI’s project of shared sustainability on this planet.

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