

BRINGING THE WHY TO SCIENCE CAPITAL: STEM CAPITXL AND INFORMAL SCIENCE LEARNING

A Practice Brief



WHY THIS BRIEF?

The theory of “science capital” is increasingly showing up in formal and informal science education. Both face the common challenge of what is often called a “theory/practice divide”: academic theory not seeming relevant to the day-to-day needs and practices of educators.

This brief shares what happened when practitioners and researchers working with the Kitty Andersen Youth Science Center (KAYSC) at the Science Museum of Minnesota took both theory and practice seriously, reclaiming terms and ideas in service of our work and communities. It explores how an informal science learning (ISL) program repurposed an academic theory to provide a lens on its programming, explicitly connecting STEM (science, technology, engineering, and math) and social justice. In other words, rather than abandoning theory as too academic or allowing academics to define the limits of the conversation, we collectively decided to define “STEM capitxl,” centering its social justice roots. We renamed and reclaimed theory, in the process outlining a practical and pedagogical tool for informal science learning that pushes the boundaries of what “counts” as STEM.

ABOUT THE KAYSC

The KAYSC at the Science Museum of Minnesota provides out-of-school programming for underserved youth (specifically, BIPOC, girls, and young people from low-income families) with the goals of building leadership skills, career readiness, and fostering confidence in and appreciation of STEM. In the KAYSC, young people build community, partner with local companies and organizations for civic engagement, and learn STEM skills and knowledges, while they research their passions and develop deeper understandings of social issues and oppression. The KAYSC understands that STEM both plays a role in continuing oppression today and can also be a tool to push against oppression. Thus, its model is **STEM Justice: a movement to redefine STEM as a tool for addressing and dismantling systems of oppression**. Young people can change our world through STEM!

WHAT IS SCIENCE CAPITAL?

In everyday language, science capital is like a container (a backpack) of science-related knowledge, skills, attitudes, and experiences that includes what you know, how you think, what you do, and who you know. A person can draw on and exchange these skills, knowledges, and identities to participate in science. Science capital includes knowledge and understanding about science (e.g., science literacy); science-related attitudes and identities; knowing people who use science; engaging in science practices and activities; and talking about and reflecting on science and its uses.

In theoretical language, science capital is “a conceptual device for collating various types of economic, social and cultural capital that specifically relate to science—notably those which have the potential to generate use or exchange value for individuals or groups to support and enhance their attainment, engagement and/or participation in science” (Archer, DeWitt, & Willis, 2014, p. 5). It draws on sociologist Pierre Bourdieu’s theories of capital: economic, social, cultural. People exchange forms of capital, deploying them in different contexts. The use and exchange of capital are shaped both by different actors and by the contexts (in theoretical language: the “field”) in which they are used. In other words, the meaning and value of science capital depend on people and on contexts. Because science is highly valued in many places, it has symbolic value as a marker of knowledgeable citizenship.

Science capital includes

- What you know
- How you think
- What you do
- Who you know

WHAT IS STEM CAPITAL?: WHY WE RENAMED

Because it is based in a commitment to social justice and to the multitude of ways people engage and transfer science, the theory of science capital fits with the work and aims of the KAYSC. We thought it could help our reflection on and practice with this ISL pathway program.

Still, we had some worries.

- First, while the theory is based in commitments to social justice and pedagogies that are reflective, collaborative, and holistic, this is not always reflected in ways the theory is interpreted or talked about. Its roots in addressing social injustices get obscured, as does why this is important.
- Relatedly, this sometimes results in deficit-based thinking: focusing on what young people or communities, specifically those who have been historically marginalized by structures of oppression, are lacking (in relationship to science).
- The theory (or its applications) may overprivilege careers or formal education, focusing on questions such as why many young people don't see science careers as being "for me" or continue in science education. Very concretely, the metaphor used to describe science capital—a backpack or the British term "holdall"—is closely related to school. But school science is itself a mechanism for pushing out or disengagement. As one of us said, "Is the 'holdall' a stand-in for western colonizing science?"
- The theory focuses on an individual and their science capital, rather than on the collective. It aims to measure why and how individuals can increase their science capital and thus result in greater representation and inclusion in STEM careers and majors.
- For those not familiar with Bourdieu's theory, "capital" may sound like a celebration of capitalism or, by extension, a conflation of people with commodities. This is reinforced with reasoning stating that we need to be most worried about the economic competitiveness of either individuals or nations. It is even further reinforced when used in combination with tools (such as measurement and statistics) that have been used for the work of oppression. In other words, does this terminology give power to oppressive systems to approve or value who and what we are or attempt to do too little, too late?

We recognize that the ways in which this theory is sometimes taken up often do not reflect its original conceptions. And still: Language has power. So **we renamed the theory.**

We **changed science to STEM** to reflect a broader emphasis and to recognize the multiplicity of meaningful experiences that young people have in informal learning contexts. In these spaces, traditional disciplinary boundaries may be more blurred; young people may be drawing on, for instance, math *and* technology as they design a system or tool. These skills are reinforced, even if not always explicitly named. For instance, programming an aquaculture tank would be a part of “what you do,” a technology-based skill. As it necessitates an understanding of engineering, technology, and math, describing this as “science” is artificially restrictive.

More importantly, **we changed capital to capitxl (pronounced “capital with an x”).** Renaming/reclaiming with an “x” better signals the theory’s roots in equity and social justice, as well as what we are pushing against. Understanding and applying this theory requires education, unpacking, and unlearning. The “x” signals both this process and invites people to ask questions; it documents opposition to systems of oppression (as in the ways marginalized communities have used an “x”). It thus aligns our work with other processes of renaming and reclaiming. Unpacking the term has power, as does reclaiming the narrative.

In our context, STEM capitxl is a practical and pedagogical tool for reflecting on how informal STEM education programming embeds STEM dispositions, practices, and knowledges in the service of social justice.

“‘Science capital’ is still centering white, western science as the epitome of what science we’re hoping people will engage with.”
~ Project participant

Why?: Because social justice

When we deeply examined the theory of science capital and its representation, we recognized that the “why” was often missing: why do we do this work? Who is it in service of? Renaming STEM capitxl grounds us in the WHY: the why of this theory is to move us toward social justice. This renaming (and the confusion it might cause at first!) grounds the work explicitly in social justice, in the intention behind why we do this work and who we are serving. We focus not on increasing representation in and inclusion into STEM systems built upon oppression, but upon addressing oppression and inequity from a systems level. We invest in young people so that they can change our communities and world.

In theoretical terms, capital exists only in relation to the field where it is exchanged or used. This field, for us, is social justice. Thus, STEM capitxl is likely talking about a different field than conversations that focus on STEM education or careers. In this ISL program, we are thinking about holistic change in the ways young people engage with STEM, engagement that is rooted in their lived experiences within systems of oppression. As one practitioner said, “they’re going to pursue STEM with a consciousness that is much bigger and deeper than just the scientific—or we’re redefining what scientific consciousness is.”

STEM capitxl, like other forms of capital, is resources, but these resources are directional: toward justice in communities (necessitating a sense of place), collective (rather than primarily individual), and with young people as activators of social change both in themselves and their communities.

Asset- and community-based

Questions of “why science education isn’t working” or “getting more underrepresented young people into STEM majors and careers” are based in deficit views of young people and communities. Instead, along with Tara Yosso (2005), we focus on community cultural wealth: what community strengths, social and cultural resources, and experiential knowledges (including STEM experiences) do young people and their communities have? How do we value them, and how do we harness these toward social justice? Formal educational or career-based STEM skills and knowledges are important, but they are not the end-all and be-all. We cannot want or inadvertently support young people in assimilating into systems of oppression that reproduce inequality. Instead, we want them to be equipped with skills, knowledges, and identities that can challenge (rather than replicate or reproduce) those systems.

Thus, STEM capitol is asset- and community-based. We learn together. KAYSC focuses on relationship-building, beginning with hiring staff from the same communities as its young people. STEM capitol is important because of its connection to and work in community, as a collective, not solely as individuals.

Reclaiming STEM

STEM is often narrowly defined: what “counts” has been defined by white, western science and by what is valuable to the market economy. STEM capitol shifts from this understanding of STEM to what is meaningful to communities for social justice. How do STEM resources serve communities and build social justice? What skills, knowledges, and dispositions are crucial for an informed public facing profound ecological, economic, and social challenges?

We must reclaim what gets called STEM, practice naming what we are doing as STEM, and challenge who has the power to define STEM. STEM exists: it doesn't require school or formal learning to provide a stamp of approval or legitimacy.

STEM capitol acknowledges multiple knowledges and knowledge systems and many, not just one, type of “science expert.” Your grandfather shifting growing practices so as to cultivate plants in a new climate and space and saving seeds is a STEM expert. Your sister rebuilding a broken computer because the family can't afford a new one is a STEM expert. In other words, our understanding of STEM capitol encourages people to recognize what they are already doing as STEM, rather than requiring them to be “brought” (and bought) into western science. It changes the narrative: there is more than one (western) way of doing STEM. As one participant said when discussing our relationships to STEM, “I've been doing this stuff and never named it” as STEM. Reclaiming narratives of self and community as STEM does honors multiple ways of being and doing: a common narrative, a “bad narrative, is that women, we are scared and we don't do STEM. Yes we do. We've always done it. . . Why don't we know about those women? And let's encourage us again to reclaim that as a field, because there's been so much narrative and data that's framing a question wrong” (KAYSC staff).

Similarly, the science capital teaching approach (Godec, King, & Archer, 2017) seeks to broaden what counts in the formal science classroom through making content relevant to everyday lives and valuing students' contributions.

“We’re in dire need of a cultural shift that values science, that values philosophy, that values thinking and critical analysis. For so many reasons. But I think that just making sure that people understand that science matters and that there are lots of challenges in our world particularly affecting communities that are already under multiple systems of oppression. And so understanding how our world works, in both a political sense—lowercase and uppercase ‘P’—but also in a scientific way, and how those things overlap is going to be really, really crucial.”
~ KAYSC staff

A practical and pedagogical tool

STEM is not disembodied, but taken up in bodies, emotions, knowledges, and practices through the KAYSC’s STEM Justice approach. Young people and adults learn, teach, and lead alongside each other in an open, accessible environment that always includes laughter, enjoyment, music, and food. “Figure it out” is how learning is approached: adults provide a scaffold and young people build learning together.

STEM skills are reinforced through hands-on learning in which young people investigate topics of interest, engage in dialogue and reflection, build community connections, and act together, all in the space of community. Centering a growth mindset in which young people are leaders today, the KAYSC builds a community network of support internally and externally. The STEM identities that young people are building are for more than careers or formal education; these skills and knowledges are put in the service of community and social justice.

These connections—these relationships—are STEM capitol. STEM capitol provides a practical and pedagogical tool to help practitioners call out the STEM in what they are doing and in young people’s lives. After working with the concept of STEM capitol and our reclaimed understanding of STEM, one practitioner named its components as “encouragement points.”

““Now that I have a different lens on what STEM is, it makes it easier to call out. So even if a youth is saying, ‘Yo! We’re not getting science,’ they can walk away at the end of their time here having been like, ‘Oh yeah, we did a lot of science, but it was different!’ And then they catch on, and that’s kind of the point. We don’t have to call it what they call it; we give it a new name, hence the X. We want [young people] to feel encouraged by it, or to feel connected to it.”

~ KAYSC educator

PRACTICING STEM CAPITXL: HOW THE KAYSC USES STEM

STEM capitxl provides many opportunities for these “encouragement points.” This theory is helping us to name and claim these STEM practices, knowledges, identities, and relationships. In other words, this is as much about helping youth recognize the STEM capitxl they *already have* as it is building new STEM capitxl.

Practitioners can also use the components of STEM capitxl in planning and in assessment. Here are some examples from the KAYSC:

- **What you know** (STEM knowledge and talk)
 - Learn about sustainable transportation, develop community surveys, and then share findings (on infrastructure, on stereotype threat) with neighbors through block parties
- **What you do** (STEM practices)
 - Design and engineer a system for higher microgreen yield in the small space that a community partner has available for growing; the microgreens are then served in their afterschool art program (skills: soldering, rewiring lights, programming arduinos)
 - Create exercise videos for young women (skills: digital recording and editing; knowledge of principles like “the rule of thirds”)

- **How you think**
 - Broaden an understanding of STEM. As one young person said: “Both my parents do jobs like that [STEM] but I never really realized before. They both work with computers.”
 - Recognize that breathing exercises to address physiological stress reactions aren’t “just playing around” but about biology.
 - Draw on the design process.
- **Who you know**
 - Neuroscientists visit the KAYSC to talk about the parasympathetic nervous system
 - Visit a local technology company to talk with technicians about their work and possible career paths

Example from a Unit on Biology and Public Health

Young people investigate healthy meals and explore the science behind nutrition and diet-related diseases such as diabetes (*what you know*). They talk with a KAYSC staff member about how he manages his diabetes and the technology that makes this possible (*what you know; who you know; how you think*). They then cook and serve fresh, healthy meals to community members, in consultation with a local chef (*what you do; who you know*). They learn about structural factors that lead to food deserts and why there are higher rates of obesity, diabetes, high blood pressure, and more in low-income and communities of color (*what you know; how you think*). They talk with their own family members and reflect on what makes healthy eating challenging in everyday life in their community and what resources they have access to (*who you know; how you think*).

INCORPORATING STEM CAPITXL IN INFORMAL LEARNING: OPPORTUNITIES AND CHALLENGES

STEM capitxl has led us to identify even more opportunities, along with some challenges. Some of the following might be common across informal settings, some might be more specific to programs that explicitly connect STEM and social justice.

Opportunities

- Connect more to museum resources.
- Work more across programs and ages (e.g., pairing elementary and high-school-aged young people).
- Identify STEM skills and knowledges used in everyday life, such as when young people fix household items with tools and resources at hand or play in activities such as “making potions.”
- Help young people to identify with the work they do: to call themselves app developers, policy workers, STEM technicians.

KAYSC young people are “embodying all the messiness and complexity in how they move around in the world and the change they’re making. . . . Learning experiences like the ones that happen in the KAYSC really do build personal, collective power to make change and innovate solutions to issues and get people into jobs and onto pathways to careers. And we can do all that at once, and **that’s what STEM capitxl is.**”

~ KAYSC Staff

Challenges

- Use the STEM capitol framework for assessment, rather than measurement; move away from quantification. It is often easier to count quantity rather than quality.
- School science is an important part of STEM capitol, but many young people, particularly those from historically marginalized communities, have negative relationships with school science and the ways in which it is taught.
- “Y’all don’t ‘do’ STEM”: A reclaimed and expanded understanding of how communities engage STEM is not widely shared. If practices don’t fit white, western conceptions of the scientific model, they may be dismissed as “not STEM.”
- Much of traditional STEM and the STEM labor market is based in oppressive systems. If young people develop an understanding of STEM as a tool for social justice, they may be challenged in the workplace by STEM practitioners who don’t have this lens; the work and understanding of these STEM Justice practitioners may not be viewed as valuable or legitimate. The challenge is to prepare young people to enter STEM majors or careers that might not be open to these ideas and that may actively (either intentionally or unintentionally) replicate oppressive systems.

OTHER RESOURCES

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KAYSC young people at Kids Want Climate Justice, Minnesota March For Science, St Paul, MN, April 2017

REFLECTION QUESTIONS

- How does your learning space understand science or STEM?
- Who (and what) is your STEM work in service of?
- How can you work to rename existing community assets and practices as STEM?
- How would you describe “STEM capitxl”?
- How do you connect theory and practice?

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