

Full Collection



YOUTH EQUITY + STEM

YESTEM

Equitable Informal STEM Learning: Tools for Practitioners

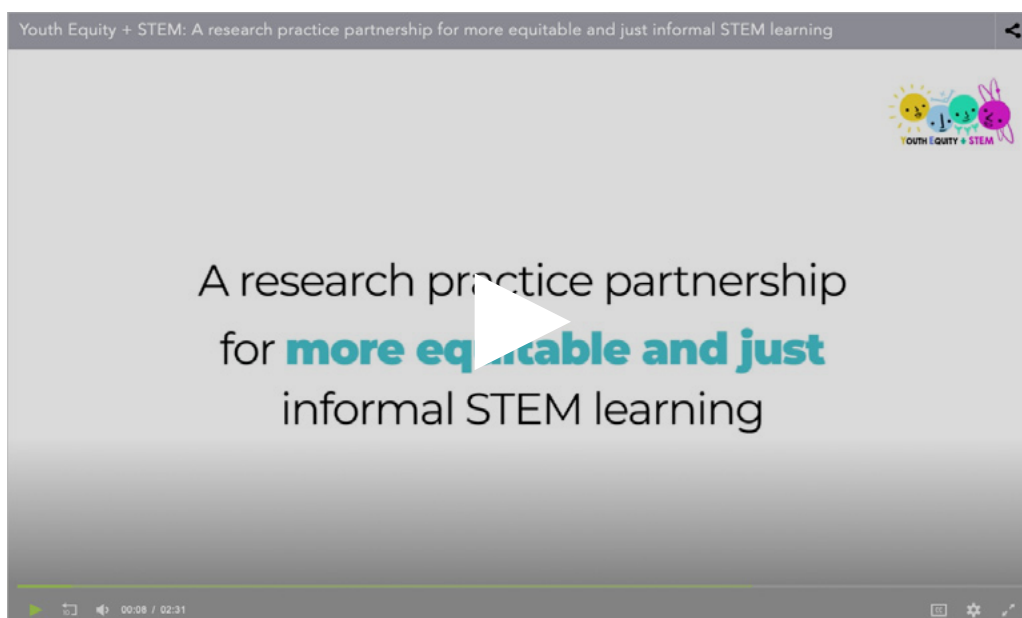


The Youth Equity and STEM project

Informal STEM learning has considerable potential for engaging young people with science, technology, engineering and mathematics (STEM). Yet, the sector would benefit from the improved capacity to understand and engage with the complexity of issues pertaining to equity and social justice, in both policy and practice.

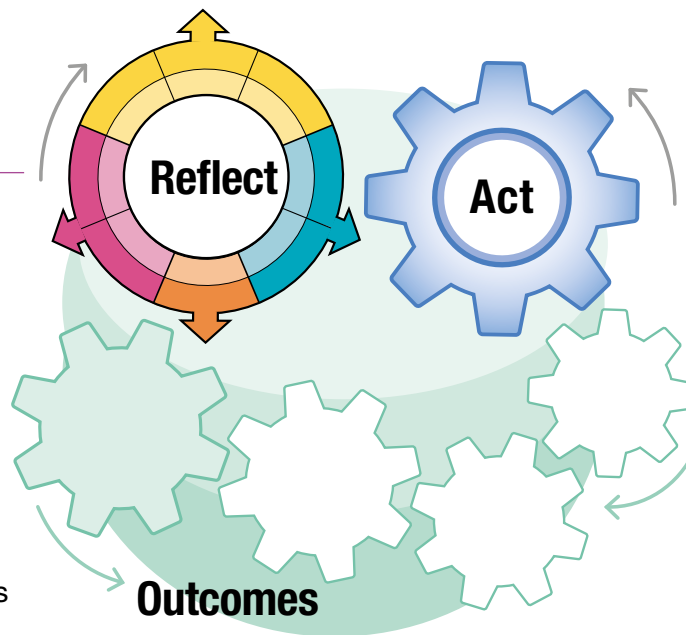
The tools and resources in this document were developed in the Youth Equity and STEM project (2017-2022), an international research-practice partnership focused on understanding and supporting equitable practice in informal STEM learning.

The materials are based on extensive mixed-method research with young people aged 11-14 and informal STEM learning practitioners, and were co-developed by a team of academic researchers and informal STEM learning organisations in the UK and the US.



The YESTEM approach

This document includes key insights and links that correspond to the YESTEM model. For additional resources, see yestem.org



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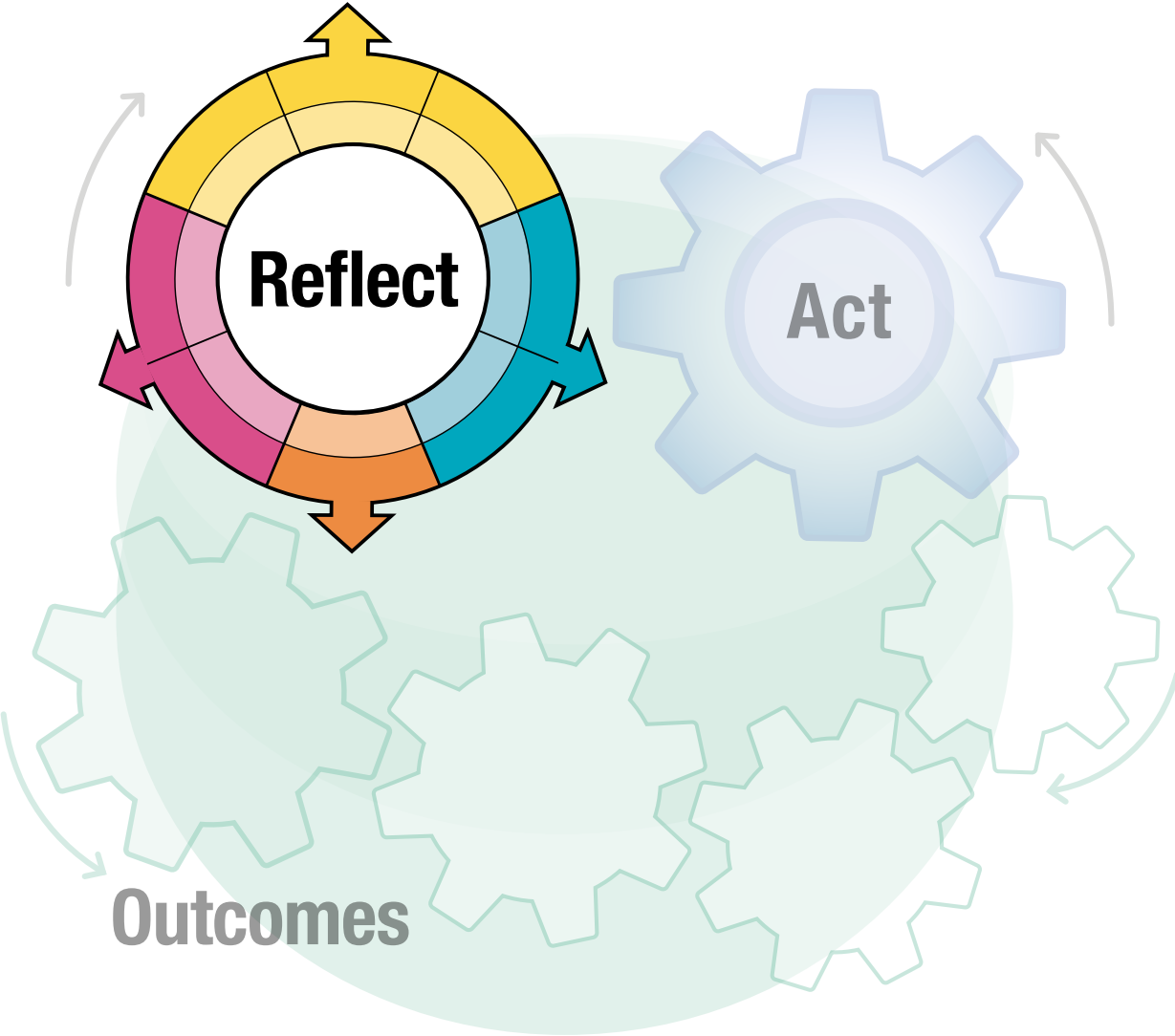
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REFLECT: The Equity Compass





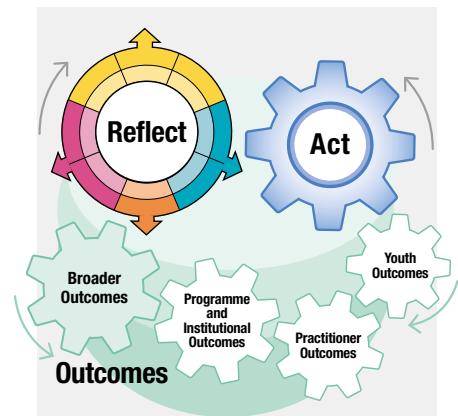
The Equity Compass: A tool for supporting socially just practice



YESTEM Insight #1

What is the Issue?

- Diversifying participation in science, technology, engineering and mathematics (STEM) remains a key challenge for policy and practice internationally.
- While informal STEM learning (ISL) settings have considerable potential to engage diverse communities, on the whole the sector does not have a diverse participation profile.
- The sector would benefit from improved capacity to understand and engage with the complexity of issues pertaining to equity and social justice, in both policy and practice.
- *Equity* refers to a model of social justice that attempts to challenge and transform social inequalities and work towards more just power relations. Whereas equality often means treating everyone the same and/or providing the same opportunities to all, an *equity* approach advocates differential treatment according to need, while also recognising and valuing differences between people.



YESTEM Model for equity in ISL

The Equity Compass is the basis of the Reflect component of this model. Please see yestem.org for the full model and related Insight documents detailing each component.

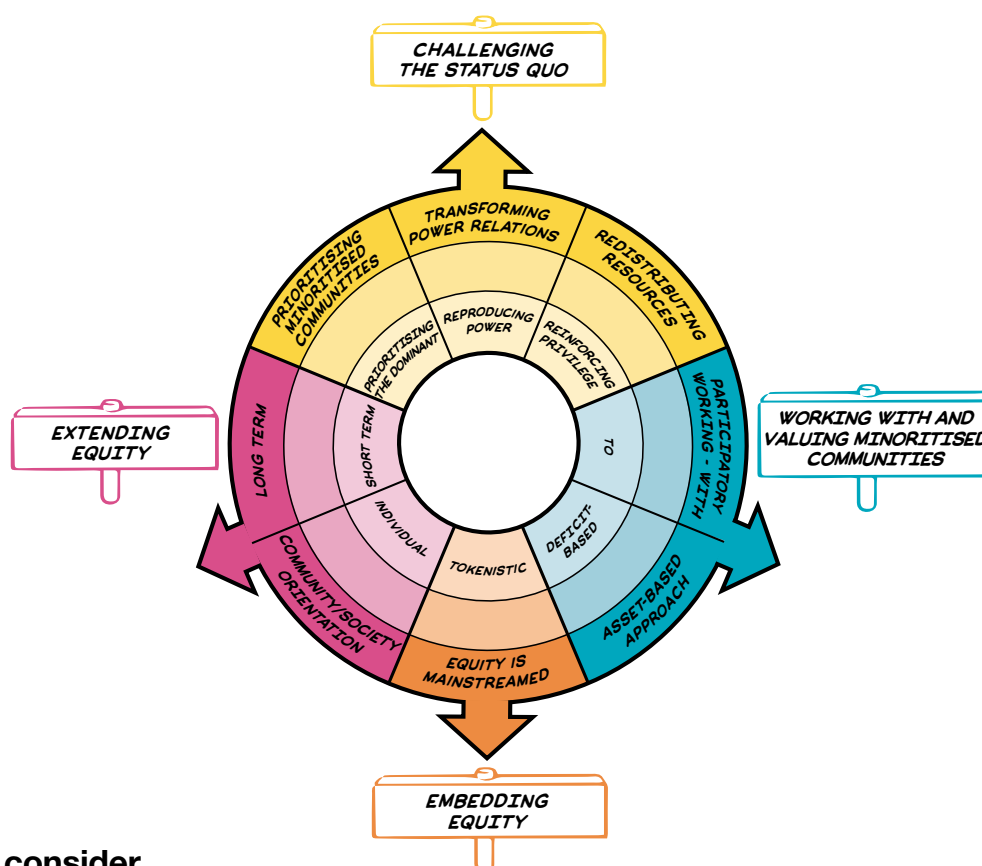
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The Equity Compass: A tool for supporting socially just practice

The initial version of the Equity Compass included eight separate dimensions (axes) of equity; the version presented here was developed further through feedback from informal STEM learning practitioners and teachers, resulting in grouping the eight axes into four overarching areas.

- Equitable practice is not just about what you do, but how and why you do it. The stance taken and the principles underlying a particular programme or activity will profoundly shape its potential for either reinforcing, or transforming social inequalities.
- The Equity Compass tool helps users to adopt a social justice mindset when developing and reflecting on their policy and/or practice. It prompts them to consider multiple dimensions of equity, as represented by the eight segments of the Equity Compass.



Things to consider

- The Equity Compass helps to identify how and why particular examples of practice may be more or less equitable. By mapping your practice, the Equity Compass can help support planning for improvements in equitable practice.
- By attending to each of the segments, the Equity Compass helps practitioners to identify ways to support young people's critical STEM agency. STEM agency is the capacity for young people, particularly those from minoritised¹ communities, to use STEM to take action in their lives on issues that are meaningful to them and which help challenge societal injustices.
- While the Equity Compass has been developed and tested within ISL settings working with young people, it has also been applied by practitioners working with adults, by teachers and educators working in formal education and in contexts beyond STEM.

¹ We use the term 'minoritised' as a shorthand for individuals and communities who are minoritised by dominant culture/society. Using 'minoritised' rather than 'minority' puts the emphasis on the systemic issues and structures that are failing to sufficiently recognise, support and value some people. People can be minoritised within a particular society depending on their race/ethnicity, gender, socioeconomic background, dis/ability, sexuality and other social axes. We acknowledge that labels are always imperfect and provisional and can vary in meaning and interpretation over time and between contexts, e.g., internationally, across different professional sectors, communities and between researchers, practitioners and young people.

The Equity Compass: A tool for supporting socially just practice

AREA	EQUITY DIMENSION	GUIDING QUESTIONS
CHALLENGING THE STATUS QUO	TRANSFORMING POWER RELATIONS	To what extent are dominant relations (e.g., ideas of scientists as white men; hierarchical relations between educators and students, narrow/elitist representations and forms of science knowledge and practice; differential experiences of ownership and belonging within STEM spaces) being reinforced vs. challenged and changed? Who has agency, power and legitimacy? Are dominant, unjust relations and conditions being reproduced, challenged or meaningfully transformed?
	PRIORITISING MINORITISED COMMUNITIES	Whose interests, needs and values drive the policy and/or practice? Those of the dominant (e.g., the institution, STEM pipeline, industry, economy) or minoritised young people and communities?
	REDISTRIBUTING RESOURCES	Are resources and efforts mostly directed at more privileged people and those who already feel 'science-y'? How are the STEM knowledge, skills, social networks, and chances of minoritised people being supported? Is the approach/experience reinforcing dominant relations and conditions, taking a compensatory approach or is it more meaningfully redistributing resources and changing ideas about what resources are valued?
WORKING WITH AND VALUING MINORITISED COMMUNITIES	PARTICIPATORY WORKING - WITH	Is the practice being done 'to', 'for' or 'with' minoritised young people and communities? Who has ownership and voice in decision making? How participatory is the practice? Are young people producers or just consumers of science? Is the practice exploitative/tokenistic? Are young people valued partners? How is youth identity and agency being supported?
	ASSET-BASED APPROACH	How are the interests, knowledge, identities and resources of minoritised young people and communities being recognised and valued (an 'assets-based' approach)? Are (some) participants treated in deficit terms (as 'lacking' information, aspiration, interest and somehow being 'out of place')? To what extent are all participants valued and recognised for who they are, rather than who they are not?
EMBEDDING EQUITY	EQUITY IS MAINSTREAMED	How central, major, intentional and foregrounded are equity issues in the programme and organisation? Are equity issues everyone's core business or are they minor, token, peripheral concerns (e.g., restricted to special programmes, and temporary funding)? How are issues and experiences of injustice recognised and challenged?
EXTENDING EQUITY	LONG TERM	Is the practice one-off, short-term or longer-term? Is attention being paid to supporting young people's trajectories and progression over time and across contexts? How are youth pathways being brokered and supported both within the experience and beyond the moment/programme/setting?
	COMMUNITY/ SOCIETY ORIENTATION	To what extent does the practice contribute to individual outcomes? To what extent are the outcomes also collective (e.g., for families, wider communities) and/or the wider field? Do the outcomes extend beyond the specific experience or programme?

The Equity Compass: A tool for supporting socially just practice

How to use in practice: Reflect and Act

- Each axis of the Equity Compass has a set of associated Guiding Questions to help you to reflect on your policy and/or practice. You can apply the Equity Compass either generally or specifically, using it to consider anything from an organizational top level policy down to a single session within a programme.
- Use the Guiding Questions to help you reflect critically on each Equity Compass axis – where would current practice ‘sit’ on each arrow? You can draw or map it on to the Equity Compass.
- Use the Equity Compass to identify areas that you would like to work on further. For instance, you might want to prioritise areas where your mapping sits in the centre zones of the Equity Compass. Use the questions and axes to help prompt ideas about how future programmes and activities might be planned in line with the eight dimensions of equity.
- Track your progress towards more justice-oriented practice by charting outwards movement on the Equity Compass axes.



Spotlight on practice

The Equity Compass is already proving to be a useful tool within ISL settings. Project partners have told us it has helped them rethink how they work with minoritised young people, introduce more participatory approaches, improve professional development and better articulate where they want to be going.

For instance, practitioners at a city science centre in the UK (with over 200 staff and volunteers) described how, despite their embracing of the centre's public commitment to prioritising underrepresented communities and improving inclusion and equitable practice, they struggled to align these goals with the complexities of practice. Tessa, who worked with young people, was sometimes frustrated by "institutional box ticking" approaches and Barbra similarly felt that there is "never enough head space" to engage with equity issues within her busy role. For Scott, 'equity' was a new concept that he was trying to understand and put into practice.

Like many others, these busy practitioners struggled to translate complex equity and social justice issues from individual practices to a collective stance on reflective action and tracking change.

They found the Equity Compass useful in many ways. For instance, Barbra felt that it helped her to articulate changes needed to better support more equitable practice and to present these to the management team: "It's great to be able to say, we considered this programme/ activity using the Equity Compass and look, our approach falls short, so let's re-address".

Tessa and Scott both found it helpful for individual reflection and planning and for having equity-based conversations with others in the organisation.

Cole, an ISL practitioner in a community zoo, felt that the approach "has truly contextualised my teaching methods and highlighted areas in which I can improve".

He felt it gave him new motivation, inspiration and ideas and helped him "more formally, clearly and confidently assist other practitioners in my industry". Cole added: "I've used the Equity Compass on existing and new programmes, and identified areas in which we can improve on our equitable practice, ensuring the sessions we run are more socially just."



About the YESTEM project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people (1,873 in the UK and 910 in the US).



Additional resources

- Click [here](#) or visit our website to see a 2-minute animation explaining the Equity Compass.
- For the full range of Insights documents summarising the project's tools and resources, including Core Equitable Practices and Equitable Youth Outcomes Model, please see yestem.org



This material is based upon work supported under a collaboration between the National Science Foundation (NSF), Wellcome, and the Economic and Social Research Council (ESRC) via a grant from the NSF (NSF grant no. 1647033) and a grant from Wellcome with ESRC (Wellcome Trust grant no. 206258/Z/17/A)

Disclaimer

Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of NSF, Wellcome, or ESRC.

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STEM AMBASSADORS EDITION



The Equity Compass: A tool for supporting socially just practice



YESTEM Insight

What is the Issue?

- Science, technology, engineering and mathematics (STEM) participation remains dominated by privileged people (e.g., White, male, middle-class, able-bodied) and diversifying the sector remains a key challenge for policy and practice.
- Public engagement and outreach activities have considerable potential to engage diverse communities.
- It is important to focus on changing practices, rather than changing the young people. Currently, many initiatives take a deficit approach that considers young people as “lacking” the right interests, motivation or awareness, and seeks to change them – rather than considering what makes engagement difficult for them. Focusing on changing practices can lead to a more sustainable change.
- Practice within this sector is often based on “common sense”, which in some cases inadvertently reinforces inequalities. The sector would benefit from research-informed practice and improved capacity to understand and engage with the complexity of issues pertaining to equity and social justice.

Whereas **equality** means treating everyone the same and providing everyone the same opportunities, an **equity** approach advocates for differential treatment of people according to need, while also recognising and valuing differences between people. A **social justice** approach seeks to change the structures and practices that create and maintain inequalities.

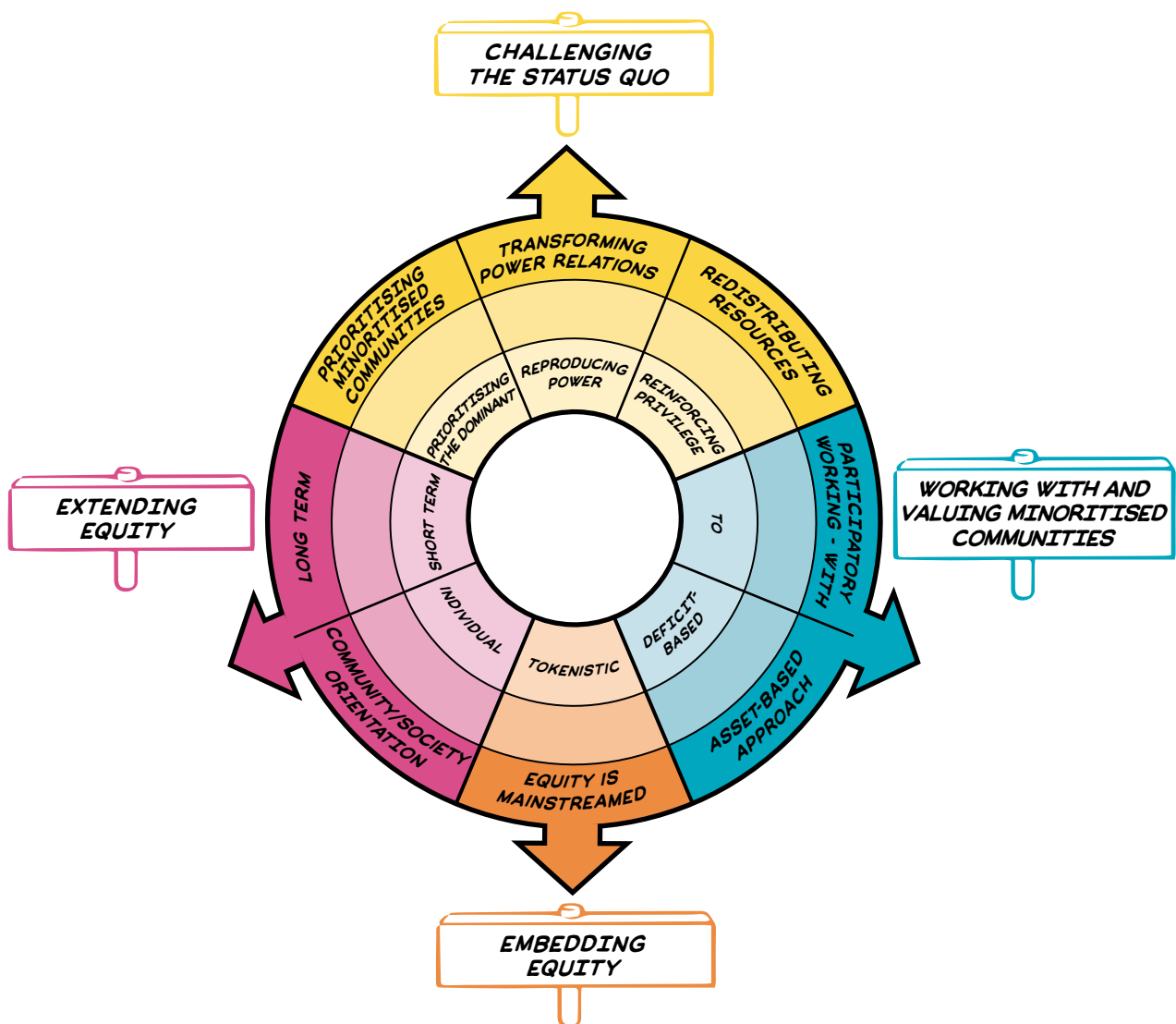
How to cite this publication: YESTEM Project Team (2022). YESTEM Insight: The Equity Compass: A Tool for supporting socially just practice – STEM Ambassadors Edition. yestem.org



The Equity Compass: A tool for supporting socially just practice

- The Equity Compass is a tool that can help STEM Ambassadors to **reflect on and develop their practice, adopting a social justice mind set.**
- Adopting an equitable approach is not just about **what** you do, but **how and why** you do it. The stance taken and the principles underlying

your approach can profoundly shape its potential for either reinforcing, or transforming, social inequalities. The Equity Compass can support STEM Ambassadors to consider multiple dimensions of equity, as represented by the eight dimensions of the Compass.



The Equity Compass was originally developed and tested in partnership with informal science, technology, engineering and mathematics (STEM) learning settings, such as science centres, zoos and afterschool clubs. It has since been applied by other educators and to funding and policy. This insight was developed as part of the training for STEM Ambassadors (UK) in Spring 2022.

The Equity Compass: How to use it

- By attending to each of the eight dimensions, the Equity Compass can help STEM Ambassadors to better support all participants, but particularly those from minoritised¹ communities.
- **The Equity Compass can help you recognise and think about key dimensions of equity/ social justice – and consider how equitable your own practice is.** Each axis of the Equity Compass has a set of associated Guiding Questions to help you to reflect on your practice from an equity perspective. For example, where would your current practice, or a specific activity, sit on each axis? Being positioned closer to the outer edges indicates stronger equitable practice.
- **The Equity Compass can be used to identify areas that you might like to develop further.** For example, you might want to prioritise an area where your mapping sits closer to the centre of the Equity Compass. The Guiding Questions can help prompt the ideas about how future activities could be planned in line with the eight dimensions of equity.
- **You could also use the Equity Compass to evidence your progress towards more equitable practice by charting outwards movement on the axes.** You could draw or map your current practice on to the Equity Compass and then repeat the exercise at a later point to map change. You could also use the worksheet provided at the end of this insight to record your reflections and plans.



¹ We use the term 'minoritised' as a shorthand for individuals and communities who are minoritised by dominant culture/society. Using 'minoritised' rather than 'minority' puts the emphasis on the systemic issues and structures that are failing to sufficiently recognise, support and value some people. People can be minoritised within a particular society depending on their race/ethnicity, gender, socioeconomic background, dis/ability, sexuality and other social axes. We acknowledge that labels are always imperfect and provisional and can vary in meaning and interpretation over time and between contexts, e.g., internationally, across different professional sectors, communities and between researchers, practitioners and young people.

The Equity Compass: Guiding questions for STEM Ambassadors

AREA	EQUITY DIMENSION	STEM AMBASSADORS
CHALLENGING THE STATUS QUO	TRANSFORMING POWER RELATIONS	Q How do you challenge dominant ideas and representations in your session, e.g., scientists as clever, engineers as white men?
	PRIORITISING MINORITISED COMMUNITIES	Q Whose interests, values and needs drive what you do? Those of powerful, dominant groups (e.g., STEM industry, your organisation, the STEM pipeline) or those of minoritised young people and communities?
	REDISTRIBUTING RESOURCES	Q How is your practice supporting young people who tend to have fewer opportunities? Or are opportunities mostly directed at and reaching people who are already more privileged?
WORKING WITH AND VALUING MINORITISED COMMUNITIES	PARTICIPATORY WORKING - WITH	Q Are sessions being done 'to', 'for' or 'with' minoritised young people and communities? How are young people involved in co-designing the sessions?
	ASSET-BASED APPROACH	Q How are you valuing and recognising young people's broad range of knowledge, skills and experience in your sessions? Might you inadvertently be treating some young people as 'lacking' information, aspiration, interest?
EMBEDDING EQUITY	EQUITY IS MAINSTREAMED	Q How central, major, intentional and foregrounded are equity issues in your sessions?
EXTENDING EQUITY	LONG TERM	Q Do you tend to do one-off sessions? How might you be able to support longer-term engagement – either through the sessions directly, or by linking with other opportunities?
	COMMUNITY/ SOCIETY ORIENTATION	Q How do your sessions support wider outcomes, e.g., for young people's families and community?

Spotlight on practice

Dr Bridges' journey to developing more equitable practice as a STEM Ambassador

A typical Dr Bridges session

Dr Bridges (a pseudonym), a white man, is a civil engineer who loves sharing his knowledge and skills with young people. He works as a volunteer STEM Ambassador with several schools across England, where he is usually invited to schools serving relatively affluent communities and/or top set² science classes where a number of students have shown interest in engineering careers. He usually begins his sessions by talking about his job and his colleagues (including women engineers); tells the students that arched bridges are stronger than flat bridges and then introduces a practical activity, building lolly stick bridges.

Dr Bridges instructs the children to build one flat bridge and one arched bridge and see how many toy cars are supported on each. At the end of the



session, he usually does a quick questions and answers session about engineering careers, seeking to enthuse young people about engineering careers that currently face a shortage of skilled candidates. If he has time left, he likes to tell the students about the contributions that engineers make to improve lives.

Evaluating Dr Bridges' session

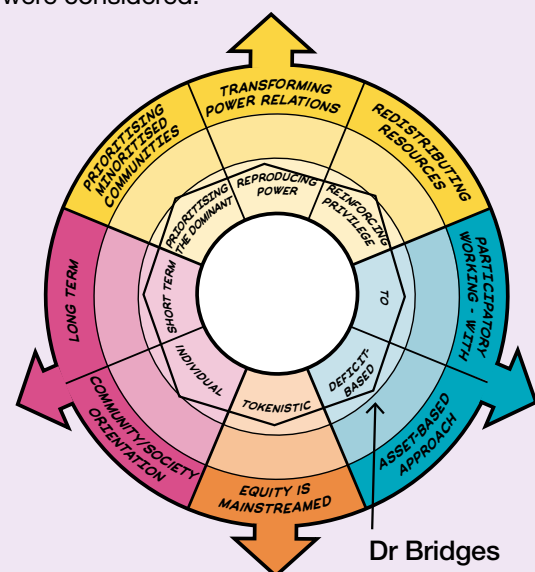
There are a number of good aspects of the sessions. Many of the students enjoy the playful hands-on activity, they increase their engineering content knowledge (learning more about bridges and structural engineering), appreciate a direct experience of meeting a STEM professional (the first such opportunity for some) and enjoy a break from the norm.

However, recent students' feedback highlighted some problematic areas. The session appeared to reinforce stereotypes about engineers (as one student wrote: **"I think an engineer is a man who is good at maths and science and needs to be strong to make stuff."**). The evaluation also showed that students who were not interested in bridges were not very engaged and struggled to connect with the topic of bridges that Dr Bridges was so passionate about (**"He was obsessed with bridges! I think he just really loved bridges."**; **"It was OK, I guess. But I'm not the most massive fan of bridges."**).

² In England, students are often taught in attainment-based groups, called sets. Top sets are groups composed of the highest attaining students in their year.

Mapping Dr Bridges' practice on the Equity Compass

When we mapped Dr Bridges' session on the Equity Compass, it was evident that his practice 'sits' close to the middle (see the figure below), although there were some aspects that were stronger than others. In the table below, we show how each of the eight dimensions were considered.



Spotlight on practice

Dr Bridges' journey to developing more equitable practice as a STEM Ambassador (cont.)

The table below shows how Dr Bridges' practice can be mapped using the Equity Compass dimensions.

AREA	EQUITY DIMENSION	REFLECTIONS ON DR BRIDGES' CURRENT PRACTICE
CHALLENGING THE STATUS QUO	TRANSFORMING POWER RELATIONS	The session largely reproduces and reinforces stereotypical images of engineering and engineers (as male and white), although Dr Bridges mentions that his team includes a few women engineers.
	PRIORITISING MINORITISED COMMUNITIES	Dr Bridges is motivated by inspiring young people to study engineering because there is a labour market/economic need for more engineers, there is less focus on the needs of the students (he is prioritising the STEM pipeline).
	REDISTRIBUTING RESOURCES	Dr Bridges tends to work with top set students and gravitate towards the "keenest" students who tend to be higher achieving, providing them with most support (and he is thus reinforcing privilege).
WORKING WITH AND VALUING MINORITISED COMMUNITIES	PARTICIPATORY WORKING - WITH	Students are not involved in the design or running of the session; the session is largely delivered one-way.
	ASSET-BASED APPROACH	Dr Bridges asks students about their knowledge of bridges (e.g., what makes a strong bridge), but nothing beyond this that would help students share their experiences of engineering more widely. He focuses on raising interest and aspirations in engineering (deficit approach).
EMBEDDING EQUITY	EQUITY IS MAINSTREAMED	Dr Bridges hasn't given equity much consideration; treats everyone the same.
EXTENDING EQUITY	LONG TERM	This was a one-off session with little/no signposting to other opportunities.
	COMMUNITY/ SOCIETY ORIENTATION	Dr Bridges makes some references to how engineering helps wider society, but the activity remains largely focused on individual knowledge/skills gains.

Spotlight on practice

Dr Bridges' journey to developing more equitable practice as a STEM Ambassador (cont.)

Dr Bridges' ideas for improving his practice

Dr Bridges was initially surprised by the evaluation of his practice from an equity perspective (“all the children seem to enjoy my visits and I’ve never had any complaints. I’m a volunteer, there is only so much I can do.”). On reflection, he admitted that he would like to understand the mapping a bit more:

“I’m keen to see how I can make my sessions more inclusive, particularly for young people who don’t see STEM as being for them. After all, the whole point I volunteer as a STEM Ambassador is to help more young people to engage with engineering.”

He also shared that he has been thinking about his own background and privilege:

“I’m a white middle class man and I benefitted from lots of science and engineering family members. Engineering always seemed like quite a natural choice for me. But I can see that not everyone has the same opportunities.”

Below, we share Dr Bridges' ideas for how he could develop his practice towards becoming more equitable.



Spotlight on practice

Dr Bridges' journey to developing more equitable practice as a STEM Ambassador (cont.)



Challenging the status quo

My ideas for challenging dominant representations of engineers

- Share relatable examples of diverse engineers.
- Highlight examples of everyday engineering skills that anyone might have, to show how everyone is an engineer, not just professionals.
- Ask the students to share their ideas or designs for things that they would like to design for themselves and their communities.

My ideas for prioritising the interests, needs and values of students

- Ask the students what is important to them.
- Ask the students what social or environmental problems they want engineering to tackle.

My ideas for ensuring the session supports students with fewer opportunities

- Make sure that I am not just visiting affluent schools or only working with top set students.



Extending Equity

My ideas for supporting young people over time

- Put together links to further resources, websites and organisations that run engineering challenges and give this to the class, so that any interested students have some 'what next' ideas.
- Work with the teacher to help them with ideas on an engineering-related activity/project for the students to work on either in class or if there is a STEM club.

My ideas for how to support wider outcomes from the session

- Take photos of the students' bridges for the school newsletter.
- Invite parents/carers to come and see the bridges, with students' explaining their work and engineering knowledge and skills used.
- Explore how to extend future sessions, so that the students get to share their own designs for what they want to create for themselves and their communities.



Working with and valuing minoritised communities

My ideas for co-designing sessions with students

- Find out about the students' interests and issues they care about, and use these in the session, e.g., I could get in touch with the class teacher beforehand and ask them a bit about the class, what they are like, what they are interested in.
- Consider branching out beyond bridges – maybe I could get the students to design or build their own structures.

My ideas for recognising and valuing young people's knowledge and experiences

- Make sure I am not just asking factual knowledge questions but elicit the students' wider life experiences.
- Ensure I value all the students' suggestions and experiences.
- Help the students to identify the engineering skills they already have (e.g., designing, testing, analysing, measuring) and help them recognise these in their home lives and among people they know.



Embedding Equity

My ideas for how to make equity issues more central in my work

- Think about equity as a core point to address in every session, not as a separate topic or an add-on.
- Always plan with equity at the forefront of his mind.
- Plan and reflect on every session using the Equity Compass.

The Equity Compass: Worksheet for reflecting on and developing equitable practice

AREA	EQUITY DIMENSION	REFLECTIONS ON MY CURRENT PRACTICE	MY PLANS FOR DEVELOPMENT
CHALLENGING THE STATUS QUO	<i>TRANSFORMING POWER RELATIONS</i>		
	<i>PRIORITISING MINORITISED COMMUNITIES</i>		
	<i>REDISTRIBUTING RESOURCES</i>		
WORKING WITH AND VALUING MINORITISED COMMUNITIES	<i>PARTICIPATORY WORKING - WITH</i>		
	<i>ASSET-BASED APPROACH</i>		
EMBEDDING EQUITY	<i>EQUITY IS MAINSTREAMED</i>		
EXTENDING EQUITY	<i>LONG TERM</i>		
	<i>COMMUNITY/ SOCIETY ORIENTATION</i>		

About the YESTEM project

- Over four years, our project involved researchers, informal STEM learning (ISL) educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people (1,873 in the UK and 910 in the US).

Additional resources

- See [The Equity Compass: A Tool for supporting socially just practice \(for informal STEM learning\)](#).
- Click [here](#) to see a 2-minute animation explaining the Equity Compass.
- See [The Equity Compass: A Tool for supporting socially just practice – Teacher Edition](#).
- See [The Equity Compass worksheet](#).



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The Equity Compass: Worksheet for reflecting on and developing equitable practice

AREA	EQUITY DIMENSION	REFLECTIONS ON MY CURRENT PRACTICE	MY PLANS FOR DEVELOPMENT
CHALLENGING THE STATUS QUO	<i>TRANSFORMING POWER RELATIONS</i>		
	<i>PRIORITISING MINORITISED COMMUNITIES</i>		
	<i>REDISTRIBUTING RESOURCES</i>		
WORKING WITH AND VALUING MINORITISED COMMUNITIES	<i>PARTICIPATORY WORKING - WITH</i>		
	<i>ASSET-BASED APPROACH</i>		
EMBEDDING EQUITY	<i>EQUITY IS MAINSTREAMED</i>		
EXTENDING EQUITY	<i>LONG TERM</i>		
	<i>COMMUNITY/ SOCIETY ORIENTATION</i>		

The Equity Compass:

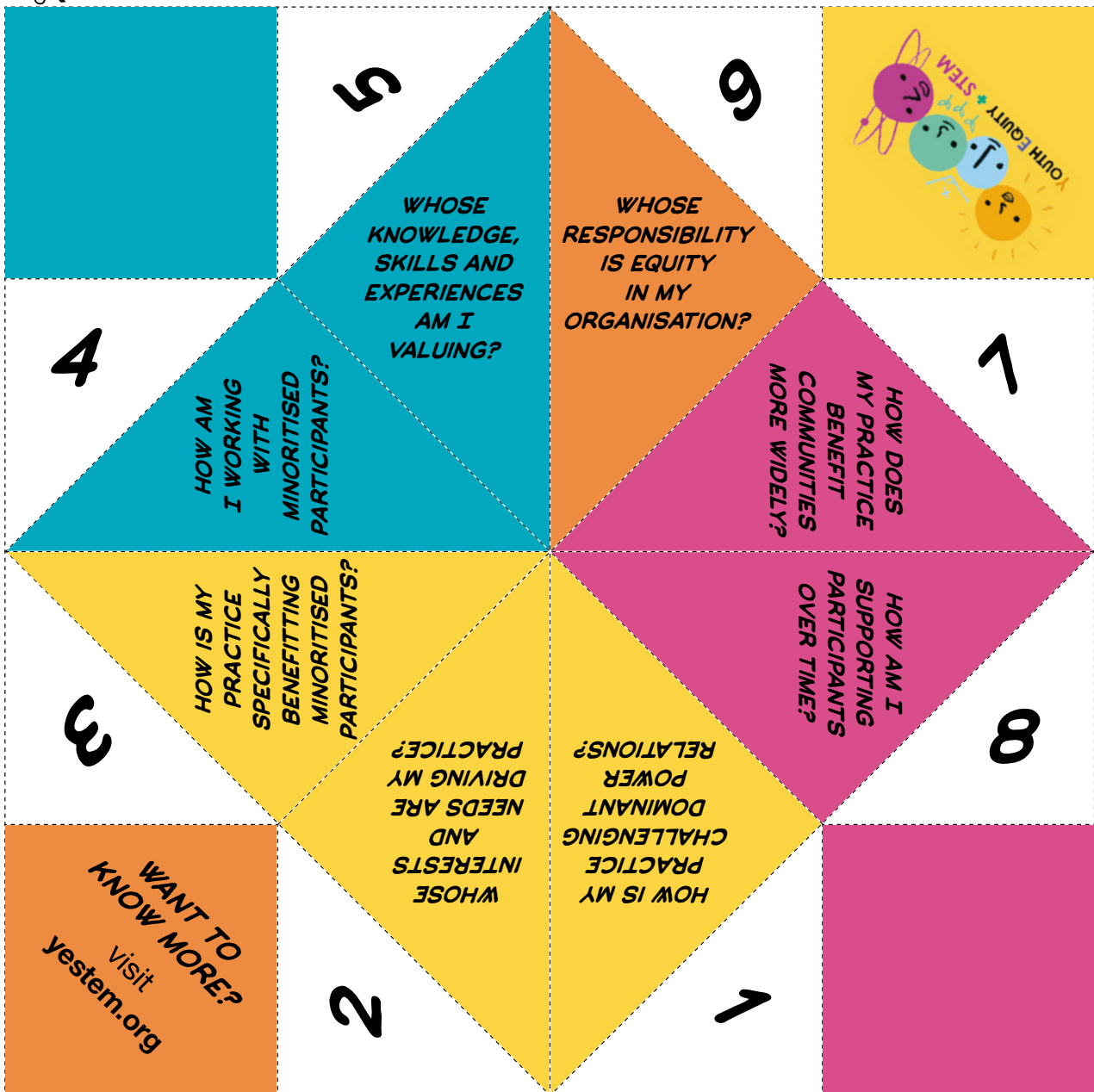
A tool for supporting socially just practice



YOUTH EQUITY + STEM

YESTEM

Instructions: Please cut out the square and follow the folding instructions



4

HOW AM I WORKING WITH MINORITISED PARTICIPANTS?

5

WHOSE KNOWLEDGE, SKILLS AND EXPERIENCES AM I VALUING?

6

WHOSE RESPONSIBILITY IS EQUITY IN MY ORGANISATION?

7

HOW DOES MY PRACTICE BENEFIT COMMUNITIES MORE WIDELY?

3

HOW IS MY PRACTICE SPECIFICALLY BENEFITTING MINORITISED PARTICIPANTS?

2

WHOSE INTERESTS AND NEEDS ARE DRIVING MY PRACTICE?

1

HOW IS MY PRACTICE CHALLENGING DOMINANT POWER RELATIONS?

8

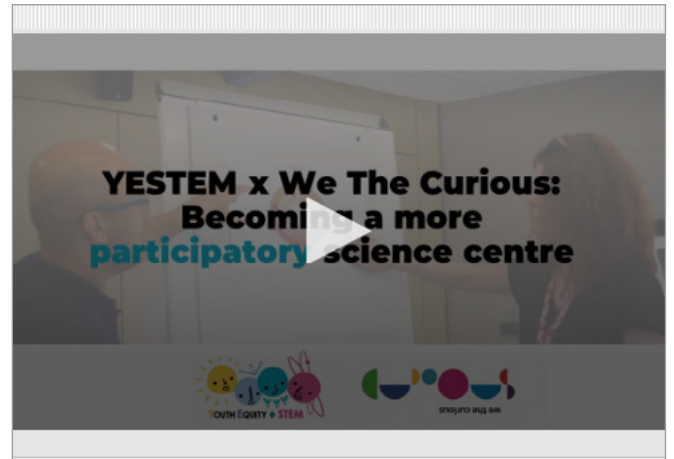
HOW AM I SUPPORTING PARTICIPANTS OVER TIME?

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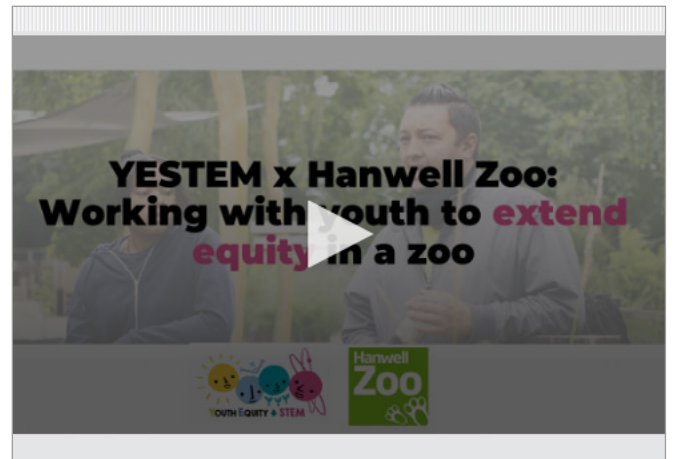
YESTEM x Stemettes: Supporting girls and non-binary young people in STEM by challenging the status quo



YESTEM x We The Curious: Becoming a more participatory science centre



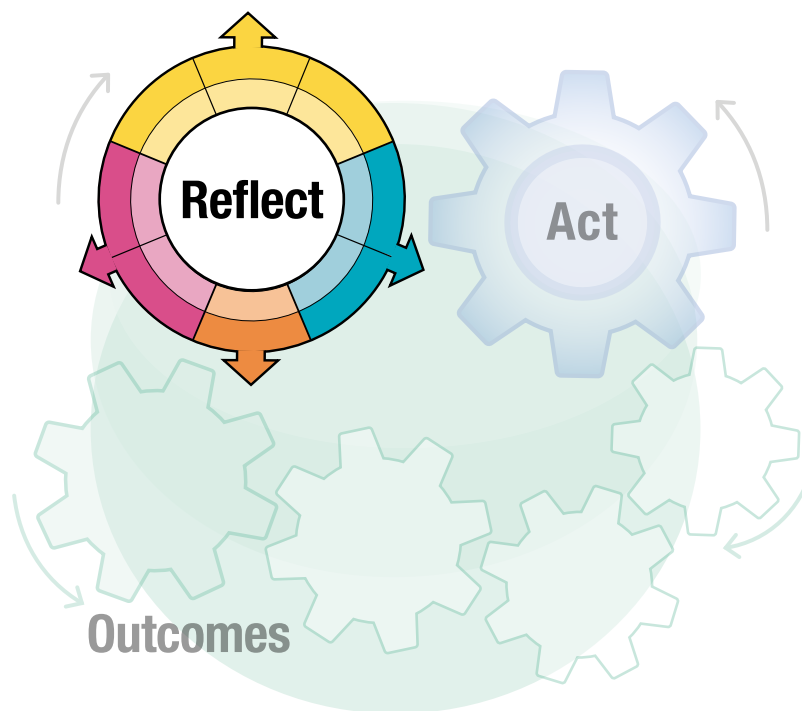
YESTEM x Knowle West Media Centre: Embedding equity throughout the organisation



YESTEM x Hanwell Zoo: Working with youth to extend equity in a zoo



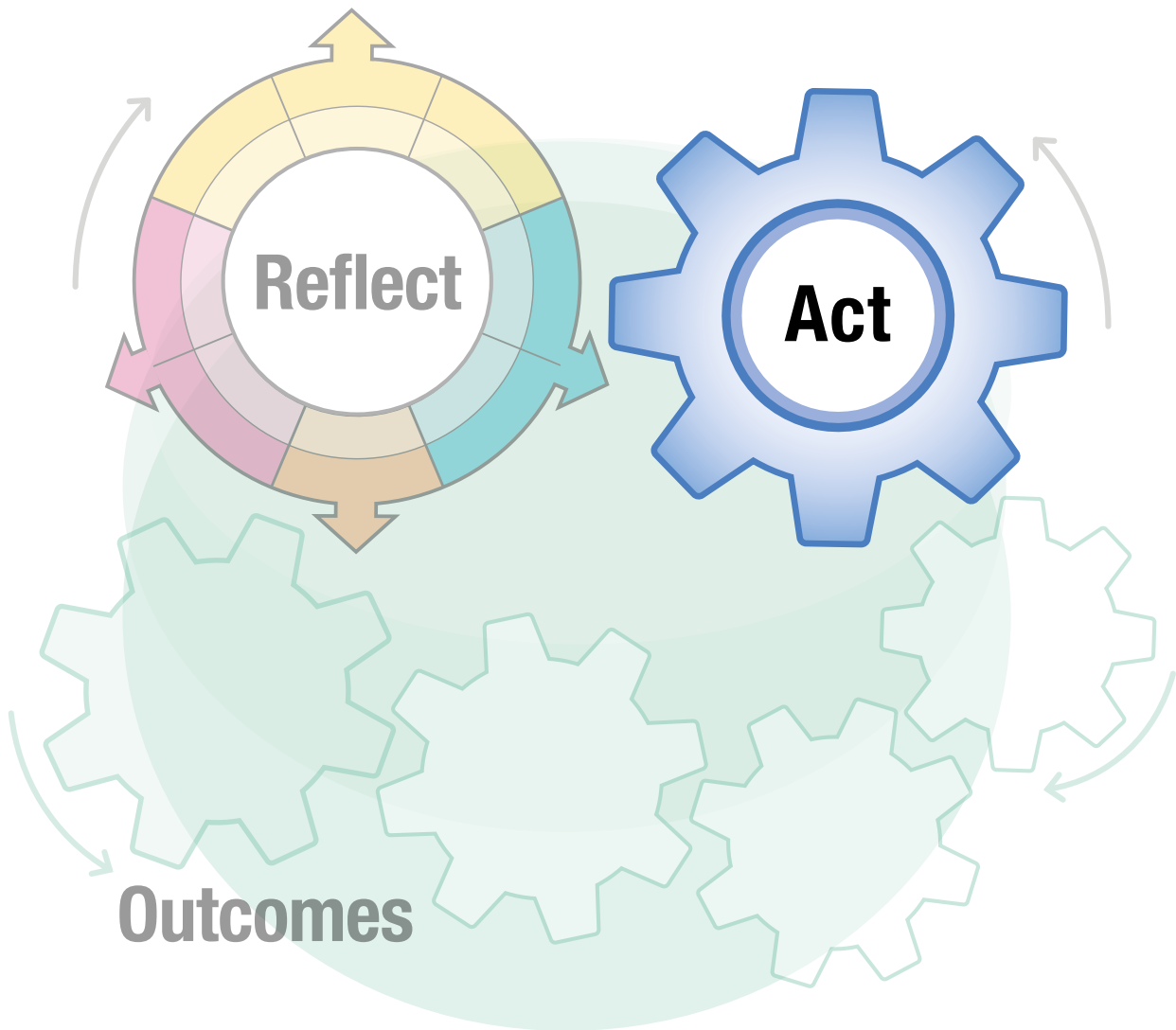
The Equity Compass Explainer



For more resources related to the Reflect part of the YESTEM model, please see yestem.org

- The Equity Compass insights for different audiences
 - [The Equity Compass - Teachers edition](#)
 - [The Equity Compass - School leaders and governors edition](#)
- Translations

ACT: Core Equitable Practices





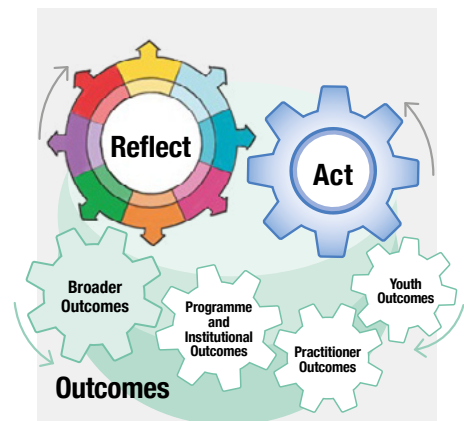
What are Core Equitable Practices in informal STEM learning?



YESTEM Insight #2

What is the issue?

- Informal STEM learning (ISL) settings hold promise in disrupting current systemic patterns of underrepresentation in science, technology, engineering and mathematics (STEM). However, while informal STEM programs and practices may be made accessible to a wide range of audiences, the learning experiences themselves may welcome some participants while excluding and alienating others.
- Whether youth feel comfortable engaging in ISL is partly a result of their experiences and their family and communities' cultural practices. **If STEM programs and activities do not encourage and support youth in ways that leverage their cultural experience, their opportunities for meaningful learning may be foreclosed.** ISL educators' practices play an important role in whether and how youth are welcomed into STEM.



YESTEM Model for equity in ISL

Please see yestem.org for the full model and related Insight documents detailing each component.

How to cite this publication: YESTEM Project Team (2021). YESTEM Insight 2: What are Core Equitable Practices in informal STEM learning? yestem.org



Our approach: Core Equitable Practices of informal STEM learning

Core Equitable Practices are pedagogical practices that support youth's learning and engagement in STEM in empowering ways. When educators engage in Core Equitable Practices, they take the stance that educators and youth are co-learners, co-disruptors and co-creators of a more just world with and in STEM. These practices pay attention to whose ways of knowing and discourses are valued in STEM, and why that matters. We refer to these practices as **Core Equitable Practices** because these practices are meant to be a part of an educator's **everyday practice**.

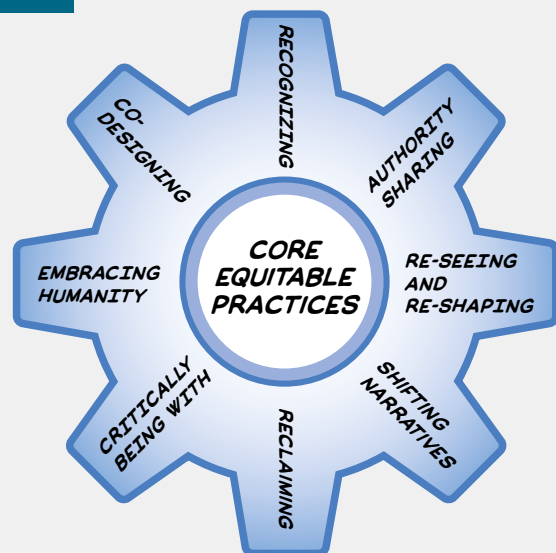
Core Equitable Practices:

- **Welcome and legitimize youth's lives, communities, histories, presents and hoped-for futures**, in the effort to re-imagine what engaging with STEM is and could be. All youth deserve opportunities to learn and become in STEM in ways that matter to them and to their communities. These practices support educators in noticing, centering and amplifying the cultural knowledge and community wisdom youth bring to learning. This is particularly important when the powerful knowledge youth bring may not have been legitimized historically in STEM spaces.

- **Disrupt dominant and unjust power relations** that have historically marginalized low-income youth, youth of Color, and girls in STEM. This involves recognizing that power and representation shape opportunities to learn through how they organize legitimate forms of knowing, doing, being, and succeeding. This also involves flattening knowledge and power hierarchies through valuing discourses, practices and forms of representation that reflect broad cultural diversity.
- **Support equitable youth outcomes** in ISL, in both individual and collective ways. These outcomes include supporting youth in developing STEM knowledge and practice alongside other powerful ways of knowing. These outcomes can help youth in participating in new ways, developing STEM agency and identities.



Act



Visit yestem.org for more information and resources from our international research effort.

Considerations

How Core Equitable Practices work

- **Core Equitable Practices are dynamic and meant to be adapted.** They may shape whole group, small group, or individual interactions/instruction, and they can, and should, be adapted to context. Learning to engage the Core Equitable Practices of ISL requires educators to learn how to notice and leverage upon youth's repertoires as well as to challenge their own personal perspectives as they learn from youth. As educators become more familiar with these practices they can employ them in more complex ways. All core equitable practices allow for variations in enactment as educators develop their craft.
- **Core Equitable Practices work across settings and time.** These practices may shape pedagogical and program activity in the moment (short-term) or over time (long-term). Educators can use the learning tools which accompany these practices to more equitably shape interactions and power dynamics in the

learning environment, as well as across learning environments, programs, and institutions. These practices are meant to shape and direct a wide range of planning, teaching and reflection activities in ISL towards more just outcomes for youth and their families and communities.

- **Core Equitable Practices work as a system of practice.** These practices are not individual or one-off or piecemeal actions. Instead, they are integrative, cross-cutting, and critically connected actions that occur across multiple scales of activity simultaneously. When enacted together, these practices are stronger than the sum of their parts and produce equitable outcomes.

A set of Core Equitable Practices. Below we offer a set of eight Core Equitable Practices. These practices are common across different kinds of ISL experiences and programs, ages and contexts.

Table 1. Core Equitable Practices defined

Practice	Definition
Recognizing	Being explicitly and publicly aware of the power of cultural knowledge and practice youth bring to STEM learning spaces, and of youth identity, agency, and expertise in STEM.
Re-seeing and Re-shaping	Building new possibilities for youth engagement in ISL through relationship building among youth, educators, space, and resources.
Co-designing	Collaboratively creating experiences, artifacts, space and desired outcomes.
Reclaiming	Fostering community dialogues and asset mapping towards creating a visible, enduring presence, disrupting and transforming what counts as STEM in the learning environment through how it's represented socially, spatially and discursively.
Shifting Narratives	Purposefully challenging and changing stories about what counts as STEM, who does STEM and how STEM ought to be done, opening up opportunities for youth to be recognized and valued for pursuing STEM experiences on their own terms.
Critically Being With	Slowing down and staying in the moment-in-action, to allow critical dialogue around inequitable classroom practices, interactions in the here-and-now and towards imagined futures.
Embracing Humanity	Valuing individual members of the teaching and learning community as fully human: as just who they are, not who they are expected to be.
Authority Sharing	Offering youth opportunities to be an expert/authority because of who they are and what they know. Giving up the centrality of adult-authority and traditional forms of STEM-authority. Supporting new forms of authority that center and amplify hybrid expertise.

Spotlight on practice: “This is Stupid!” (US)

Supporting youth in drawing upon their strengths and agency to take actions through ISL on the issues they care about is integral to how educators approach their roles at the Community Center in Lansing. Maria, one of the STEM Club educators, spoke about how it was important for her to **critically be with** the youth during their club sessions so that she could better recognize and respond to their ideas and worries from a place of their strength. This often caused her to pause in her own facilitator efforts to **share authority** with youth, **to critique or change an activity in the moment**.

Maria, an educator in an afterschool STEM club, explained how critically being with helped her to understand one youth, William’s, frustration, when he found an e-textile activity not worth the effort to struggle through the complexities of making circuits with conductive thread. She reflected:

When William threw down his bookmark during [our e-textile unit] declaring loudly, ‘this is STUPID! I want to make a fanny pack!’, at first I thought he was just frustrated with how his circuit kept shorting. You know using that conductive thread is not easy. It frays and you can short circuit without even knowing you did so. He had been so proud that his grandma taught him to sew, and I didn’t want to lose that connection. All eyes were on him as his peers stopped what they were doing and looked on. I just wanted to give him some space in that moment to express his frustration, but I also didn’t want him to just give up, and like I said everyone was watching. So, I just decided to take him at his word and ask, ‘What should we do? What do you need?’ It was then he said he wanted to make a fanny pack because it was something real, something he was gonna actually use.

In this comment Maria **recognized** how the challenges of constructing e-textiles might be too frustrating, especially if youth did not see real value in the activity itself. In that moment, she chose to **legitimize his frustration** when she said **“What should we do?”** in response to William’s expression of his frustration. She explained that when she asked the question about what to do, William said a fanny pack would be a more useful project because he could put his money and other prized items in it, and keep it on his body to prevent it from being stolen. She explained how his peers joined in, offering different ideas for why a fanny pack was a good idea:

After that a whole group was making fanny packs, using William’s pattern. While they were making, they started talking about an incident in the lunch room that day. One of the girls said a friend’s purse had gotten stolen at the lunch room that day, and another girl replied, ‘You mean her money got stolen.’ And I remember that’s when William declared, sort of matter-of-factly, “and that’s why you gotta have a fanny pack.” It was a powerful moment as I had not realized how much that meant in that moment.

Making a fanny pack did not change the technical challenges presented by e-textiles that William encountered with the bookmark. However, **William viewed the fanny pack as a worthwhile space in which to engage with both the technical and social dimension of the project**. Also, layered into his new engagement were the potentials for the “afterlife” of his project – how his fanny pack might be used, by whom, and with what impacts. Opportunities for this new form of engagement expanded the ways in which William’s cultural knowledge/practice (e.g., sewing, knowledge of his peers’ needs) became more legitimized in and hybridized as a part of a STEM project, re-shaping whose cultural knowledge had capital.

Maria’s comment further reflected the stance held by our educator partners who viewed youths’ oppositional action not as a form of misbehavior, but rather as an effort to make visible – to help educators recognize – what was unfair or inequitable in their learning spaces. Supporting William in this moment meant helping him and his peers re-imagine the task into one that made visible the ways in which e-textile making carried salience in their lives in that moment.



Spotlight on practice:

Core Equitable Practices at a community zoo (UK)

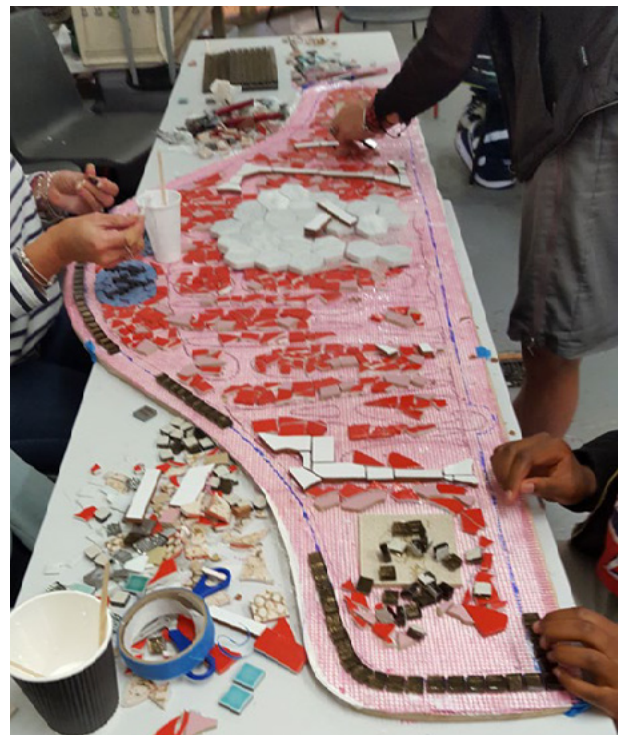
Supporting and working with a wide range of people in the local community, particularly those from marginalized groups, is an integral part of the work at the community zoo in London. Through educational programs focusing on conservation, the zoo has worked with young people attending alternative educational provision, those with special educational needs, young people on youth justice schemes and those living at a local homeless shelter.

Kevin, one of the zoo practitioners, spoke about the importance of including and welcoming these young people at the zoo and showcasing their work so they are recognized and valued as members of the zoo community. For instance, young people's artwork is displayed prominently and signage, enclosures and gardens in the zoo are all made by program participants, reflecting the practices of **Co-designing** and **Reclaiming** the space. Kevin explains "A lot of the reason we started these programs was to help show the public the value and contributions that these people make."

Showcasing the young people's work in the zoo also exemplifies the practices of **Recognizing** young people's skills and expertise, within and beyond STEM and **Authority Sharing** – as the young people played a key role in shaping the design, look and feel of the zoo.

The task of embedding Core Equitable Practices is not always easy. In the early days, the zoo's approach faced resistance from some local wealthy residents, who complained that displaying young people's work 'lowered the tone' of the zoo. However, the zoo team persisted and are pleased that their approach is now widely accepted and praised within the community.

Cole, who facilitates the education program with young people at the zoo, recognizes that respecting and valuing young people's identities, interests and existing knowledge in STEM and beyond is a key feature of his practice of **Embracing Humanity**. Cole's caring relationship with the young people is characterized by mutual trust, sharing and valuing between himself and the young people, which is evident not only in formal sessions but also during informal break times, when he chats with young people about their lives. In addition to valuing and engaging with young people, Cole also explicitly foregrounds societal injustices within his pedagogy, as exemplified by his practice of **Critically Being With**, when he openly talks with and listens to the young people, as they discuss the various challenges they experience, such as school bullying, racism and sexism.



Additional tools and resources

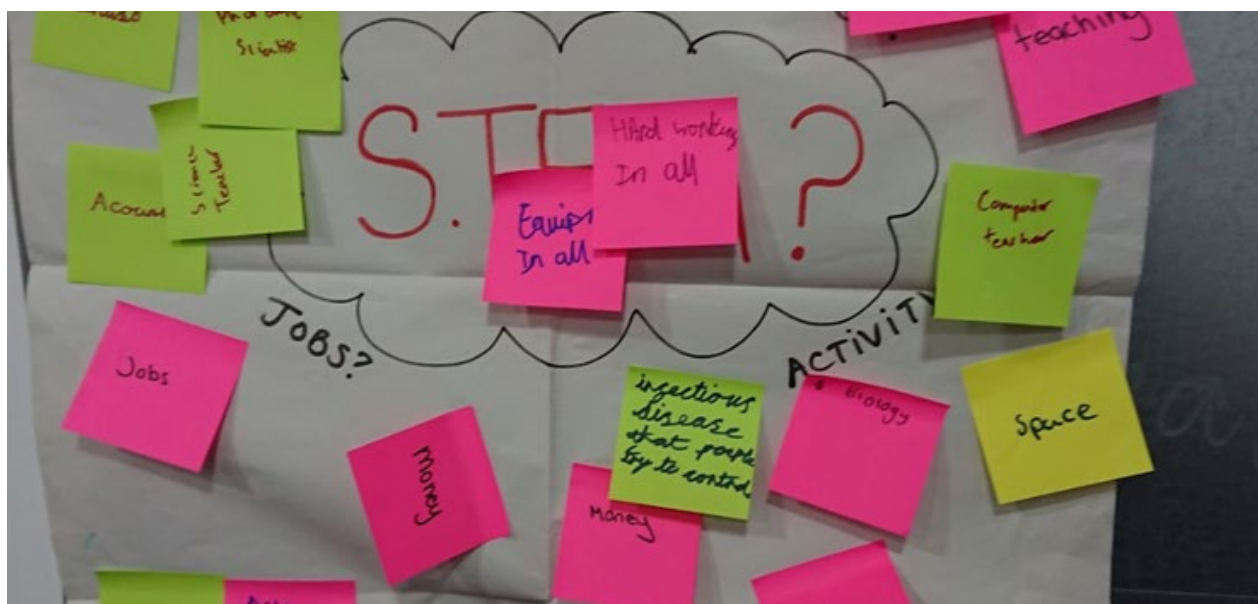
Our research-practice partnerships (RPPs) collaboratively co-authored a “suite of tools” for how each Core Equitable Practice may be implemented in context.

These tools include:

- *RPP Insights* describing the Core Equitable Practices.
- Associated “postcards” of practice, with illustrative vignettes of the Core Equitable Practices.
- Tools to support educators in planning with and enacting Core Equitable Practices.
- Practical measures for documenting impact of Core Equitable Practice implementation.

About our project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people.



For the full range of Insights documents summarizing the project’s tools and resources, including Core Equitable Practices and Equitable Youth Outcomes Model, please see yestem.org

This material is based upon work supported under a collaboration between the National Science Foundation (NSF), Wellcome, and the Economic and Social Research Council (ESRC) via a grant from the NSF (NSF grant no. 1647033) and a grant from Wellcome with ESRC (Wellcome Trust grant no. 206258/Z/17/A).

Disclaimer

Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of NSF, Wellcome, or ESRC.

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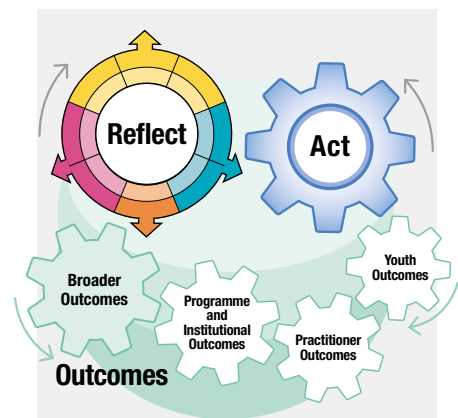
Constellations of Core Equitable Practices



YESTEM Insight

What is the issue?

- Working towards justice in informal STEM learning (ISL) is an on-going endeavor. Justice is not achieved in a single moment, nor does it result from a single action. Because the nature of injustice in ISL is so layered and complicated, working towards justice involves many actions, enacted over time, and in relation to each other.
- Youth experience injustice in ISL in a number of ways, from how their lives are welcomed as important and integral to ISL to opportunities youth have to voice ideas and concerns about how they want their ISL learning environment to look and feel. If educators are to address the range of ways youth experience ISL, they need a range of practices that can work in coordination with one another.



YESTEM Model for equity in ISL

The Equity Compass is the basis of the Reflect component of this model. Please see yestem.org for the full model and related Insight documents detailing each component.

How to cite this publication: YESTEM Project Team (2022). YESTEM Insight: Constellations of Core Equitable Practices. yestem.org



Our approach: Constellations of Core Equitable Practices

Core Equitable Practices are pedagogical and institutional practices that support youth learning and engagement in STEM in equitable ways by disrupting and transforming power, and by valuing youth, families, and communities. When enacted over time, they support equitable outcomes for youth, educators, and institutions.

When Core Equitable Practices are enacted over time and in constellation with each other, they support equitable learning community and individual outcomes, such as developing STEM capital, agency and identity, having fun and developing interest along with more equitable patterns and ways of participation.

Core Equitable Practices, especially when enacted in constellations, support youth's learning and engagement in STEM in equitable ways by disrupting and transforming power, or by disrupting the exclusionary ways in which ISL is traditionally enacted. They value youth, families, and communities such that their lives, experiences, and wisdoms are integral to what it means to know, do, and become in STEM, expanding possibilities for engaging in STEM agentic lives. These practices pay attention to whose ways of knowing and discourses are valued in STEM, and why that matters. We refer to these practices as Core Equitable Practices because these practices are meant to be integrated within an educator's everyday practice.

Why constellations?

Constellations are typically thought about as a set of visible celestial objects, such as stars, that group together in patterns that can be recognized. Different cultures have identified, observed, and named different constellations, each tied to its own unique story and history.

We use the term constellation to reflect three key points:

- First, just as individual stars can be viewed together in a recognizable pattern, *constellation* refers to how Core Equitable Practices work together to create an effect stronger than any individual practice.
- Second, as educators engage Core Equitable Practices in constellation, they work with their partnering youth to create a new storyline in

STEM about who can participate in STEM, what participation looks like, and even what STEM is and can be.

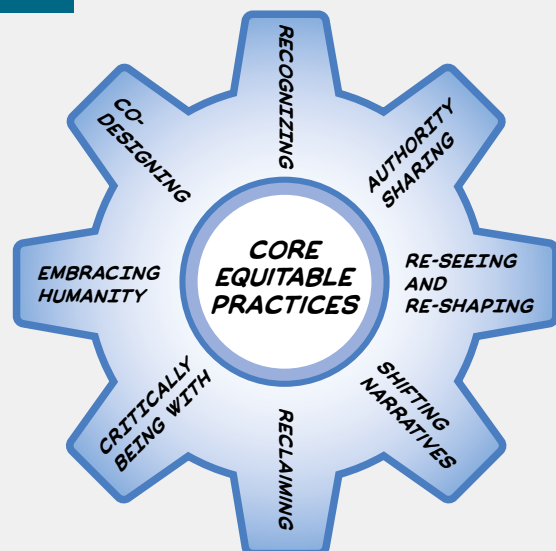
- Third, just as different cultures have observed and named different constellations involving some of the same stars and that have been recognized and shifted over time, educators, as they work in particular contexts and with particular youth, design and enact new and changing constellations of practice. In addition, when practices are enacted in constellation, they can also create space for additional Core Equitable Practices to take shape.

In short, Core Equitable Practices are meant to be enacted in constellation, with effects adding up to promote justice for youth in STEM.

Considerations: How to Enact Constellations of Practice

We recommend starting by pairing two practices that connect to your program or activity goals (one practice you might feel more familiar/comfortable with and one practice that feels new). Consider for example, how Maria paired the practice of 'critically being with' with the practice of authority sharing.

Act



Visit yestem.org for more information and resources from our international research effort.

Spotlight on practice: Enacting Constellations of Practice (US)

In seeking to critically be with youth (See **YESTEM Insight 2.6: Critically Being With**), during circle time one day, Maria asked, “What helps you to feel included or excluded here?” Louise immediately got up from her chair and marched to the red couch in the corner of the room, expressing that it was a comparatively more humanizing space where she felt included. Plopping down and stretching out on the couch and hugging herself, she exclaimed, “this is when I feel included,” which was “different from school” where she felt like someone “no one liked in my classroom.” Louise’s statement was immediately greeted positively by her peers. Her peers shared that the red couch was “their space,” “more like home,” and “not like school” and that “it was the kids’ idea to have a couch in here.”

Central practice: Critically Being With: We view critically being with as a deliberate choice to relate to each other ethically (Villenas, 2019). It implies that youth are continually calling on adults to join them as allies. This allyship means listening to youth experiences, considering how these individual experiences are affected by injustice or unfairness, and seeking to show up for youth by acknowledging and addressing those issues directly with youth towards improving the learning space.

Maria shared later that she had been aware that the youth loved the couch but had not previously considered how it might be important to physically include the couch “as centrally a part of our STEM activity together.” Maria embraced humanity (See **YESTEM Insight 2.7: Embracing Humanity**) as she further reflected on how youth might experience the space as whole people:

“I began to see the youth’s yearning for a place... that welcomed them for who they are as young people, who’ve just spent eight-plus hours in school being quiet, sitting in chairs. They were, in part, asking to be realized for their desire to just be. I think the red couch also symbolized... what it meant to fully welcome young people in our space together.”

Maria then sought to share authority (See **YESTEM Insight 2.8: Authority Sharing**) by asking the youth if they wanted to rearrange the room to reorient their circle time, physically, around the couch. She stood back as the youths moved the furniture around in their designed configuration, asking if they needed help and what they would like her to do. In fewer than 10 minutes, the couch was moved from the corner to the middle of the wall. Chairs were placed around the couch to complete the circle (from then on, the couch served as the organizing point of their circle time).

Louise, now back on the couch and swinging her legs back and forth, continued the conversation. She narrated a past moment in which Maria had positioned Louise as an expert, which also helped her make new friends in the STEM Club:

I remember last week when you [Maria] asked if anyone knew how to sew. I raised my hand and other kids did, too. You said, “Look around and see everyone with their hands up? They are experts at sewing and can help us today.” That made me feel included because it was important and felt good. My Auntie taught me how to sew, and when I could help others I got to know them better and make new friends.

Louise explained that it was important for educators to ask about youth’s experiences and expertise, which emphasized the importance of situating youth’s experiences and expertise as legitimate and central to ISL. She was proud to share sewing knowledge that she learned at home, and proud that it helped her build new relationships.

Supporting Practices: Embracing Humanity and Authority Sharing: In this example, the practices of **authority sharing and embracing humanity** fit together with **critically being with**.

As Maria sought to critically be with youth, she tried to embrace humanity by better understanding how they felt in their club. As she learned more, she shared authority with youth by explicitly using their ideas to inform her actions.

Additional tools and resources

Our research-practice partnerships collaboratively co-authored a suite of toolkits for how each Core Equitable Practice may be implemented in context.

These tools include:

- Insights describing the Core Equitable Practices.
- Associated Youth Bids guides, with illustrative vignettes of how educators used the Core Equitable Practices to notice and respond to youth efforts.
- Talk Moves tools to support educators in planning with and enacting Core Equitable Practices.
- Practical measures for documenting impact of Core Equitable Practice implementation.

About our project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
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Recognizing



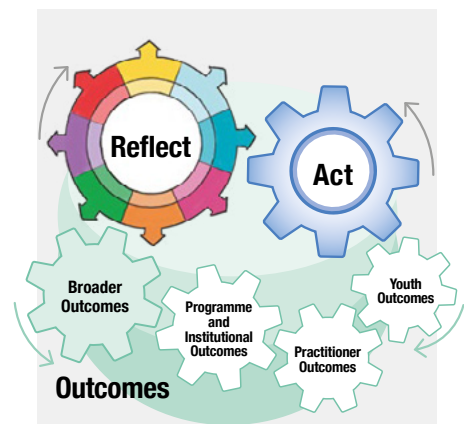
Recognizing



YESTEM Insight #2.1

What is the issue?

- Youth use powerful ideas, experiences, and practices to make sense of the world, but not all youth have their ideas, experiences, and practices valued in STEM learning.
- Because many STEM learning materials and spaces were designed in alignment with White, male, and Western perspectives, youth of Color and girls are often unjustly positioned as STEM outsiders. This results in racial and gender inequalities in who has a rightful presence in their Informal STEM Learning (ISL) community.
- **Recognizing** is an anti-racist practice. Recognizing values youth identities, cultural practices, community wisdom, personal experiences, and racial histories as central to STEM engagement, instead of something unrelated. Scientists are people first, and valuing youth as whole people supports youth-positive STEM learning.
- Valuing such knowledge and practices as relevant to STEM positions youth as legitimate experts rightfully present in STEM.



YESTEM Model for equity in ISL

Please see yestem.org for the full model and related Insight documents detailing each component.

How to cite this publication: YESTEM Project Team (2021). YESTEM Insight 2.1: Recognizing. yestem.org



What is the practice?

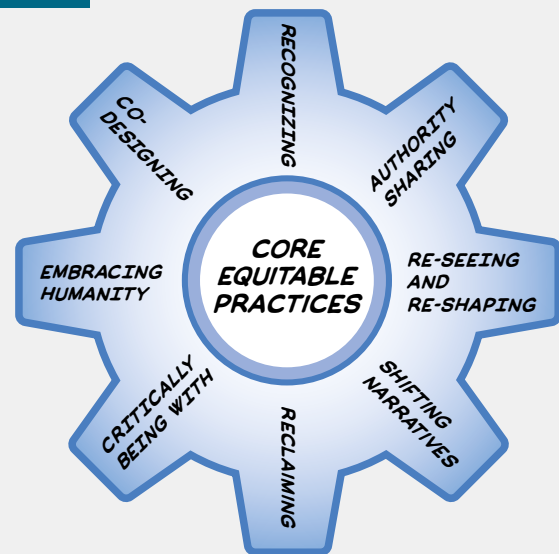
Recognizing is **when educators engage in purposeful strategies to notice the lived lives and community wisdom** that youth bring to STEM learning, **and then to leverage these resources** towards powerful learning opportunities for youth. Oftentimes, the resources that minoritized youth bring to STEM learning are not legitimized in learning environments. These resources include the interests, identities, and knowledge that youth develop in their families and communities.

The practice of Recognizing seeks to reverse this trend of marginalization with the goal of ensuring that youths' whole lives matter in learning and doing STEM. Recognizing de-centers Whiteness in STEM and STEM education.

Recognizing looks like:

- Noticing or eliciting and then publicly validating youth ideas, practices, and life experiences,
- Encouraging youth to learn from each other's expertise.

Act



By Recognizing youth ideas, experiences, and practices as relevant to STEM learning, educators can help youth see themselves as connected to STEM content, practices, and possible future professions.

Visit yestem.org for more information and resources from our international research effort.



Spotlight on practice: Louise on recognizing in STEM (US)



At the start of one of their after-school sessions, 12-year-old Louise answered a group reflection prompt of “what helps you to feel included here?” She volunteered that she felt included when people noticed her in “good ways” saying, “I feel included in STEM lessons **when people notice good things** about me. I know how to do some [things], and helping others know how to make and do stuff helps me to feel included. Sometimes y’all be like **‘Who is a pro at this?’** or ‘Look, Louise is pro!’ When you talk about one specific person, that helps.

Like when we made e-textiles **you asked if anyone knew how to sew**. I raised my hand and other kids did, too. You said, ‘Look around. See who has their hands up? They are experts at sewing and can help us today.’ This made me feel included.” Louise further said it was important for kids to feel “like experts.”

Spotlight on practice: Tiddlybot experts (UK)

One of the YESTEM sites is a community based digital arts center in a major UK City. The center runs an after school tech club. The sessions invite open ended exploration of robotics, software programming and media design. In this context, recognition of young people’s emerging expertise has an energy of its own and is built from many private and public validating interactions by the practitioners.

For instance, we observed Erin introducing Tiddlybots by saying **“BnW [one of the participants] in the corner is our tiddlybot expert”**. Other club members are also regularly celebrated for their expertise e.g. **“just look towards Ginger”** for Scratch, Minecraft, Roblox. The young people named turned and grinned as they received recognition as experts from staff and peers.

Erin explains: **“during a session, I try really hard to get to know every individual person.....like BnW, ... he’s like our little tech wizard. I say ‘BnW you’re really good at tech’.**” Describing her own practice, Erin reflects, **“I don’t know everything, but it does not matter, because you let them explore and learn.”** Erin’s consistent and empathetic practice helped normalize an assets-based approach for all club members.



How to use this practice: Reflect

Reflection questions

1. How are youth currently being recognized in your learning space?
2. How can you use or convert youth work to be materials for a public “showcase of expertise” in your learning space?
3. What obstacles to supporting youth recognition more broadly at your institution could be addressed?

How to use this practice: Act

Things to do

1. Questions help to create opportunities

At a lesson’s start, publicly inquire who might already be familiar with relevant skills of the day. Publicly name as “experts” those who indicate familiarity. Ask your new experts if they’d be willing to share that expertise if peers need help.

2. Honor how youth share their resources

Youth bring ideas, knowledge, innovative critiques, experiences, leadership, and care for their community. By paying attention to the assets youth bring to a space, educators can support youth by publicly recognizing them as active and important contributors to a shared learning community.

3. Redirecting requests helps everyone

Recognizing brings multiple benefits. When youth request assistance with a particular skill during an activity, you can publicly redirect them to peers with that skill. This gives you more flexibility in where you direct your time and energy and publicizes your recognition of youth as experts and leaders.

4. Publicly display evidence of youth efforts

Put youth-created work materials (ones that matter to youth and represent them well) in well-lit, well-seen places. Consider planning to keep these visible for long periods of time. Making their work a more permanent part of your shared learning space supports youth in feeling recognized and valued.

5. Embody authenticity in recognizing

Make sure you actually mean it when you vocalize what forms of youth expertise you notice. Young people are more perceptive than they get credit for. They notice subtleties and can tell when adults are patronizing them.

6. Artifacts can mediate recognition

There are many ways to recognize experience, ideas, and practices. Some youth may not like to speak in front of others or receive verbal public praise, but you can offer specific praise on a post-it note, or ask if they’d welcome displaying their work anonymously. Showing you noticed doesn’t have to be loud.

Additional tools and resources

Try out some “Talk Moves”

Talk moves are simple verbal mini-reminders to elicit, identify, publicly recognize, and build upon youth contributions in group discussion. Talk moves can be helpful first-step tools and daily-habit supports.

Publicize youth ideas, actions, and expertise

- “Mary, that is a tough, but necessary question to ask. Let’s think further about Mary’s question...”
- “That is powerful. So you mean that [revoice youth’s idea]?”

Use questions to create opportunities for recognition

- “What you just said sounds really important. Would you tell us a bit more about it?”
- “Does anyone here know how to [insert relevant skill for the day’s activities]? That is so great. Would you help us [skill] today?”

Remember and draw on youth interests and expertise over time

- “I remember you saying that you enjoy reading. Is there a book you are currently reading? What’s it about?”
- “I noticed that you really like [a particular activity]. How can we incorporate that into our [program activity]?”
- “You said that this activity could be better. What changes would you recommend?”

Example tools from educators

- **Publicize youth ideas and work in verbal and visual ways:** Set up a weekly sharing time for youth to share their project updates, new ideas, and questions with peers and adults. Create a showcase wall where youth work is displayed.
- **Embodied recognition:** Use your facial and body expression as ways to make your recognition visible to youth (pausing to listen, walking with youth to continue to listen and recognize their contributions).

About our project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people.

For the full range of Insights documents summarizing the project’s tools and resources, including Core Equitable Practices and Equitable Youth Outcomes Model, please see yestem.org

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Guide to Youth Bids

Recognizing is when educators engage in purposeful strategies to notice the lived lives and community wisdom of youth. It involves noticing what youth bring to STEM learning, and then leveraging these resources towards powerful learning opportunities for youth.

What are youth bids? Youth take actions to prompt and seek attention from educators and peers. When youth make a recognizing bid, they seek to share their expertise, lived experiences, culture, values, and imaginations.

This guide provides:

- One example of how to enact the Core Equitable Practice (CEP) of Authority Sharing, as described in the Recognizing Insights 2.1 document.
- Examples of how youth may seek to gain recognition, drawing on our partner educators' implementation of informal STEM programs.
- Ways to notice these bids and readily respond to them in ways that value youth for who they are and what they bring to the learning environment.

Questions for Group Discussion

- How have youth had **opportunities to get recognized** in my/our program because of who they are, what they have experienced and/or what they know? How have youth been **denied recognition**?
- How have I/we **responded to such bids**? Which **new learning outcomes**, if any, emerged from my/our response to bids for authority sharing?

Things to Keep In Mind

- Youth bids can require multiple responses at once. For example, youth bids to gain recognition by presenting their skills and imaginations can also require the core equitable practice of sharing authority.
- This tool can be used alongside the Equity Compass tool to enhance discussions on youth bids goals and outcomes.

Why do youth make bids? Youth often actively seek to do the following:

- To **disrupt** the ways in which everyday knowledge and practice of STEM and schooling position students as deficient, or without power and authority.
- To **amplify** their already-present brilliant and agentic acts of everyday knowing and practice and to have their transformative potential made visible.
- To be **rightfully present** and legitimately belong as fully human in ISL.

Examples of Youth Bids

Disrupting: Asking to be recognized with their experiences and knowledge

In STEM club, Jamie proposed “GET City news” for which youths would interview with one another and video-record the interviews using the portable digital cameras so that they could share, collect, and record **successful moments of their project**.

Maria and other STEM club educators **recognized Jamie’s suggestion as meaningful and disruptive** of how the digital cameras had been mostly used for adults’ purpose of video-recording and research data collection. Educators **amplified Jamie’s ideas** to use the cameras as tools to actively recognize and legitimize important youth moments and events as they occurred in real time in the ISL (informal STEM learning) space.

Bid: Asking to be seen as someone with ideas

Response: Noticing the bid, amplifying ideas shared

Recognizing: Youth takes on leadership role to showcase developing group expertise

Amplifying: Wanting Adults to Know and Honor their (and their peers’) ideas

During one of the Youth Action Council sessions in a science center, youths and educators were brainstorming how to co-design and name a conference room. Walking with his peer Lulu to the educator (Ms. Olga), youth member Trey said, “Ms. Olga, **she has a really great idea**. We should listen to her.” Trey **solicited Olga’s attention to his peer’s ideas**, and Lulu **shared her idea** of redesigning the room.

Olga **carefully listened to and asked follow-up questions**. Olga helped Lulu express her ideas by drawing together some visual descriptions, including Trey, so that they all can concretize Lulu’s ideas. Olga also encouraged Lulu to continue thinking of redesign ideas throughout the week, **reaching out to her** if other ideas came up after that day.

Bid: Bringing a peer’s ideas to an authority figure

Response: Noticing bid, recognizing and valuing both the peer’s ideas and the speaker’s support

Recognizing: Youth is supported and shares further support with others

Rightfully Present: Advocating for their (and their peers’) legitimate belonging with their ideas, expertise, and hope

During a summer STEM camp in a science center, Lulu approached adult educator June and **advocated for her peer**, Su’Zanne, who was working on a task different from what June instructed youth to do that day. **Lulu suggested** that Su’Zanne’s off-task activity of mixing beats using an online application could be helpful to the rest of the group. Suggesting where the music beats could be used, Lulu argued, “Ms. June, look at Su’Zanne. Can she make music to be used for the drone video we made yesterday? We also need our own music to be the background of our showcase as well as the videos we made.”

June immediately **recognized this as Lulu’s bid** for publicizing her peers’ expertise as legitimate, productive, and even necessary for their learning community’s success. June **discussed Lulu’s idea with Su’Zanne**, asking if she would be interested in making background music for the group.

Bid: Re-presenting a peer’s activity as not off-task but central to group success

Response: Hearing, taking time to discuss options

Recognizing: Many activities and ways of being a group member as helpful and welcomed

Reflecting:

- Which example of youth bids resonates with your experience?
- Share and add youth bids for recognition that you have experienced.
- How might you respond to recognize youth in your space?

Guide to Talk Moves

Recognizing is when educators engage in purposeful strategies to notice the lived lives and community wisdom of youth. It involves noticing what youth bring to STEM learning, and then leveraging these resources towards powerful learning opportunities for youth.

What are talk moves? Talk moves are the pedagogical moves that educators make to facilitate and scaffold engagement in ISL among youth without being the one doing all the talking or decision-making.

This guide highlights pedagogical moves to create and sustain an equitable learning community. It serves as one example of how to enact the Core Equitable Practice (CEP) of Recognizing, as described in the Recognizing Insights 2.1 document.

Questions for Group Discussions

- How have I/we sought to recognize youth in my/our program -- drawing from who youth are and what they bring -- their feelings, ideas, histories, hopes and fears?
- Have I/we been successful in recognizing practices with some youth more than others?
- What makes me/us uncomfortable with recognizing youth in STEM spaces? Why?
- From my/our own experience, what talk moves have I/we used or experienced to recognize youth?
- What are some ways recognizing talk moves might be combined with other practices (e.g., co-designing)?
- What talk moves have I/we already used? Which do I/we want to add? Which ones will be the most impactful to support recognizing youth? Which will be difficult?
- In the most recent lesson taught, how could I/we integrate these talk moves to transform who/what matters in STEM?

Things to Keep in Mind

This tool has been designed with partner educators. Themes include publicizing, using questions to recognize, embodied recognition, and sustained recognition.

Some talk moves can work for multiple practices. For example, questions to recognize youth may also work to critically be with youth

This tool can be used alongside the Equity Compass tool to enhance discussions on talk move goals and outcomes.

Some of these talk moves may look like ones you are used to seeing, such as voicing. However, **we call attention to when and how these moves are used to unsettle what/who matters in STEM and what expertise is and can look like.**

Examples of Talk Moves

Publicizing youths' ideas, actions, expertise, and artifacts (elevating personal to public, leveraging peer resources)	Validating Youth Ideas	"Thank you for sharing your story. I like the passion in your statement. That is a tough, but necessary question to ask. Let's think further about Mary's question."
	Revoicing	"That is powerful. So you mean that ...? Oh, so his point is this ... " Writing down youths' ideas on a white board
	Showcasing youths' artifacts	Displaying youth work in prominent places of ISL spaces. Using youth-produced work to educate visitors to the space. For example, a youth-made light up sign greets visitors at the door of their program.
Using questions to create recognition opportunities	Questions for eliciting and recognizing youths' ideas	In the beginning, instead of starting with content delivery, elicit youths' related experiences and ideas. "We're exploring {topic} today. What do you think might be going on here? What does this remind you of?" "What kind of interrogative questions can we ask?" "What you just said sounds really important. Would you tell us a bit more about it?"
	Questions for eliciting and recognizing youths' actions	"Would any of you know how to sew (or insert practice)?" => "Look at those who raised their hands. They are experts of the day." "I learned (x) from my dad." "That is so great. Would you teach us...?"
Embodied recognition	Body languaging	e.g., inclining your body to youth, nodding, opening arms
	Facial expression	e.g., smiling, eye-contact, engaged listening
	Shift in actions to recognize	e.g., pausing to listen, walking with youth (to continue to listen and recognize)
Sustained recognition (in-depth, developing authentic relationships with youth, connecting experiences across space and time)	Verbalizing what was recognized before and connecting it to the current recognition	"Is there a book you are reading right now? May I ask what it is about?" (Insert any activity youth enjoy.) Based on knowing a youth wants to become an entomologist, "I found this spider while cleaning up! Do you want to help safely identify it?"
	Verbalizing what was recognized before and leveraging it to help youth enact expertise	"I noticed you really liked the [activity/tool/material]. Ok. Then, why don't we add a fun design project using [activity/tool/material]. Any of you having any ideas?"
	Making youths' critique/suggestions present by changing instructional plans and tools	"You once said that this activity may look better with some changes. Which change would you recommend?" "Does the change we made work?"

EXIT PASS

Help us learn about how your day went!
You don't need to write your name.

I felt other people cared about my ideas and work today:

YES

NO

WHO CARED?

HOW DID THEY SHOW THEY CARED?

I cared about someone else's work today.

YES

NO

WHOSE WORK DID I CARE ABOUT?

WHY?

I felt like an expert today.

YES

NO

WHEN?



Re-seeing and re-shaping

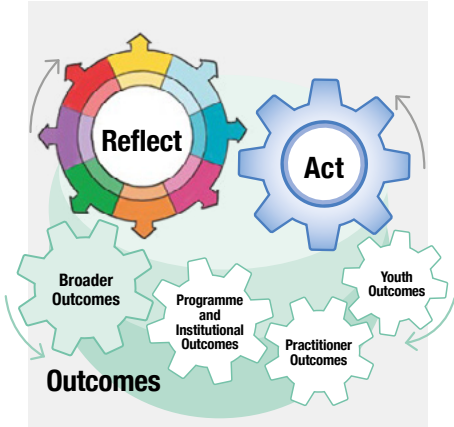


Re-seeing and Re-shaping

YESTEM Insight #2.2

What is the issue?

- The informal STEM learning (ISL) terrain is made up of multiple organizations, institutions, people, resources, and opportunities. Re-seeing and Re-shaping how the different parts of the terrain relate to each other creates new possibilities for participating in ISL.
- For example, if a youth is interested in robotics, she might ask family members about their experiences with robotics. She might join the robotics team at school or an after-school robotics club. She might attend a STEM summer camp focused on robotics. She might reach out to a university robotics team, faculty member, or department to ask about their experiences and opportunities available to learn more.
- Each of these institutions, people, and resources are only available to a youth if they 1) know they exist, and 2) the tools and resources they have to engage with them are recognized as relevant to robotics.
- While there may be multiple institutions, people, and resources related to STEM in a particular place or field, youth may not know they exist or may not have feasible means to connect with them.
- In addition, the people, organizations, and programs may not recognize the tools and goals youth bring to the field if they look different from those that have shaped these people, organizations, and programs.



YESTEM Model for equity in ISL

Please see yestem.org for the full model and related Insight documents detailing each component.

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What is the practice?

Re-seeing and Re-shaping is the practice of making visible the ISL terrain—the institutions, people, resources and opportunities—as they currently exist, while simultaneously noticing the rich assets youth bring for Re-shaping the terrain in powerful ways.

Re-seeing is about seeing the terrain (ISL institutions, people, and opportunities) and youth assets and interests as they are and as they could be in relation to one another.

Re-shaping is about organizing for new possibilities in ISL by facilitating connections between youth and people, resources, and opportunities that highlight how youth might use the tools and resources they bring to STEM.

Re-seeing and Re-shaping can help adults refine and expand our mental models of youth, what matters to them (and how/why), and what this could mean for their futures.

Re-seeing and Re-shaping supports youth to:

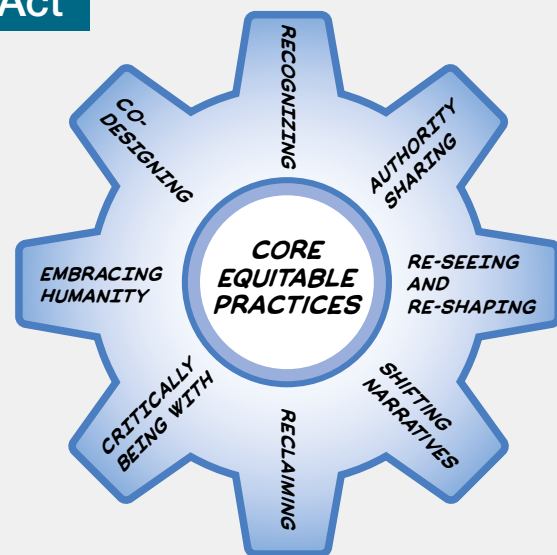
- Develop expertise and social capital beyond STEM
- Access resources and social networks not available in school
- Connect STEM to everyday experiences and loved ones
- Challenge what counts as STEM expertise
- Create pathways to future learning

Re-seeing and Re-shaping can help educators and organizations:

- Tailor programs and opportunities to youth interests and goals in STEM
- Deepen their understanding of how their STEM field connects with their local community
- Challenge what counts as STEM expertise



Act



Re-seeing and Re-shaping matter. Adults can help create new opportunities to expand youth learning and development. These opportunities should position youth as experts by inviting others to engage in youth experiences, social connections, and visions for the future.

Visit yestem.org for more information and resources from our international research effort.

Spotlight on practice: “Mashup” (US)

Institution Level

There is a science center that provides a variety of informal science educational experiences for youth in the community, including public exhibits and specialized programs for school groups, parties and summer camp. In the same community, there is an afterschool club that provides a place for youth to socialize while doing homework, playing sports, creating artwork and science and engineering projects. The directors of these two institutions met and were discussing their institutions’ programs. These directors appreciated the opportunities provided for youth by each institution. Then they took this a step further and thought, **why not expand who has access to the STEM programs of the Science Center to youth at the Community Club?** This was how the “Mashup” program was born. The director of the Community Club made space for a STEM program every Friday afternoon and the Science Center director talked with her educators and decided one of their veteran educators would implement a Forensic Science program at the Community Club during this time. The two directors engaged in **Re-seeing** the ISL terrain **when they identified the opportunities their institutions were providing local youth and imagined a way to create connections that would expand these opportunities.** Rather than expecting youth to come to the Science Center, directors **reshaped the ISL terrain** by bringing part of the Science Center programming to the youth at their Community Center.

Educator and Youth Level

When the Science Center educator, Addison, came to the Community Center, she and the youth there also worked to Re-see and Re-shape the ISL terrain. One of the youth, Chloe, already knew Addison because her school participated in a Science Center Program. She had also joined the Science Center’s Youth Action Council (YAC) which was a group of youth and Science Center staff who met monthly to get youth perspectives on possible new maker projects for the Science Center and to redesign the makerspace at the Science Center. Another youth, Louise, asked Addison what YAC was and if it was free. Addison told Louise that not only was it free, but it came with a year membership to the Science Center for the youth and their family. When Louise left to go home, Addison said she hoped to see Louise the next day for YAC. Louise became a regular YAC member, attending the monthly meetings and participating in a project to redesign one of the Science Center rooms to center the lives and histories of people of Color. **Together, Addison and Louise identified opportunities available and Louise’s skills in making to jointly create a new connection between Louise and local ISL terrain (YAC).** By joining YAC, Louise reshaped ISL terrain through her very presence at YAC and through her participation in literally reshaping Science Center spaces to be purposefully youth-focused.



Spotlight on practice: Young people Re-shaping the science center (UK)

A science center started a year-long program for young people from a disadvantaged area of the city, who generally tend to be less likely to visit the center. The program combined school-based STEM club sessions and organized visits to the science center. While delivering activities outside the physical building is not uncommon for science centers, the specific program led to Re-shaping science centre's physical environment and ways of working.

The young people in the program were invited to share issues and topics that they would like to see featured in future science center exhibits. Through working closely with the science center staff, their ideas were developed into permanent exhibits, with the young people's input being explicitly recognized in the public space of the science center. In this way, the young people were able to directly Re-shape the ISL setting to better reflect the interests of young people.

Another part of this program included work experience, whereby the young people were matched with science center staff aligned with their interests and aspirations (young people's choices included working with technicians, web designers and facilitators).

Through young people's presence and regular interactions with staff across different science center departments, young people contributed to Re-shaping the practice at the science center that went beyond the specific activities they were involved in. One of the staff reflected that **"just having the young people in the building, walking around the staff area, in itself, had quite an impact"**, adding that **"there is now an even greater commitment to ensuring that young people's interests are represented throughout the work we do. The learning from that activity is forming the root of all our new activities with young people"**.



How to use this practice: Reflect

Reflection questions

1. What organizations, people, resources, and opportunities exist in your field/community? What assets/tools do youth bring to STEM?
2. How do you support youth in building on their assets/tools to connect with relevant organizations, people, resources, and opportunities?
3. What obstacles could be addressed to support Re-seeing and Re-shaping more broadly at your institution? Who would need to be invited to those planning/ reflection sessions?

How to use this practice: Act

Things to do

1. Build caring and trusting relationships with youth

Building relationships is fundamental to Re-seeing and Re-shaping. Pay attention to youths' ideas, actions, and choices. Try to understand and identify their needs, expertise, and vision. One way to start could be giving a quick survey at the beginning of your program such as questions about youths' interests and goals or more specific questions about what youth are interested in or want to accomplish related to your institution's goals and resources. **Make notes of youths' interests and connections you see to resources, people, programs you're familiar with. Integrate these connections into your program or share with specific youth individually.** This can help educators identify and understand the assets and tools youth bring to STEM, and make visible connections to people, resources, and opportunities that would be most beneficial for youth.

2. Organize information of various opportunities and make accessible to youth

Pay attention to and note possible learning opportunities that can be shared with youth. Put together a set of programs, resources, people, and opportunities available in your institution to which you can connect youth. This way, as interests and goals related to these come up, you have relevant information easily accessible (e.g., in the form of pamphlets, flyers, a website, a connections corner where educator and/or youth post interesting

opportunities and resources). Consider integrating Re-seeing and Re-shaping opportunities into your program (e.g., field trip, inviting/visiting experts, inviting/visiting community members, showcasing artifacts of other people, connecting school activities).

3. Make space for youth to share their resources

Youth bring knowledge, expertise, and social connections into the STEM learning space. Offer opportunities for youth to mentor and share these resources with one another (e.g., showcase youth-created artifacts, ask youth to invite parents/ other relatives as guest speakers, invite youth to share learning opportunities with friends).

4. Make space for youth to Re-see and Re-shape

Listen to youths' ideas of what connections they want to make and how. Help youth identify what they'd like to do as the next step and what kind of access to resources, experiences, or people would be helpful. Note where these resources, experiences, or people exist and how they might be brought into the learning space (physically or virtually). Decide who should work toward accessing these resources (i.e., should the educator use their connections to arrange to bring in materials or invite guests to the space? Should youth make a phone call or write a letter requesting access themselves?)

Additional tools and resources

Try out some “Talk Moves”

Talk moves can be helpful daily-habit tools for verbal reminders of Re-seeing and Re-shaping practice.

Asking youth to express their interests, goals, expertise

- “What is your name?”
- “What do you like to do?”
- “What is something you do really well?”
- “What do you want to do or be in the future?”
- “Let’s brainstorm to whom you want to showcase your projects.”

Recognizing what youth are into at the moment

- “Do you like []? You might try [].”

Including an explanation as to how the new activity/event/program is related to the young person’s current interest

- “It seems like you like programming. Did you know our science center offers programming camp in the summer?”

Educators keeping in touch with youth even after their program is completed

- “If you need help and this is really what you want to do, here’s my card”
- “Talk to your parents and please let me know whether you can meet the engineers.”

Ways to elicit and recognize youth bids for Re-seeing and Re-shaping

- Youth offer verbal cues for educators to leverage upon as to identify and navigate what and how to Re-shape.
- You may use exit surveys to elicit youths’ ideas for Re-seeing the assets/tools and interests they bring to STEM.

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- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
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Guide to Youth Bids

Re-seeing and Re-shaping is the practice of making visible the informal STEM learning *terrain*—the institutions, people, resources, and opportunities that host and structure youth engagement in ISL — as they currently exist, while simultaneously noticing the rich assets youth bring for re-shaping the terrain in powerful ways.

What are youth bids? Youth take actions to prompt and seek attention from educators and peers. When youth make a re-seeing and re-shaping bid, they seek to share their knowledge, expertise, and perspectives.

This guide provides:

- One example of how to enact the Core Equitable Practice (CEP) of Re-seeing and Re-shaping, as described in the Re-seeing and Re-shaping Insights 2.2 document.
- Examples of how youth may seek to re-see and re-shape, drawing on our partner educators' implementation of informal STEM programs.
- Ways to notice these bids and readily respond to them in ways that value youth for who they are and what they bring to the learning environment.

Questions for Group Discussion

- How have youth had **opportunities to re-see and re-shape** in my/our program because of who they are, what they have experienced and/or what they know? How have youth been **denied such opportunities**?
- How have I/we **responded to such bids**? Which **new learning outcomes**, if any, emerged from my/our response to bids for re-seeing and re-shaping?

Things to Keep In Mind

- Youth bids can require multiple responses at once. For example, youth bids to re-see and re-shape the terrain of ISL (informal STEM learning) can also require the core equitable practice of reclaiming.
- This tool can be used alongside the Equity Compass tool to enhance discussions on youth bid goals and outcomes.

Why do youth make bids? Youth often actively seek to do the following:

- To **disrupt** the ways in which everyday knowledge and practice of STEM and schooling position students as deficient, or without power and authority.
- To **amplify** their already-present brilliant and agentic acts of everyday knowing and practice and to have their transformative potential made visible.
- To be **rightfully present** and legitimately belong as fully human in ISL.

Examples of Youth Bids

Disrupting: Youths disrupting the host-guest binary

After a youth action council meeting for co-designing a new conference room in his city's science center, when Trey's family arrived to pick him up, **Trey urged them to follow him and gave them a tour** of the new room he participated in redesigning.

Along the way, **he acted as a docent, disrupting the implicit norm positioning him just as a welcomed guest** to the science center. He explained the rooms, exhibits, and programs of the Science Center. When they arrived, he shared the story of naming the room and the future design plans. He refined his vision of the room by discussing with his family members how he wanted to celebrate community members' lives with STEM on the walls, ceiling, window, and signage.

Bid: Presenting a new shift in roles

Response: Noticing the bid and allowing it to happen uninterrupted

Re-seeing and Re-shaping: Youth try out and embody new roles in STEM spaces

Amplifying: Wanting to continue working on design ideas across ISL spaces

Community center STEM club youth member Lulu was introduced by her educators to a youth action council (YAC) meeting at a science center. In the meeting, members participated in co-designing a new conference room. At her community center STEM club later that week, **Lulu continued working on the design idea** she had suggested in the YAC meeting. She shared with her peers what she experienced during YAC and what and how she wanted to complete her co-design work for the next YAC meeting.

Maria, the community center educator who also worked with the science center YAC, **recognized** how Lulu wanted to continue building connections across the science center and the community center. Maria **provided Lulu with space and materials** at the community center so that she could prototype her YAC design ideas into drawings and building models.

Bid: Seeking to move expertise and materials across spaces

Response: Noticing bid, supporting youth desire for stronger connections

Re-seeing and Re-shaping: Youth develops expertise across spaces

Rightfully Present: Wanting to navigate and expand opportunities to learn across different programs

Steffany, an educator in charge of facilitating a volunteering club, **visited the community STEM club** room to announce the start of the volunteering club's meeting for the next hour in the room next door. **Michelangelo asked Steffany if he could join** in their volunteering group.

Steffany recognized this as a bid to be welcomed but not necessarily a commitment. So she **publicly welcomed his idea** but suggested that he could ask peers what the leadership group was like, what members do and were responsible for, what types of volunteering happened there, and how many days and for how long they were required to meet. Once he had done this, **he could decide if he wanted to join them and then find her to share his decision**. Instead of pushing him to make every connection possible, she encouraged Michaelangelo to explore what groups matched his interests, **assuring him that she would support him either way**.

Bid: Asking for a program invitation

Response: Offering a welcome to join while encouraging youth to learn more before committing

Re-seeing and Re-shaping: With unconditional support offered, youth can choose to accept invites or not without pressure

Reflecting:

- Which example of youth bids resonates with your experience?
- Share and add youth bids for re-seeing and re-shaping that you have experienced.
- How might you respond to re-see and re-shape in your space?

Guide to Talk Moves

Re-seeing and Re-shaping is about making visible the informal STEM learning *terrain*—the institutions, people, resources, and opportunities that host and structure youth engagement in ISL — as they currently exist, while simultaneously noticing the rich assets youth bring for re-shaping the terrain in powerful ways.

What are talk moves? Talk moves are the pedagogical moves that educators make to facilitate and scaffold engagement in ISL among youth without being the one doing all the talking or decision-making.

This guide highlights pedagogical moves to create and sustain an equitable learning community. It serves as one example of how to enact the Core Equitable Practice (CEP) of Re-seeing and Re-shaping as described in the Re-seeing and Re-shaping Insights 2.2 document.

Questions for Group Discussions

- How have I/we sought to re-see and re-shape with youth in my/our program -- drawing from who youth are and what they bring -- their feelings, ideas, histories, hopes and fears?
- Have I/we been successful in re-seeing and re-shaping practices with some youth more than others?
- What makes me/us uncomfortable with re-seeing and re-shaping in STEM spaces? Why?
- From my/our own experience, what talk moves have I/we used or experienced to re-see and re-shape with youth?
- What are some ways re-seeing and re-shaping talk moves might be combined with other practices (e.g., co-designing)?
- What talk moves have I/we already used? Which do I/we want to add? Which ones will be the most impactful to support re-seeing and re-shaping? Which will be difficult?
- In the most recent lesson taught, how could I/we integrate these talk moves to transform who/what matters in STEM?

Things to Keep in Mind

This tool has been designed with partner educators. Themes include learning about youth interests, soliciting youth as opportunity brokers, and sustaining relationships.

Some talk moves can work for multiple practices. For example, questions to recognize youth may also work to critically be with youth

This tool can be used alongside the Equity Compass tool to enhance discussions on talk move goals and outcomes.

Some of these talk moves may look like ones you are used to seeing, such as revoicing. However, **we call attention to when and how these moves are used to unsettle what/who matters in STEM and what expertise is and can look like.**

Examples of Talk Moves

Eliciting youth goals, interests, and experiences (Youth create connections to interests)	Checking with youth about their interests	You seem like you're really enjoying [activity]. Is my impression correct?
	Asking youth to express their interests, goals, expertise	Let's get to know each other better! Let's take turns sharing what I really love to do, what I do well, and what I want to do in the future. What kind of activities do you want to do next week? Let's brainstorm who you'd want to see your presentation.
Suggesting connections based on youth interests, experiences, and goals (Offering connections to future opportunities in and out of institutions)	Encourage youth to be the brokers	The program will be open to 9th-12th graders. Do you have siblings or friends who might be interested? You can take this flyer and share it.
	Informing of upcoming opportunities to participate in programs and events	We start our new program next week. You may enjoy the new one as it is related to what we do here. You can google [topic youth expressed interest in]. The website shows other similar events near you. We will take a fieldtrip to [location]. Please, fill in the form if you are interested. We can take a fieldtrip. Where would you like to go?
	Noticing Youth Interests and Offering Connections	Do you like [topic/activity]? (If youth say yes): Would you like to know about other programs related to that topic? (e.g., Did you know our science center offers programming camp in the summer?)
	Engaging parents and guardians in supporting youths' connections to STEM activities and resources	You (the parent(s) or guardian(s)) may already know how much [their child] loves doing [topic/activity]. She was so focused on it today! I think she might really enjoy the [related event] this weekend.
Sustaining relationships to continue Re-seeing and Re-shaping (Educators keep in touch with youth to offer continued terrain support)	Following up on previously suggested connections	"Is there a book you are reading right now? May I ask what it is about?" (Or insert any activity youth enjoy.) How was the program (the educator had suggested)? Was there anything interesting or useful to you?
	Supporting Youth in Following Through on Connections (logistics)	Have you talked with your parents/guardians about the event? Talk to them and please let me know whether you can meet the visiting engineers next week. If this is really what you want to do in the future, but next week doesn't work, tell your parent/guardian to text me and we might be able to figure out another time or way to meet them. If you want to go to the program, do you have a ride? ...Here are dates you can choose. When works the best? ...I checked that the program would be free (or cost).

EXIT PASS

Help us learn about how your day went!
You don't need to write your name.

<p>I felt other people cared about my ideas and work today.</p> <p>YES</p> <p>NO</p> <p>WHO CARED?</p> <p>HOW DID THEY SHOW THEY CARED?</p>	<p>Today, I shared with others what I know from my own life.</p> <p>YES</p> <p>NO</p> <p>WHAT?</p>
<p>People who cared about my ideas introduced me to other learning opportunities (Circle all that apply):</p> <p>PROGRAMS OR EVENTS:</p> <p>PEOPLE OR PLACES:</p> <p>OTHER RESOURCES:</p>	<p>From what I did today, I have an idea about what I want to do next time!</p> <p>YES</p> <p>NO</p> <p>WHAT?</p>



Co-designing



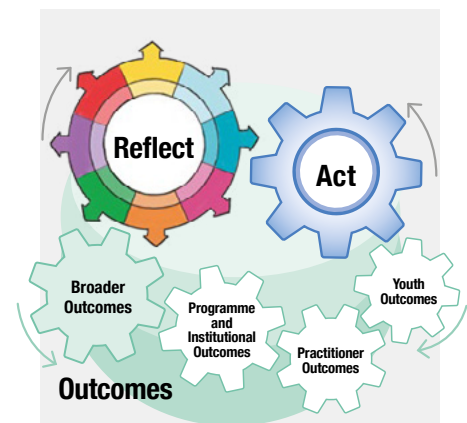
Co-designing



YESTEM Insight #2.3

What is the issue?

- Informal STEM learning (ISL) spaces are characterised by many different sorts of activity, including hands-on workshops, events and exhibits. Routinely, ISL activities and spaces are designed, created, and managed by adults, while young people are typically seen as users and consumers of ISL, or as an audience that is catered to. Often, young people’s views on ISL are restricted to evaluations and feedback on the activities, rather than young people being actively involved in shaping the ISL spaces and activities.
- As a result, **many ISL spaces tend to reflect the needs, values, and practices of privileged adults, rather than providing opportunities for young people to engage with STEM in ways that make sense to them.**
- Co-designing is a practice that seeks to disrupt this status quo by advocating ISL design *with* and not just *for* young people. Co-designing is one way that youth can contribute to Reclaiming STEM (see YESTEM Insight 2.4: Reclaiming). From an equity perspective, this practice can support engagement with STEM among young people from underserved communities who have historically been excluded.



YESTEM Model for equity in ISL

Please see yestem.org for the full model and related Insight documents detailing each component.

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yestem.org



What is the practice?

This Insight provides examples of how ISL practitioners can use the practice of Co-designing to support equitable participation through a range of means, including youth panels/boards, focus groups, design teams, and also project and research teams. Creating opportunities and spaces for young people to enact their agency in the Co-design experience has the potential to transform taken-for-granted practices in ISL but, as the spotlights show, genuinely **Co-designing with young people has to be adapted to context.**

Co-designing orientated towards social justice can disrupt the dominant power relations (e.g., those based on whiteness, masculinity, etc.) and supports more equitable forms of power-sharing between young people and adults.

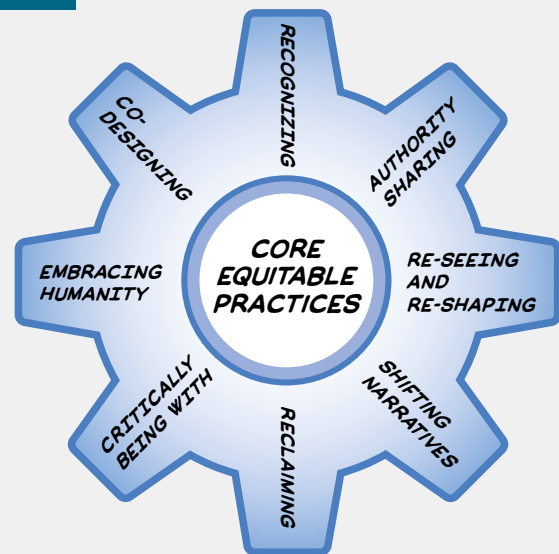
Organisational cultures are the cumulative effect of beliefs, values and actions that are often produced through unequal power relations. Within any ISL setting, the organisational culture shapes possibilities for how different young people might feel and behave and will facilitate or limit their agency. Embedding the practice of Co-designing into an organisational culture can help scaffold the engagement of young people, particularly those from communities who have been historically marginalised within STEM.

Co-designing can recognise young people's interests, experiences and contexts, and provide opportunities for them to play an active role in shaping their ISL experience. This requires ongoing commitment from practitioners to **recognise, challenge and change socially unjust practice.** (see YESTEM Insight 1: The Equity Compass: A tool for supporting socially just practice).

Co-designing provides young people a visible and valued presence in the ISL environment, supporting young people's agency and publicly respecting and recognising what they bring to the setting. Critically, this means working with young people on an **ongoing basis** to enable them to shape an ISL organisation's goals, processes, activities, programmes, projects, and accountability structures.

Co-designing draws on a myriad of inter-related practices (please see the section on Additional tools and resources).

Act



The practice of Co-design is about sustainable and non-hierarchical ways of working with young people individually, in groups and through youth representative to collaboratively create experiences, artefacts, spaces, processes and desired outcomes.

Visit yestem.org for more information and resources from our international research effort.



Spotlight on practice: Adapting Co-designing to context (UK)

In a community-based digital arts centre the staff demonstrated an on-going commitment to seeking young people's opinions and input as they designed new hands-on workshops, events, projects and spaces. Erin, one of the ISL team leaders, said she saw the value of setting up a youth board with dedicated time to work *with* young people on specific tasks but at first did not see how it would work in their setting. The team went on to adapt the idea of a youth board for their setting by Co-designing their youth board with young people.

Initially the dedicated youth board time was treated as a 'learning experience' for both adults and the young people. At these sessions the young people were invited to become advocates and ambassadors empowering them to be representatives and tasking them with enthusing and drawing in other young people. The young people were **given ownership of gathering ideas for activities, events, workshops, projects and the design of ISL spaces**. Erin explained that the young people were familiar with using an interactive board to share ideas and a tactile voting device to make decisions. In this device different coloured balls are used by young people to cast their votes. This fun and engaging approach valued young people as partners in generating ideas and making decisions. As Erin said, this was a stepping stone to enabling young people to opt into joining special interest project groups.

Erin described the genesis of one of the workshops. "So we did one about what issues you care about in [city] with the options like 'Climate Change', 'Arts and Culture', and 'Politics'. There was a real interest around climate change, so we did a workshop on climate change the following week." In another example young people were valued for their experience and ideas about their own needs where a group of young people opted to co-design what activities would be offered at the centre and contribute their design for the planner leaflet (see the photo on the right for some of the young people's images). Erin said "We've also had our leaflets done; you can see all of their designs on the front. As soon as they saw that, and they walked through the building they immediately saw that they had ownership over their programme." This momentum has come from the adapting the youth board concept as a vehicle for valuing young people's interests, knowledge and choices.

By adapting the idea of a youth board to an ISL setting, the centre has avoided the 'box-ticking', token exercise (consulting but not acting). Instead, we can see that young people's authentic decision-making power arcs towards equitable outcomes for young people, including voice and agency, being heard, being recognised, feeling appreciated and purposeful, having ownership and a sense of belonging, as well as gaining new skills. The practitioners were taken by surprise by some of the young people's ideas. The young people asked for a cinema club and wanted responsibility for running this; they asked for a homework club and help with maths. Erin told us "**The young people have started back this week, they've already come in asking: When are we having our next meeting?**"

This is an example of equitable practice because in adapting youth board ideas to the community-based digital arts centre, young people's agency is being nurtured both within the experience and beyond the moment in organisational change.



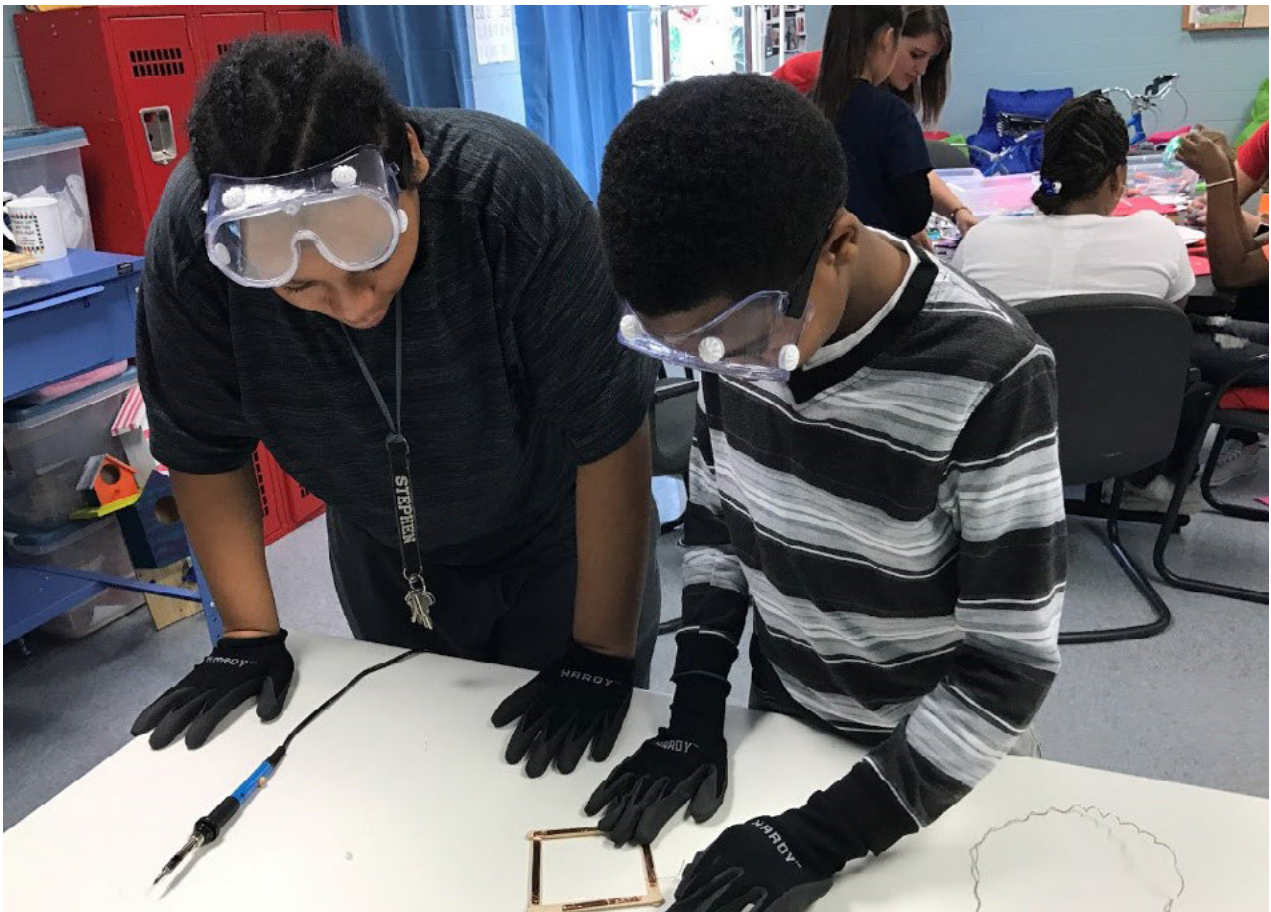
Spotlight on practice: Electric Art Community Workshop (US)

On a chilly October evening in Great Lakes City, sixteen youth welcomed over one hundred visitors to the first ever Electric Art & Green Energy Maker Workshop that took place in a Community Club makerspace. The youth transformed their own makerspace and an adjacent room into where visitors of all ages, from children as young as six years old to parents, could create their own electric art. In the rooms decorated with the youths' electric projects, visitors were able to make light-up artifacts (e.g., bracelets, wristbands, mini-bulletin boards, canvas art, and card-designs) powered by traditional and renewable energy sources. In some activities, visitors were able to learn about energy, circuitry and making (e.g., using multimeters, soldering, solar panels, and power tools). In one corner, visitors could experience a bicycle renovated to power their smartphones. In addition, the youth made “snack zones” and “chill zones,” where visitors could enjoy music, food, and electric-art games designed by the youth, especially if their maker projects became “frustrating” or they “needed to blow off steam.”

How youth and educators Co-designed the workshop

This workshop was an outcome of Co-designing practice the sixteen youth and their makerspace educators enacted over the course of four weeks, across 12 sessions (three afternoons per week). As one of the ISL educators, Maria, explained,

The youth in our program kept saying how much they wanted their friends and families to have the chance to make things with electric art like they did. This gave us the idea that we should co-design what those experiences could be. It would not have been the same if we, adults, did the planning, as the youth are the experts on what they want for their families and friends. They are experts on how and why electric art matters in their lives.



Responding to and resonating with the youths' hope and desire, educators and youth Co-designed the workshop in ways that directly linked to the youths' community. Their Co-designing was enacted in multiple interconnected phases:

1. Establishing the purpose and expected outcomes of the workshop:

They conceived a workshop that would offer opportunities, tools, and resources for visitors to make things to take home, do something with, or convey serious messages juxtaposed with playfulness. One of the main goals of the workshop was, in one youth's words, to help other youth "feel accomplished" because of "what you learned, how you worked on it, and how others saw it and what it meant to them."

2. Educating one another on the STEM knowledge and practice needed for Co-designing the workshop:

Youth educated and learned with and from one another knowledge that helped explain how to build and power different electric circuits with different energy sources. This was critical to further planning the workshop.

3. Prototyping artifacts and activities for the workshop:

Youth brainstormed and tested out different ideas for designing electronic-circuit artifacts that might be of interest to the visitors from the youths' community. They also helped each other learn how to solder, use multimeters, and trouble-shoot problem circuits.

4. Examining the utility and values of the prototyped workshop activities and artifacts:

Youth continuously examined what activities would be most interesting to the visitors, what approaches would lead to durable and usable products, and what technical knowledge and challenges they needed to figure out to help visitors.

5. Designing the spatial organisation of the workshop:

To help visitors navigate the activities, they organised the workshop rooms to have different making stations, exhibit areas, and refreshments areas. They decorated and put signages showing where different activities would take place. They also created a green-energy corner where a bicycle they hacked was available to power smartphones.

Through Co-designing and holding the workshop, the youth centred on local community assets and potentialities. It was not enough for the youth to simply offer an enjoyable experience with an artifact for one to take home. In the Co-design the youth sought to ensure that the ideas and practices brought to the workshops by the visitors and their peers became a part of their efforts to deepen and extend their STEM knowledge and practice. STEM-rich making had to involve more than, as Jazmyn explained, "science mumbo-jumbo."



How to use this practice: Reflect & Act

The table below sets out five Co-designing practice areas with guiding questions for reflection and action. The **first three areas** (review, critique and adapt) are there to prompt generative envisioning of Co-designing ‘with’ young people and working with youth to adapt Co-designing practice to a specific ISL programme and/or setting. The **fourth area** (visible and present) suggests some guiding questions specific to Co-designing of ISL spaces and artifacts ‘with’ young people. The **fifth area** is about building partnerships with young people. Youth boards are one way of enacting co-design but this can be complicated. The guiding questions for reflection and action signpost some of the complexities that require ongoing negotiations, sensitivity, creativity and sometimes workaround and compromise.

In YESTEM research we observed examples of some *pitfalls* which can stall socially just Co-designing practice. In addition, as well as the examples in the ‘Spotlight’ section, we also observed how ISL practitioners embraced *opportunities* for Co-designing with young people. Some of *pitfalls to watch out for* and *things to consider* are included as comments in each of the five areas of Co-designing practice.

Focus area	Guiding questions for reflection and action, with comments on potential pitfalls (what to watch out for) and examples, things to consider and why	
<p>Reviewing and critiquing the current state/ status of how youth voices are integral to ISL design practice.</p>	<p>Reflect</p> <ul style="list-style-type: none"> • What and when are we currently co-designing with young people? • Where and how do young people have ownership of ideas and a say in the decision making? • How central is co-designing practice to the culture of our organisation? 	<p>Act</p> <ul style="list-style-type: none"> • Where and when can we share/critique our experience of co-designing practice with each other? • How do we find out what young people say about our co-designing practice? Do they think co-designing is being done ‘to’, ‘for’ or ‘with’ them?
<p>Watch out for co-designing practice being conflated with good relations with youth, or blanket claims of “We are doing it already”, and/or aspirational vision statements about consulting the public. Social justice orientated practitioners argue that co-designing practice that supports the development of youth identity and agency must be recognised as continually work in progress ‘with’ young people and therefore policy and practice should be reviewed regularly.</p>		
<p>Developing new critical understandings of and possibilities for organisational culture of co-design.</p>	<p>Reflect</p> <ul style="list-style-type: none"> • Critically reflect on current practice by applying the YESTEM Insight 1: Equity Compass: A tools for supporting social justice practice. • Using your compass map as a lens - what is new and critical in your understanding of equitable socially just co-design practice? How does this compare to the current organisational culture of co-design? • What do young people say about the culture of co-designing in your ISL organisation? 	<p>Act</p> <ul style="list-style-type: none"> • How can we run joint ISL practitioner and youth working groups to build on our collective experience, knowledge and skills and act on our new and critical understanding of co-design practice? • How can we support young people to engage with co-designing with us on an ongoing basis? • What resources will be needed to build and sustain a vibrant culture of co-designing with young people? • What does <i>ineffective</i> forms of co-design practice look like?
<p>Watch out for <i>tokenistic</i> claims of co-designing, which come from corporate rhetoric of consulting the public, while in practice, power relations remain hierarchical and youth input has no ‘weight’. <i>Weak forms</i> of co-design include scenarios where co-design practice sits outside the structure of the organisation and where there is no reporting or accountability. <i>Short-term</i> co-design projects are initiatives without a legacy plan. <i>Short circuited</i> co-design projects put effort into engaging young people but there is no follow-through into action.</p>		

Focus area	Guiding questions for reflection and action, with comments on potential pitfalls (what to watch out for) and examples, things to consider and why	
<p>Adapting co-designing practice to the specific context of ISL setting.</p>	<p>Reflect</p> <ul style="list-style-type: none"> • What co-designing practice can be adapted to your specific ISL context? (See spotlights). • How will the envisaged co-design practice recognise and disrupt systems and processes that block more equitable forms of power-sharing between young people and adults? • Discuss possible starting points (see examples below) and how they can be adapted to your specific ISL setting. 	<p>Act</p> <ul style="list-style-type: none"> • How will young people and ISL practitioners share ownership of planning specific co-designing practice? • When and where will young people voice their interests and needs and have an integral role in the design of activities and events that act on their ideas? (See spotlight). • How will organisational processes follow through in a timely way and ensure that ongoing co-designing with young people is sustainable?
<p>For example, consider adapting/combining/reinventing any of the following: youth consultation panels, youth boards, youth representation on management committees, youth led focus groups, youth focused design teams, youth-led special interest projects, youth design and lead events and youth researching their own experiences and interests.</p>		
<p>Visible and present by co-designing physical spaces and objects.</p>	<p>Reflect</p> <ul style="list-style-type: none"> • Who designs the physical and virtual spaces; and the activities and events that take place? • How equitable is the allocation of space and resources? • When and where do young people have a say in the design process? • How are the young people's contributions recognised? • What happens to artifacts that are created by young people? • Where is there provision for continuity and leveraging of past co-designing activity? 	<p>Act</p> <ul style="list-style-type: none"> • How do we find out if young people feel an ownership of the different spaces and artifacts? • Where, when and how will there be recognition of young people's input and expertise in redesigning spaces and creating artifacts? • How can spaces/objects created by young people be given a sense of permanence (e.g., beyond the programme where they were created)? • Are the spaces/objects integrated 'as is', without being appropriated by organisational branding?
<p>Thing to consider. The diversity of ISL settings means that co-designing practice is open to interpretive imagination. For example, in a large Science Centre young people were given a research role and worked with professional installation designers to make exhibits. Evidence of their influence on the final design was exhibited alongside the installation (e.g., workshop photographs). In a zoo ISL setting young people redesigned the signage which was then permanently installed. In this case, the young people's work was recognised in that they were given passes to invite family and friends to the launch event.</p>		

Focus area	Guiding questions for reflection and action, with comments on potential pitfalls (what to watch out for) and examples, things to consider and why	
<p>Youth Board a vehicle for co-designing sustainable partnerships with young people.</p>	<p>Reflect</p> <ul style="list-style-type: none"> • What will recruitment process look and feel like to young people? Consider formal vs. informal, virtual vs. in-person. Consider creative/open approaches like videos and mixed media. • What issues will impact on equitable recruitment e.g., fair inclusion of geographical, social, ethnic, class, language, disability, and age range representation? • What are the considerations in enabling all youth can participate? For example, after discussion anonymised voting on the name of the group ('what do you want to call yourselves') and on projects and action priorities. • What is involved in co-creating code of conduct, negotiating frequency of meetings, timings, and actions in between meetings? How is this same/different to adult responsibility for basics of health and safety, data protection, safeguarding, and legal compliance? • In the organisational structure - what will be the role of the youth representative(s) e.g., appointed to trustees and/or senior managers? Discuss the complications e.g., the connection to existing structures can be empowering but is also reproducing the status quo and is difficult to sustain in smaller ISL settings. • What are the considerations for valuing and recognising youth involvement? For example, with titles, pay, incentives and crediting. In principle young people's contribution should be visible with a share of organisations marketing and publicity but care is needed to act on data protection regulations. 	<p>Act</p> <ul style="list-style-type: none"> • Design the recruitment approach and evaluate the plan to address equity of physical and digital access. • Design processes to ensuring an equitable and balanced youth council. Include transparent decision-making processes where some categories exclude others; and transparent prioritising to address limitations of resources. • Make provisions for paying for attendance, travel, food and time but give due consideration to scheduling times, transportation, chaperoning and safety and security generally. • Ensure that in meetings/workshops all youth have a voice so that no one dominates. • Support the board to be effective and productive. Ensure age and setting appropriate clarity around collective responsibility, young people's responsibility and adult responsibility of equitable 'duty of care'. • Build consensus on where in the organisation the youth board can exercise power and have 'teeth' (influence on the organisation). • How can our ISL setting get the most out of having youth representatives? In some cases there maybe the possibility for youth representatives to receive outputs directly with mandates to act, respond and engage, with an allocated budget (where appropriate and possible) and be given fundraising powers. • Appoint a youth representative champion in a leadership role with ownership and responsibility for stable resourcing, monitoring of socially just practice, and ensuring visibility in policy and practice of young people's contribution.
<p>Things to consider. The ISL practitioner with an equity/social justice mindset has a key role to play in allowing and embracing innovative co-designing practice. What was evident from YESTEM fieldwork in diverse ISL settings in the UK and US is that engaging 'with' young people on a power sharing bases generates a new energy and momentum so that the dynamics of adult/youth collaboration are mutually recognised as "the obvious way to go". (See UK and US spotlights).</p>		

Additional tools and resources

This Insight has focused on Co-designing practice as opportunities for ISL practitioners to disrupt and transform the status quo by nurturing power sharing between young people and adults. Co-designing depends on other inter-related practices. The additional resources explore these.

- Finding ways to position young people as experts on youth experiences, their own social connections, and their passions and dreams for the future (see [YESTEM Insight 2.2: Re-seeing and Re-shaping](#)).
- Working with young people to understand how ISL spaces can feel exclusive or uninviting. Focusing on experiences of young people and their needs and desires can help to ensure that the ISL experiences, spaces, as well as tangible material and digital design and creation of things, can productively serve all youth (see [YESTEM Insight 2.4: Reclaiming](#)).
- Valuing and amplifying young people's experiences as integral to their engagement in STEM. This practice can shift dominant constructions of under-served youth as not "science-y" or not active in informal STEM learning (see [YESTEM Insight 2.5: Shifting Narratives](#)).
- Finding ways to empower young people by tapping differences in young people's experiences and the complex context of their lives (see [YESTEM Insight 2.6: Critically Being With](#)).

About our project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people.

For the full range of Insights documents summarizing the project's tools and resources, including Core Equitable Practices and Equitable Youth Outcomes Model, please see yestem.org

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Disclaimer

Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of NSF, Wellcome, or ESRC.

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Examples of Youth Bids

Disrupting: Demanding a space to explore learning in youth-centered ways

Maria noticed that William was frustrated. **He was ripping off the switch he had sewn** onto a felt spaceship bookmark he made. An LED light was going to be the spaceship’s “fire,” the conductive thread its flight path, and the battery/battery holder/switch the “Earth.” Maria thought William was frustrated by the sewing -- it was new to him. **She asked him what was wrong**, and he said the bookmark was “stupid” and he did not want to make it. Maria suggested he could make something else, and had shown him a phone carrier (like a small purse) she had made as an example, and he said, **“I’d rather make a fanny pack.”**

So **Maria sat down with William and helped him sketch** out what a fanny pack could look like using the materials they had available.

Bid: Asking to change the focal activity

Response: Noticing asking questions, and supporting shifts in activity

Co-designing: Youth and educator work together for more meaningful projects

Amplifying: Presenting youth-authored ideas to be heard, shared, and followed

Team leader Erin said she first only saw value in a youth leadership boards/councils as a “learning experience.” **Youth gathered ideas for activities and projects using an interactive board to share ideas and a tactile group voting device to make decisions.** Erin described these tools as a stepping stone to more frequently position youth in leadership roles.

Eventually, the stepping stones turned into real shared action. For example, **“There was a real interest around climate change, so we did a workshop on climate change the following week.”** Youth continued to co-design center activities and **contribute their design for the planner leaflet** (see the photo on the right for some of the young people’s images). Erin said “We’ve also had our leaflets done; you can see all of their designs on the front. As soon as they saw that, and they walked through the building they immediately saw that they had ownership over their program.”

Bid: Sharing past experiences and interests

Response: Noticing bid and adjusting workshop and including youth designs in materials

Co-designing: Activities and materials shaped by youth and adults

Rightfully Present: Brainstorming events and spaces to lead others, both peers and adults

Educator Maria shared, **“Youth in our program kept saying how much they wanted their friends and families to have the chance to make things with electric art like they did. This gave us the idea that we should co-design what those experiences could be.** It would not have been the same if adults did the planning, as the youth are the experts on how they want electric art to matter in their lives.”

After four weeks (12 sessions) of **co-designing among 16 youth and makerspace educators**, over 100 people joined their workshop. Youth transformed their makerspace and an adjacent room into spaces where visitors of all ages could create their own electric art. In rooms decorated with ongoing electric projects, visitors made light-up wristbands and canvas art. Youth also led lessons on energy, circuitry, and making (e.g., using multimeters, soldering, solar panels, and power tools). In one corner, visitors rode a bicycle renovated to power their smartphone. **Youth also designed “snack zones” and “chill zones,”** where visitors could enjoy music, food, and electric-art games, especially if their maker projects became “frustrating” or they “needed to blow off steam.”

Bid: Stating the importance of friends and family experiencing STEM maker activities

Response: Listening and working with youth to realize their vision of STEM

Co-designing: Creating an event together to include family and friends in STEM

Reflecting:

- Which example of youth bids resonates with your experience?
- Share and add youth bids for co-designing that you have experienced.
- How might you respond to co-design materials, activities, and spaces with youth in your program?

Guide to Talk Moves

Co-designing involves supporting youth by working with them in sustainable and non-hierarchical ways individually, in groups and through youth representatives to collaboratively create experiences, artefacts, spaces, processes and desired outcomes.

What are talk moves? Talk moves are the pedagogical moves that educators make to facilitate and scaffold engagement in ISL among youth without being the one doing all the talking or decision-making.

This guide highlights pedagogical moves to create an equitable learning community through co-designing with youth. This guide serves as one example of how to enact the Core Equitable Practice (CEP) of Co-designing, as described in the Co-designing Insights 2.3 document.

Questions for Group Discussions

- How have youth had opportunities to co-design in my/our program because of who they are, what they have experienced and/or what they know? How have youth been denied those opportunities?
- Have some youth been granted opportunities to co-design because of who they are and how their experiences and cultural knowledge may more clearly map onto STEM?
- What makes me/us uncomfortable with youth-adult co-design of spaces and programs? Why?
- From my/our own experience, what talk moves have I/we used or experienced to support youth co-design practices?
- What are some ways co-design talk moves might be combined with other practices in ISL (e.g., authority sharing)?
- What talk moves have I/we already used? Which do I/we want to add? Which ones will be the most impactful to support co-designing with youth? Which will be difficult?
- In the most recent lesson taught, how could I/we integrate these talk moves to transform who/what matters in STEM?

Things to Keep in Mind

This tool has been designed with partner educators. Themes include reviewing and critiquing, representing, and making youth presence visible.

Some talk moves can work for multiple practices. For example, questions to co-design with youth may also work to promote youth authority.

This tool can be used alongside the Equity Compass tool to enhance discussions on talk move goals and outcomes.

Some of these talk moves may look like ones you are used to seeing, such as voicing. However, **we call attention to when and how these moves are used to unsettle what/who matters in STEM and what expertise is and can look like.**

Examples of Talk Moves

Reviewing and critiquing with youth to develop new and critical organizational knowledge

Create spaces for youth to lead by eliciting youth ideas via wait time, think/pair/share, etc.

"What's missing in this space right now? **What would you change** to make this program more empowering and helpful for others?"

"What if you could re-design this whole robotics camp? Would you have different learning goals, or the same goals but different activities?"

Asking for and centering youth expertise

"Maddie, **can you share more** about that? **How would you lead** a light up lesson to help teach younger children about electricity?"

Verbally acknowledging no one knows everything and we're learning together

"You know yourselves, your desires, your dreams, and your ideas. **We need that expertise to make this program better.**"

Scaffolding youth ownership of design goals and in decision making

"Let's spend 10 more minutes discussing each other's sketches for the new tool corner. Then after lunch **we will get into small groups to combine ideas** into collaborative blueprints on poster paper."

Adapting co-design to specific contexts of the STEM learning space

"Because we only have 2 weeks for this unit, let's look at this list of activities and **let's decide what's doable** in that time frame."

Representing youth-adult co-design to adults in power

Prompting further participation to ensure representation

"What do others think about the ideas we have so far about how we might change this camp schedule to better support our work? **What would you add or change** to our list before we share it?"

Prompting youth to invite adults into their ways of being, knowing, seeing, and feeling the world

"How do you want visitors to feel when they enter this space?"

"What should the Board of Directors **learn about us and what we do** already in this program?"

Create space/time for co-designing practice to become central to organizational culture

"I want everyone's ideas represented in the staff meeting next week when the graphic designer's here, so **I'll copy all statements into this summary document.** Should I include names?"

Communicating to turn youth co-designs into Institutional reality

To supervisors: **"What needs to happen** by March to get this new program jumpstarted?" "Who needs to be CC'd on this email?"

Evidence of visibility and presence by co-designing physical spaces

Populating spaces with youth-chosen objects, youth-co-designed display features, and youth-created work artifacts

"Should we use this shelf to display work-in-progress or final prototypes? **What's our goal** for displaying works in progress here?"

To visitors: "Here's a postcard describing how youth leaders designed this room. Did you see the sign with all of their signatures?"

EXIT PASS

Help us learn about how your day went!
You don't need to write your name.

<p>My educator noticed and worked to understand my experiences or perspectives:</p> <p>YES</p> <p>NO</p>	<p>Who my experiences mattered to today (Circle all that apply):</p> <p>Teacher</p> <p>Peers</p> <p>Others (Who?)</p>
<p>My ideas mattered in class today:</p> <p>YES</p> <p>NO</p>	<p>I felt proud of my work today:</p> <p>YES</p> <p>NO</p>
<p>How my ideas mattered (Circle all that apply):</p> <p>My teacher used my idea(s)</p> <p>My peers used my idea(s)</p> <p>I used my idea(s)</p> <p>Other (How?) _____</p>	<p>I had a chance to work on something I wanted to today:</p> <p>YES</p> <p>NO</p> <p>What I worked on: _____</p>



Reclaiming



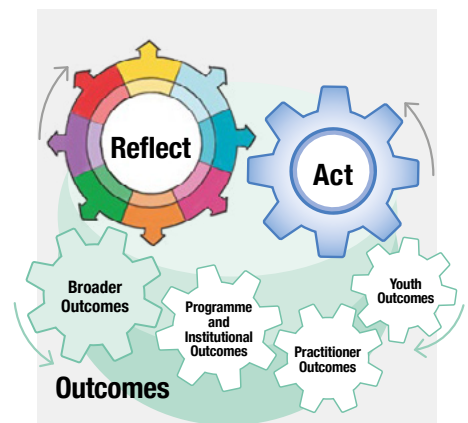
Reclaiming



YESTEM Insight #2.4

What is the issue?

- How young people see themselves in informal STEM learning (ISL) is related to the physical and material dimensions of their ISL experience (e.g., what materials are available, how a space is physically arranged, what artifacts hang on the wall, etc.). This is because how people relate with each other is shaped through what these physical and material dimensions reflect regarding whose knowledge matters and how people should interact.
- For example, the seating arrangements shape how people are able to relate to each other. Whose work is displayed, when and for what purposes reflects what is valued in a space.
- The challenge is that many ISL programs happen in spaces where young people’s lives and ways of being are not reflected in the physical or social design of ISL experiences.
- ISL spaces tend to be organized, socially and physically, around White and patriarchal narratives. For example, **whose images and stories make up a space, the tools and materials made available in a space, all send messages around who belongs.** It also shares broader constraining messages about what STEM is, who does STEM and what that looks like.



YESTEM Model for equity in ISL

Please see yestem.org for the full model and related Insight documents detailing each component.

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What is the practice?

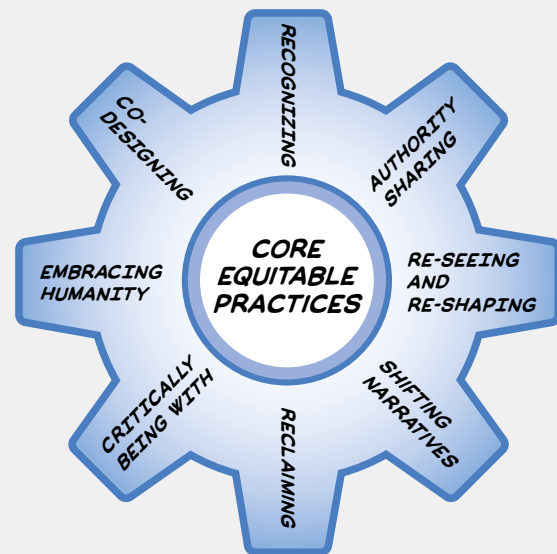
Reclaiming space and narratives works to restructure power relations and center **youth in shaping the social and physical spaces of STEM**. For example, Science Center staff worked with their Youth Action Council to investigate why their rooms were only named after men, and conducted research to rename their classrooms after women scientists of Color whom the youth admired, e.g., Katherine Johnson. This included changing signage (physical dimension), but also changing activities and images within those renamed rooms to reflect how each scientist inspired youth (social dimensions).

Programs open to Reclaiming space and narratives are more likely to meet youth needs and interests, by supporting youth ownership over the space and the learning within it. When youth share their imaginations for a space and educators support the realization of youth-reimagined spaces, youth can Reclaim ISL and STEM more broadly.

Reclaiming involves:

- Youth **'taking back' power** to claim who belongs in STEM or what it means to engage in science in their lives by shifting the allowable arrangements of materials and relationships in order to center youth lived lives and their pasts, presents and hoped-for futures with and in STEM.
- Educators recognizing and exposing what has maintained injustices, such as racism and classism, and then disrupting and transforming unjust visible and symbolic structures by critiquing and changing the space.

Act



The practice of Reclaiming involves working with youth to both identify how an ISL space may feel exclusive and modify the space to be more welcoming.

Visit yestem.org for more information and resources from our international research effort.



Spotlight on practice: Reclaiming through nameplates (US)

“Marble mazes are cool and kinda fun. I was having fun with all of the tools, and like try to make one. But I was thinking about what else I could do? Like, with all of the tools, and I saw this big piece of wood. We don’t have our own sign. I could make us a sign. . . I think when people see my sign they think ‘that’s cool. I want to do that too.’ It kinda **shows who we are and what we do.**”

Samuel, age 12.

“I think it was cool to see myself up there. It shows that you don’t need to be an accomplished adult. Like kids did that. We did that. Kids of color and girls and like all of the people who grew up in their science classes, they didn’t grow up seeing people like us. To have people see our names on the wall, on our nameplates, the projects we made, **permanently hanging on the wall.** That is inspiring!”

Ivy, age 12.

These quotes drew from a ‘nameplate’ project led by a Science Center’s Youth Action Council (YAC). During a YAC session in which youth were asked to build marble mazes, Samuel instead wanted to “make us a sign that shows who we are and what we do” in the Science Center. Inspired by Samuel’s use of STEM artifacts to make his life and community more visible, the YAC educators planned a ‘nameplate’ activity and supported every youth in making their own nameplate. They also displayed the youths’ nameplates on the makerspace wall, providing visitors with a visual reminder of the youths who helped make that space a reality. As Ivy notes, presenting the youth-authored nameplates in the Center’s space made youths’ presence and expertise visible “permanently hung on the wall.” Furthermore, the nameplate activity expanded to many of the Center’s outreach programs. For example, the Center educators worked with youth from the local refugee community to construct their own nameplates and stories of home, which later were exhibited in the Center and attracted many visitors.



Spotlight on practice:

Young people Reclaiming physical and social space in a community-based digital arts center (UK)

A community-based digital arts center had a number of rooms that it used both for young people's programs and other activities serving the surrounding community. The center supported young people to **Reclaim physical space** by showcasing their work on the walls of all their rooms. For instance, as part of a photography summer program, **young people contributed their favourite images to be hung permanently on the walls** of one of the rooms – therefore claiming physical space in the center as their own and building a sense of the center as somewhere that welcomes and belongs to the young people. Young people were proud to have their work displayed – Spuggs, a regular participant at the center said, "I like showing people what I do", whilst pointing at his photograph on the wall. The practice of Reclaiming extended beyond the young people's programs, with the center frequently exhibiting STEM-related work created by members of the local community, such as female gamers.

The center also supported young people to **Reclaim social space**. Erin, one of the educators, facilitated the development of a '**contract of participation**' for the weekly STEM club, which the young people co-constructed and agreed to follow (including points such as 'play nicely' and 'be respectful'), as denoted by the public display of their signatures on the contract. Erin explained that the agreement was deliberately called a contract and not a set of rules "because they come from the young people", allowing young people to Reclaim the social space and ways of participating in the STEM club.



How to use this practice: Reflect

Reflection questions

1. What would it mean to Reclaim your institution, programs, and rooms in which you enact everyday practice?
2. How do you want to integrate the practice of Reclaiming in your institution, programs, rooms, and daily routine? Who would need to be invited to that planning session?
3. How can you recognize and support youths' bids for Reclaiming?
4. What obstacles could be addressed to support Reclaiming more broadly at your institution?

How to use this practice: Act

Things to do

1. Youth as designers

The educator does not have to be the only expert in the room. Youth bring their own knowledge and experiences to spaces. Find ways to include youth in designing programs and activities. The educator may bring a framework for eliciting youth ideas and ways to support the realization of youth ideas. When do you take opportunities to include youth in designing activities and programs?

2. Providing protected brainstorming space/time

Circle time (regular, whole group discussion) is used for students to share projects, and educators encourage youth to share input on project development. Supporting youth in sharing and providing feedback on peer ideas creates an environment in which youth are experts shaping their learning experience. How might you build in time for youth to hear from each other?

3. Youth Action Council (YAC)

One way to involve youth in Reclaiming space through co-creating spaces and programs is to form a group of youth who collaborate with program administrators. This group of youth would meet regularly with educators/administrators in an environment where youth ideas are listened to and used to shape programs and spaces. How might your organization benefit from forming a YAC?

4. Supporting youths' investigation, documentation, and reflection of their Reclaiming project practices

Support youth in documenting and sharing their own thoughts about Reclaiming (e.g., sketch out ideas for a makerspace, interview each other on ideas for Reclaiming, critique the design of other spaces). How might you include youth in designing and shaping your organization's physical spaces?

5. Creating a visible and enduring presence

Having a physical indicator that a space is made for and by youth can support youth ownership of these spaces. One way to do this is to support youth in making nameplates to display in the room. Were youth involved in designing educational spaces? In addition to nameplates, how can you demonstrate that these spaces belong to youth?

6. Asking youths' advice on adults' ideas

Test out initial activities provided by adult facilitators, and modify them according to youths' interests and vision. When and how do you elicit and respond to youth feedback on program activities?

Additional tools and resources

Try out some “Talk Moves”

Talk moves can help to create spaces for transformative discourses and practices.

Ask youth for their vision of the space

- Draft a mission statement together. This can start with a single question: “What is our room a space for?”
- “In which spaces do you feel you belong?”
- “What would you want to change in this space?”

Support youth investigation of the space

- “What kinds of STEM learning spaces do you want to make?”

Support youth imagination of what the space could be

- “We are planning our [program name]. These are the programs we did last year. What kind of activities would you suggest?” (And then, you can engage youth in designing and proposing potential activity, and testing out their proposed activity).
- “What needs to be hung on the wall to make this space to feel the way you imagined this room to be?”

Example tools from educators

- Secure multi-purpose space within the room so that youth can create and change how to use the space.
- Use walls and corners of the room as spaces to represent youths’ presence.
- Exit surveys can help to elicit ideas even from quiet or shy youth.

About our project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people.

For the full range of Insights documents summarizing the project’s tools and resources, including Core Equitable Practices and Equitable Youth Outcomes Model, please see yestem.org

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Disclaimer

Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of NSF, Wellcome, or ESRC.

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Examples of Youth Bids

Disrupting: Asking to create new activities disrupting normalized boundaries

During the YAC session of a science center, in which youths were asked to brainstorm how they would like to redesign and reorganize the makerspace, Megan stated that **“we want to see activities that are not traditionally feminine or masculine or that split us up.”**

Megan Added, “Whether we are making paper circuits to make a card for a friend, to make a nightlight or designing something to change the world like a jacket to prevent bullying, **we want to be supported in having our concerns matter**, and in being able **to take action** on those concerns.”

The lead educator, Olga **recognized the critical message** of Megan and asked her and other youths to further unpack her ideas and examples. Then Olga **drew from these ideas to further plan and design** new maker activities with YAC youth.

Bid: Asking to ensure gender parity in programs

Response: Noticing the bid and following through with commitment

Reclaiming: Youth supported in taking on coalition spokesperson role to support equity for peers

Amplifying: Wanting to create a space that honors youth projects in-process

During the YAC session of a science center, in which youths were asked to brainstorm how they would like to redesign and reorganize the makerspace, Fall stated, **“kids need to know that nothing is perfect.** Nothing is done. So, let’s create this space to display kids’ projects in-process. Kids’ ideas and projects matter, the process matters and is valuable enough to be shared.”

As lead educator, **Olga brought Fall’s idea into the science center’s staff meeting** to build a display shelf to showcase youths’ in-the-making artifacts in the makerspace. Olga followed up with Fall on the shelf design first-drafted by adult staff, **asking which revision Fall may recommend** to the design staff. Finally, this shelf was placed in the new makerspace.

Bid: Sharing ideas for changing space

Response: Noticing bid, valuing and facilitating voicing youth ideas to people in power

Reclaim: Youth envisions physical change and is supported in realizing it

Rightfully Present: Wanting to create a space to support youth need to be who they are

During the YAC session of a science center, in which youths were asked to brainstorm how they would like to redesign and reorganize the makerspace, Ivy stated, **we want “activities that can let us be who we are.** I want to do things that let me be me. In school sometimes it’s hard to be me.”

The educator revisited Ivy’s idea of ‘letting us be who we are.’ **She asked youths to unpack the idea and develop summary statements** that would help publicly represent the space to let others know this would be a space that supports youth identities and self-expressed authenticity. Based on the statements youths proposed, the educator worked with the science center staff to make a wooden panel sign as a **permanent public representation of their manifesto** to present and support the core summary statements/visions for the space.

Bid: Sharing a desire for acceptance and celebration of identity

Response: Listening, taking time to discuss as a group, representing youth ideas externally

Authority Sharing: Youth ideas held up as legitimate and valuable to the broader public

Reflecting:

- Which example of youth bids resonates with your experience?
- Share and add youth bids for reclaiming that you have experienced.
- How might you respond to youth bids for reclaiming in your space?

Guide to Talk Moves

Reclaiming involves restructuring power relations so youth shape social and physical STEM spaces. It means youth ‘taking back’ power to claim who belongs and what it means to engage in STEM by shifting how materials and relationships are allowed to be structured. This centers youth lives and their pasts, presents and hoped-for futures with and in STEM.

What are talk moves? Talk moves are the pedagogical moves that educators make to facilitate and scaffold engagement in ISL among youth without being the one doing all the talking or decision-making.

This guide highlights pedagogical moves to create and sustain an equitable learning community. It serves as one example of how to enact the Core Equitable Practice (CEP) of Reclaiming, as described in the Reclaiming Insights 2.4 document.

Questions for Group Discussions

- How have I/we sought to support youth to reclaim STEM in my/our program -- drawing from who youth are and what they bring -- their feelings, ideas, histories, hopes and fears?
- Have I/we been more successful in supporting reclaiming practices with some youth than others?
- What makes me/us uncomfortable with youth reclaiming STEM spaces? Why?
- From my/our own experience, what talk moves have I/we used or experienced to support youth reclaiming?
- What are some ways reclaiming talk moves might be combined with other practices (e.g., co-designing)?
- What talk moves have I/we already used? Which do I/we want to add? Which ones will be the most impactful to support reclaiming with youth? Which will be difficult?
- In the most recent lesson taught, how could I/we integrate these talk moves to transform who/what matters in STEM?

Things to Keep in Mind

This tool has been designed with partner educators. Themes include soliciting youth visions, supporting reclamation actions, and publicly showcasing youth reclaiming.

Some talk moves can work for multiple practices. For example, questions to embrace humanity may also work to critically be with youth

This tool can be used alongside the Equity Compass tool to enhance discussions on talk move goals and outcomes.

Some of these talk moves may look like ones you are used to seeing, such as voicing. However, **we call attention to when and how these moves are used to unsettle what/who matters in STEM and what expertise is and can look like.**

Examples of Talk Moves

Asking for youths' vision for reclaiming space	Asking youth to critique and reimagine a space's powerful potential	"What kinds of spaces (or what kinds of changes to this current space we're in) would you want to see and visit that would help youth to learn about and do things in STEM?" "In which spaces here do you feel you belong? How about outside this building? What components of a space make us feel powerful, smart, comfortable, accepted/welcomed, happy, focused, etc.? What about a space can make us feel tired/unfocused, frustrated, unheard, etc.?" "What would you want to change in this center?"
	Asking for youths' imaginations and presenting educators' own hopes for the space	"Before, you came up with this statement: This is a space for making cool things and building confidence in STEM. Do we all still love that?" "We would like to make new signage for this room. This is our current prototype. Would you help us design the sign? How would you want it to look? How do we want people to feel or what do we want them to know when they see this sign or this display?"
	Drafting a mission together	"What is our room a space for? Who is our room for (e.g., what ages)? Which adults should be allowed in, or not? Why? What kind of adult help, and what kind of helpful materials, should be offered here?" "What kind of experiences should our science center offer for youth? What should they be able to do, say, touch, hear, see? How do you want them to feel or think or create?"
Supporting youths' reclaiming space and narratives	Facilitating youths' examination of the programs, rooms' display, and practices	"Let's take a tour of our science center together. We would like you to share your imagination...how you want to change the space -- the walls, the signages, the furniture?"
	Acting on youths' vision for the space	"Following your ideas and requirements (within budget limits), we created this new space, now officially named the Chill Zone. Thanks so much for leading this design process! What do you think of it?" "By looking back at your initial designs, would you like to add any more ideas to make this Chill Zone feel more like the space you imagined?"
Showcasing and Publicizing youth efforts to be visibly present in the space	Showcasing	"What needs to be hung on the wall to make us feel 'at home and included' in this space, or like how you imagined this room?"
	Publicizing	"We would like to have an event to show our community the space you transformed. What do you want to highlight during the event?" "How do you want to introduce our transformation to the community?"

EXIT PASS

Help us learn about how your day went!
You don't need to write your name.

I felt other people cared about my ideas and work today:

YES

NO

WHO CARED?

HOW DID THEY SHOW THEY CARED?

I cared about someone else's work today.

YES

NO

WHOSE WORK DID I CARE ABOUT?

WHY?

I felt like an expert today.

YES

NO

WHEN?



Shifting narratives



Shifting Narratives

YOUTH EQUITY + STEM

YESTEM Insight #2.5

What is the issue?

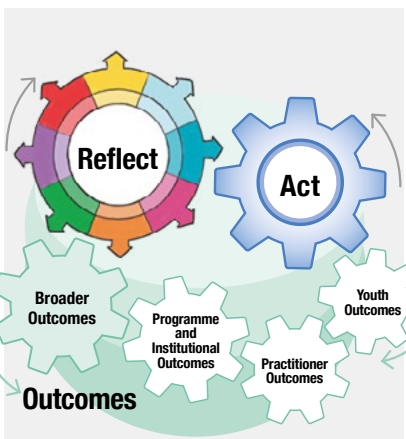
- The stories we tell about science, technology, engineering and mathematics (STEM) and who these subjects are ‘for’ are too often **shaped by entrenched, elitist ideas.**

- For instance, our capacity to think broadly about what ‘counts’ as STEM is often limited by widely held narratives about STEM, such as **the idea that STEM is purely objective.** Our experiences of physics, chemistry, biology and mathematics at school can also profoundly affect our views about STEM.

- These narratives inevitably shape Informal STEM Learning (ISL) too. Narrow views of what ‘counts’ as STEM can leave little space for young people’s STEM-related interests and skills. Valued knowledges and practices from young people and their communities are too often rejected and/or made invisible in their encounters with ISL.

- At the same time, common narratives about **STEM being the preserve of ‘clever’, typically white, male and wealthy people** negatively impact the school STEM and ISL experiences of all young people, but particularly those from minoritised communities.

- Understandably, many young people find these narratives off-putting. **If ISL is to be equitable, these stories need to change.**



YESTEM Model for equity in ISL

Please see yestem.org for the full model and related Insight documents detailing each component.

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 YESTEM Insight 2.5: Shifting Narratives.
yestem.org



What is the practice?

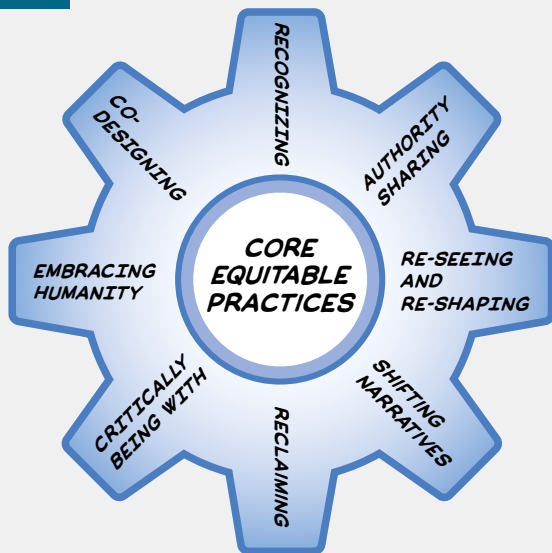
Shifting Narratives about what and who ‘counts’ in STEM is an urgent, crucial part of equitable, meaningfully inclusive ISL practice. **ISL practices can purposefully challenge and change stories about what ‘counts’ as STEM, who does STEM and how STEM ought to be done.** For instance, practitioners can work with young people and their communities to reframe STEM knowledge and practice in ways that break down stereotypes about STEM as ‘stale, pale, male’, and reserved for the cleverest people. Shifting these narratives can open up opportunities for more young people to be recognised and valued for pursuing STEM experiences on their own terms.

Placing youth agency at the heart of the YESTEM project helped us to think critically and intentionally about using ISL practices to challenge exclusive narratives about STEM. We took the stance that **young people are knowledgeable, not only in relation to STEM, but from their experiences of structural inequalities, such as racism, sexism,**

class discrimination, homophobia, ableism (and their intersections). Purposefully working from, valuing and representing young people’s experiences and expertise allowed us to collectively discuss injustices – such as the complex colonial histories of zoos or the practice of naming science centre rooms after wealthy white men. These conversations enabled youth and practitioners to challenge unjust narratives, and importantly, change practices.

Shifting narratives in ISL goes beyond superficial representational politics. It helps young people ‘see’ themselves in ISL and STEM. It supports young people’s agency through meaningfully inclusive practices that are purposefully designed to transform power dynamics. **Such practices value and honour minoritised young people’s agency, assets and needs so that minoritised youth can both ‘see’ and ‘be’ themselves in ISL and STEM, in both the short and long term.**

Act



The practice of Shifting Narratives is about thinking differently about the stories we tell about what ‘counts’ as STEM, who does STEM and how STEM ought to be done.

Visit yestem.org for more information and resources from our international research effort.



Spotlight on practice:

Changing STEM narratives in a community-based digital arts centre (UK)

One of the YESTEM sites is a community-based digital arts centre in a UK City. Practitioners from this space **worked across multiple time-scales, programmes and practices to challenge and change normative stories about STEM.**

Notably, their emphasis was always on how to best support the assets and needs of the young people they worked with, rather than trying to ‘get them into’ STEM. In other words, supporting young people, rather than a STEM recruitment agenda, shaped their practice.

Practitioners at the community-based digital arts centre understood the power of stories about STEM within and beyond their walls. For instance, talking about the possible STEM futures of young people in her programmes, Erin told us **“we know that tech is predominantly male, so we actively work at creating female spaces”**. Centre staff talked about challenging and changing the stories about **who could do STEM** and **what ‘counts’ as STEM** though showcasing the work of female game-designers and Manga artists and by actively supporting girls’ engagement in their programmes.

One of the centre’s after-school tech clubs provides a good example of how youth and practitioners challenged and changed narratives about STEM in multiple, complementary ways. **What ‘counts’ as STEM** was purposefully broadened to include the young people’s knowledges and skills, as well as including digital arts content. The young people’s passion for gaming, for instance, is valued in this space, with one computer always available for them to use to play Minecraft if they would rather not do that week’s activity.

Stories about **who can do STEM** as well as **how, where & why** it ought to be done were also purposefully challenged and changed in the club. For example, Ginger, an 11-year-old boy, was recognised and respected by club facilitators and other young people for his YouTube gaming channel

and his coding expertise. Ginger commented that he bet the gamers on his YouTube channel would be surprised to know he was only 11, saying “people think because of how advanced my games are that I’m much older”. Young people were encouraged to share their STEM experiences outside of the club, such as re-building computers with friends or making scrap go-carts at home with family members.

Well aware that challenging and changing narratives about STEM (not least in terms of *what, who, how, where and why*) took effort, club facilitators worked to, as Nadia put it, **“land the learning” for young people**. Practitioners welcomed and valued examples and topics from the young people’s lives that went far beyond the narrow scope of ‘school science’ – including home experiences, hobbies, and creative arts. These interests and forms of expertise were purposefully drawn on and openly valued in the space as ways of engaging with STEM. These facilitation practices foregrounded young people’s skills and expertise, supporting them to ‘be themselves’ in the club and to engage with STEM on their own terms.



Spotlight on practice: Reclaiming narratives in a science centre (US)

Reclaiming our Science Centre was an annual community project that centred the practice of Shifting Narratives involving youth, educators, and researchers at one of our US YESTEM sites, a Science Centre. By reclaim, we mean that adults made space for Shifting Narratives for youth to take back power to challenge historical representations of science and decide how their lives, histories, stories, and communities get represented at the Science Centre. As one youth, Bella, stated, **“Our goal is to reclaim [the Science Centre] so that we see ourselves here. We also want to honour the people, like us, who came before us, but whose stories don’t get told.”**

Specifically, the youth led the co-design of a new classroom based on the life and work of Dr. Katherine Johnson, who calculated the orbital mechanics for the first American in space; and a series of displays and activities about women of Colour in science. Designing these new features of the Science Centre together required the careful development of a new and shared spatial imagination of what the Science Centre could be. Foregrounding youth as legitimate critics and reclaimers of science spaces, educators and researchers enacted a set of pedagogical practices for Shifting Narratives in three important ways.

First, through **critical examination of the Science Centre spaces**, youth shared their critical noticings, questions, and comments on who/what was represented and seemed to ‘belong’ in the Centre and in STEM. As Jazmyn stated, **“Like, I knew that most places only talk about the accomplishments of White men [in science], like I, as a Black girl,**

don’t matter, but by doing this research, it made it, like, something we had the power to change.”

Second, educators and youth co-developed **justice-oriented criteria for STEM representation** and applied them to imagining a new classroom for the Science Centre. For example, the youth developed criteria for naming the classrooms after: “People who don’t get noticed,” “People who have credit taken away from them,” and “People who inspired other people.”

Third, youth also applied the criteria to how a room should be designed to best represent who belongs in science. For example, the youth design a room recognising Dr. Katherine Johnson, who calculated the orbital mechanics for the first American in space. Designed interactive experiences to engage visitors in her life and work, showcasing her life story, accomplishments, and how she confronted racism and sexism. They hoped to raise visitors’ consciousness around issues of race, while also humanising what it meant to be a person of Colour in STEM.

With these changes, educators and youth shifted the narrative of who belongs at the Science Centre, how and why. This on-going practice has turned out to be powerful accomplishment for youth (“**I feel accomplished because we actually made something happen,**” Gerard). They became legitimate owners of the space (“**We are changing the rules by changing this room,**” Lulu) and advocate of as they described, “ordinary people like us” (Ivy) who come to the science centre.



How to use this practice: Reflect & Act

The table below details a series of prompts ISL practitioners can think about Shifting Narratives around STEM in their practice. It is structured around five classic questions: what, who, how, where & why? These prompts, their context and the example questions provided are not exhaustive, but can support ISL practitioners in their work to develop more inclusive practices.

Theme	Context	Guiding questions for reflection and action
What?	STEM has much to offer young people, but balancing the positives of STEM engagement with STEM's complex history is crucial for developing meaningfully inclusive ISL practices. Narrow, dominant narratives about STEM knowledge, skills and applications as objective, truth and/or as beneficial solutions to problems persist in our societies. These stories have a complex history, rooted in colonialism, racism, sexism, homophobia, ableism and their intersections (among others). Shifting narratives about <i>what</i> 'counts' as STEM helps young people see their own interests, experiences and knowledge as valued and relevant within STEM and ISL.	<ul style="list-style-type: none"> • How do we represent STEM in our programmes and exhibits? Who/what 'counts'? Who/what is absent? • What assumptions are built into the boundaries we draw around what does and does not 'count' as STEM in our practices? • Whose histories are we foregrounding and whose are we disparaging or ignoring when we represent STEM? • What activities could support young people to challenge narrowly framed stories about what STEM is? • How can ISL practice build on the interests, issues faced by and experiences of young people to broaden what 'counts' as science?
Who?	Narrowly framed stories about <i>who can engage with STEM</i> abound in popular culture and education (e.g. the TV show <i>The Big Bang Theory</i>). Challenging and changing who 'counts' in STEM and ISL requires that we pay attention to patterns of representation, language, programme design, staff and youth recruitment strategies as well as the design of physical and digital spaces.	<ul style="list-style-type: none"> • Who is visibly represented amongst our staff and visitors? • Who is visibly and positively represented in our displays, marketing and online presence? • Who do we celebrate through named exhibitions, prizes, statues or buildings? • Whose knowledges, practices and skills do we proclaim as important for science? How do we signal this? • How can we challenge and change these established practices? • What activities would support discussion and generate alternative narratives, practices and/or material resources?
How?	Minoritised young people are too often failed by STEM learning practices that favour the behaviours of white, middle-class boys. Where they do engage with STEM, their efforts, skills, knowledges and practices risk being invisible, misrecognised and/or seen as inappropriate. A meaningfully inclusive ISL practice means meeting young people where they are, recognising their interests, valuing their skills, building their confidence and agency.	<ul style="list-style-type: none"> • How can we disrupt behavioural expectations in ISL about how to engage with STEM? • Which of our 'standard' ISL practices (from facilitation, to exhibition design, to marketing) close down opportunities for young people from minoritised backgrounds and which open these opportunities up? • How can we understand and disrupt assumed behavioural norms embedded in ISL about the 'right way' to do things?

Theme	Context	Guiding questions for reflection and action
Where?	STEM engagement can happen anywhere and everywhere; from home to school, from a community youth club to a science centre, through hobbies and games, alone or in groups. Thinking broadly about <i>where</i> STEM engagement happens means recognising, respecting and valuing activities outside the traditional STEM and ISL scope. What about the coding involved in young people's collaborative fan-fiction websites, micro-blogging or environmental activism? It is crucial to open up the digital and physical spaces where minoritised youth can engage with STEM, to meet youth wherever and whenever they want and need, and—importantly—in ways to ensure they feel safe and comfortable doing so.	<ul style="list-style-type: none"> • How can we recognise, value and draw on the STEM activities across the full breadth of young people's lives in ISL practices? • What messages might we (intentionally and unintentionally) send about legitimate and illegitimate spaces of STEM engagement? • Which spaces do we openly discuss, respect and advocate for and which spaces are largely overlooked or actively dismissed? • How do space and place function to reinforce or undermine stories about who matters in STEM and what forms of STEM matter?
Why?	In placing youth agency at the heart of the project we wanted to think critically and intentionally about <i>why</i> STEM matters for young people from minoritised backgrounds. In doing so we purposefully decentred STEM from these stories, focusing instead on youth agency, assets and needs. For instance, while the STEM pipeline can be an important pathway for young people, we did not prioritise it over practices that support young people in their daily lives and that help them achieve their own goals, <i>whether within, through or beyond STEM</i> .	<ul style="list-style-type: none"> • How can we disrupt widely held expectations that the STEM pipeline is the only successful destination for young people involved in ISL? • Are we purposefully or inadvertently 'selling science' through our ISL practices? • What do we need to change in our practices to support STEM engagement as a route to youth agency?

About our project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people.

For the full range of Insights documents summarizing the project's tools and resources, including Core Equitable Practices and Equitable Youth Outcomes Model, please see yestem.org

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Guide to Youth Bids

Shifting Narratives involves expanding what counts as STEM, who does STEM, and how STEM can be done by honoring the agency and assets of youth and adults. Shifting the narratives of who can belong in STEM helps youth “see” themselves in STEM in both the present and the future.

What are youth bids? Youth take actions to prompt and seek attention from educators and peers. When youth make a shifting narratives bid, they seek to adjust the story of who counts in STEM to include their knowledge, expertise, and perspectives.

This guide provides:

- One example of how to enact the Core Equitable Practice (CEP) of Shifting Narratives, as described in the Shifting Narratives Insights 2.5 document.
- Examples of how youth may seek to shift narratives, drawing on our partner educators’ implementation of informal STEM programs.
- Ways to notice these bids and readily respond to them in ways that value youth for who they are and what they bring to the learning environment.

Questions for Group Discussion

- How have youth had **opportunities to share their narratives** in my/our program because of who they are, what they have experienced and/or what they know? How have youth been **denied opportunities to share and shift narratives**?
- How have I/we **responded to such bids**? Which **new learning outcomes**, if any, emerged from my/our response to bids for shifting narratives?

Things to Keep In Mind

- Youth bids can require multiple responses at once. For example, youth bids to shift narratives by presenting their expertise and knowledge can also require the core equitable practice of educator sharing of authority.
- This tool can be used alongside the Equity Compass tool to enhance discussions on youth bids goals and outcomes.

Why do youth make bids? Youth often actively seek to do the following:

- To **disrupt** the ways in which everyday knowledge and practice of STEM and schooling position students as deficient, or without power and authority.
- To **amplify** their already-present brilliant and agentic acts of everyday knowing and practice and to have their transformative potential made visible.
- To be **rightfully present** and legitimately belong as fully human in ISL.

Examples of Youth Bids

Disrupting: Speaking back to societal narratives framing STEM practice in the real world

During a fingerprint card making activity, Addison said the card can be used to identify a person. To demonstrate, she asked, "Would any of you help me lift my fingerprints?" Youth Monica said, "I should. I am a police officer." Meanwhile, Monica and Cassi were lifting fingerprints. **Monica spontaneously started to role play**, saying "Cassi, you are guilty. We saw your fingerprints at the crime scene." Cassi said, "What? No, that is my room. So, I have my fingerprints there." Monica brought a rubber hammer over, tapped the desk three times and said, "I AM a JUDGE. You are guilty." **Chloe exclaimed, "you cannot say she is guilty yet. I am her lawyer. Show me EVIDENCE."** Monica created a story in which Cassi might have committed the crime. Chloe replied, "No. that is not evidence. That is what you just say. We need evidence. Before then, she is not guilty."

When Addison noticed the roleplay, **she called the attention of the whole group and asked how they could extend it.** What other parts would they need people to play?

Bid: Starting a role play illustrating STEM application in real world setting

Response: Noticing the bid and amplifying and extending it

Narrative Shifting: Role playing is a valid way to explore STEM concepts in a real world context

Amplifying: Wanting youth definitions of a learning space to be institutionally recognized

The Community Center was making posters describing programs. **Star checked in with youth** on the name of their new coding program. **Youth renamed it "Coders Hangout."** Chloe said "At school I have to learn. But here I get to learn so I want to learn. No offense Star, but learning does not have to happen here, but it does happen. **We are a hangout of coders**, and no one is making me learn. **I don't have to learn, which me makes want to learn more**, because it's fun."

Star stated, "**I felt an obligation to what youth wanted the space to feel like.** What I wanted them to learn was second to that, and what I wanted to report about what we accomplished was third. **What they wanted for their learning community's culture**, which was clearly supporting their identity development, **was more important** than anything predetermined by adults."

Bid: Renaming and reframing a space and its goals

Response: Soliciting and representing youth voice

Narrative Shifting: Youth welcome new peers while teaching adults

Rightfully Present: Wanting to legitimately belong in ISL space as just who they are

Preparing for a robot showcase, one peer group made spider-ladybug robots to present a story in which a spider catches a ladybug after it eats another spider. **These girls wanted to convey the message that the weak win out over the strong.** The girls' designs and movements were not easy to realize. **They freely expressed their confusion and frustration** during their troubleshooting.

Addison gave them questions to consider and feedback on how to monitor their progress instead of giving direct answers and solutions. When they started to feel frustrated, they encouraged each other, saying "close," "almost there," and "keep going." Through trial and error, the girls' frustration was transformed to joy as they accomplished this difficult task.

Bid: Making STEM a site to rewrite tales of strength and vulnerability.

Response: Praising and questioning to support progress.

Narrative Shifting: Storytelling and vulnerability count in STEM.

Reflecting:

- Which example of youth bids resonates with your experience?
- Share and add youth bids for shifting narratives that you have experienced.
- How might you respond to bids for shifting narratives of what/who counts in STEM in your space?

Guide to Talk Moves

Shifting Narratives involves expanding what counts as STEM, who does STEM, and how STEM can be done by honoring the agency and assets of youth and adults. Shifting the narratives of who can belong in STEM helps youth “see” themselves in STEM in both the present and the future.

What are talk moves? Talk moves are the pedagogical moves that educators make to facilitate and scaffold engagement in ISL among youth without being the one doing all the talking or decision-making.

This guide highlights pedagogical moves to create and sustain an equitable learning community. It serves as one example of how to enact the Core Equitable Practice (CEP) of Shifting Narratives, as described in the Shifting Narratives Insights 2.5 document.

Questions for Group Discussions

- How have I/we sought to shift narratives with youth in my/our program -- drawing from who youth are and what they bring -- their feelings, ideas, histories, hopes and fears?
- Have I/we been successful in shifting STEM narratives with some youth more than others?
- What makes me/us uncomfortable with shifting the narratives we implicitly tell in STEM spaces? Why?
- From my/our own experience, what talk moves have I/we used or experienced to shift narratives with youth?
- What are some ways shifting narratives talk moves might be combined with other practices (e.g., embracing humanity)?
- What talk moves have I/we already used? Which do I/we want to add? Which ones will be the most impactful to support narrative shifting? Which will be difficult?
- In the most recent lesson taught, how could I/we integrate these talk moves to transform who/what matters in STEM?

Things to Keep in Mind

This tool has been designed with partner educators. Themes include collective critique, establishing new narratives, and institutionally supporting narrative shifts.

Some talk moves can work for multiple practices. For example, questions to shift narratives with youth may also work to critically be with youth

This tool can be used alongside the Equity Compass tool to enhance discussions on talk move goals and outcomes.

Some of these talk moves may look like ones you are used to seeing, such as revoicing. However, **we call attention to when and how these moves are used to unsettle what/who matters in STEM and what expertise is and can look like.**

Examples of Talk Moves

Collectively critiquing currently dominant narratives about STEM

Making observations together about STEM

“How would you define/describe [science, technology, engineering, math, or related subject]? What do you love about it? What do you dislike about it?”

“Who does STEM [or specific area of STEM work]? What is the purpose point of learning or doing that? Who could be affected by that?”

Speaking back to societal narratives framing STEM practice in the real world

“How have you seen or heard of scientists or engineers or computer coders [or other STEM profession] represented in movies or TV or video games or magazines, or by your school teachers?”

“How does the world / others describe STEM [or insert sub-topic]? Do you agree/disagree? Why?”

Establishing new STEM narratives based on youth and community histories, experiences, and goals

Prompting youth to reflect on their desired identities in STEM

“What do you wish the world knew about you as a STEM thinker, maker, learner, and/or doer?”

“How would you change the world with STEM?”

Asking youth to express their interests, goals, expertise externally

“Let’s get to know each other better! Let’s take turns sharing what I really love to do, and what I do well.”

“Now let’s explore **how what we do well already can help** us, others, or the bigger world when we use it with STEM tools, learning, or skills.”

Institutionally sustaining & expanding the impact of new, youth co-authored STEM narratives

Engaging parents and guardians in supporting youths’ connections to STEM activities and resources

To parent/guardian: “You may already know how much [their child] loves doing [topic/activity]. She was so focused on it today! I think **she might really enjoy** the [related event] this weekend.”

Presenting youth re-imaginings publicly

“Let’s brainstorm **whom you’d want to see** at your presentation.”

Making time and space to re-think and re-design learning frameworks to better reflect re-imagined STEM narratives

“Let’s re-organize the lessons in this unit to highlight how each one connects more to what you all shared that you like to do NOW, and what you might want to do in the future! Let’s start with forces and motion. How could this lesson help Alex’s goal to be a race car driver in the future? How could it help Nick’s skateboarding this weekend?”

“What STEM lessons are still missing, that you would want to add this year, to help us with our current lives or our future lives?”

EXIT PASS

Help us learn about how your day went!
 You don't need to write your name.

I felt other people cared about my ideas and work today.

YES

NO

WHO CARED?

HOW DID THEY SHOW THEY CARED?

Today, I shared with others what I know from my own life.

YES

NO

WHAT?

How people heard my stories or about who I am and who I want to be (Circle all that apply):

WHO HEARD ABOUT ME:

WHEN/WHERE:

OTHER THINGS YOU SHOULD KNOW ABOUT ME:



Critically being with



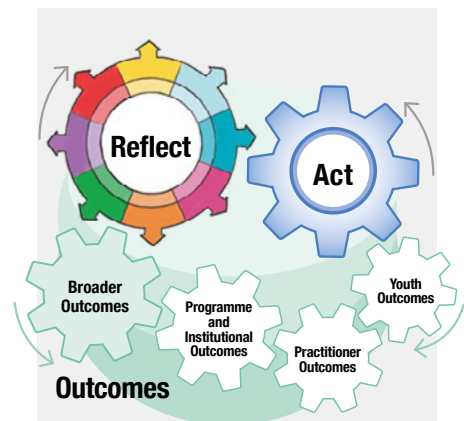
Critically Being With



YESTEM Insight #2.6

What is the issue?

- Youth bring different lived histories and experiences into learning spaces. These histories and experiences are shaped by social structures and identities such as race, gender, socioeconomic and linguistic status, culture, and class.
- If informal STEM learning (ISL) environments value White, Western, masculine culture more than others, then the worldviews and lived experiences of many youth are easily sidelined. This can make daily ISL discourses and practices oppressive, instead of empowering and expansive.



YESTEM Model for equity in ISL

Please see yestem.org for the full model and related Insight documents detailing each component.

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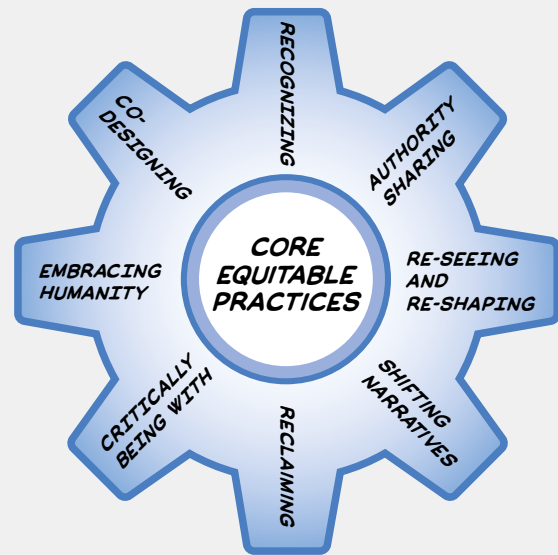
What is the practice?

When we are “**Critically Being With**”, we are making a choice to meet someone where they are, instead of expecting them to meet us where we think they should be. This practice goes beyond daily check-ins and content scaffolds. Critically Being With **is a relational and ethical practice to foreground the present experiences of youth**. This shifts relationships and insights by humbly moving towards common ground with youth.

Educators can Critically Be With youth in many ways:

- **Giving witness** to how youth experience historical and systemic racism on a daily basis (including inequality in informal science) by:
 - Attending to narratives youth share about the conditions and contexts of their lives,
 - Learning about existing structures of ISL and who designed/who still directs them,
 - Learning how ISL can either reproduce or disrupt oppressive/exclusionary norms, routines, practices, and ways of speaking.
- **Making space with** youth for youth-valued meanings, understandings, practices, and social futures.
- **Recognizing and supporting** the ways youth are already working to make visible/disrupt/transform injustices within and beyond the ISL space.

Act



The practice of Critically Being With is about meeting youth where they are and seeking ways to honor and center their experiences and contexts. It means making space for the complex ways youth live their lives, including how they may have experienced ISL in oppressive ways because of their race, gender, language and sexuality.

Visit yestem.org for more information and resources from our international research effort.



Spotlight on practice:

Creating space for youths' experiences with racism in STEM-rich making (US)



In this vignette we show how one educator, Taylor, created a welcoming space for a youth, Nila, to share her experiences with racism, and then supported youth in organizing their makerspace activities in ways that disrupted racism. Taylor's purposeful decision to make the activity central to the makerspace reflected her desire for youth to be seen in STEM in ways of their choosing. This practice led to creating a visible, enduring presence of youths' racialized lives in that space.

Taylor began a session by asking if youth had stories or experiences they wanted to share. Nila shared her worry that racism was creeping into all aspects of life, that racism was "getting worse," and that this was stressful and exhausting for her. Nila's comment was greeted with animated agreement as other youth called out their own concerns about racism. **Taylor noted that "youth wanted to have discussions of race"**. While this felt like a contentious moment, she also noted that this was a part of the youths' realities.

As Taylor opened a space for the youths to share their stories, the group talked about racism at school, on the bus, and at the grocery store. **Taylor encouraged the youths to ask each other questions, and to really listen to each other's stories.**

She explained later:

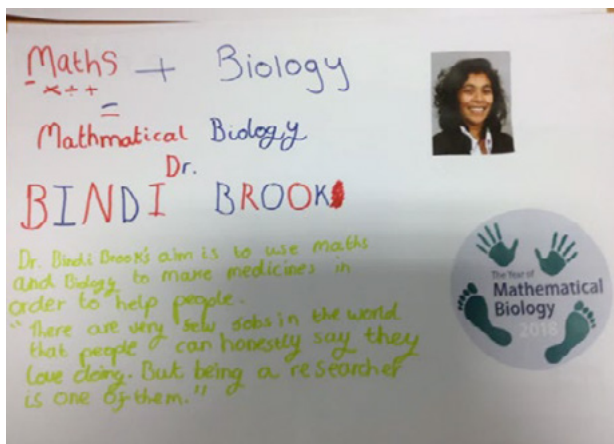
"What I hear from the youth is, 'This is how I'm navigating my blackness, my brownness, my whiteness within the context of my middle school experience. This causes me to perform in particular kinds of ways. I cannot be my full self in K-12 but I can be my full self here.'... They know right now ain't right. They are having to do this stuff as they are acknowledging problems and designing solutions in STEM."

Taylor gave witness to Nila's concerns by sharing her own experiences with and feelings about racism, as a Black woman. She bore witness to collective injustice, grief, and anger, acknowledging that honoring the fullness of youth experiences in and out of STEM, the good and the bad, is a part of honoring youth efforts to reimagine what can be possible in STEM.

Next, Taylor directed the conversation towards their makerspace activities by asking, "So what does Nila's story about racism tell us about our projects? Like, how could this help us with our projects?" The critical talk on racism created new opportunities for Nila and her peers to think about how they could use STEM in ways that disrupted injustices like racism. Nila and a couple of her peers documented where, when and how people in her community experienced racism, brainstormed possible strategies for combating racism in her community, and ultimately designed and built a light-up #StopRacism sign now displayed on the wall of their STEM Club. In addition to youth using the sign to call attention to racism, they also used the sign in support of their own maker efforts. For example, youth often pulled the sign out to examine the circuits Nila constructed. They also put the sign near the front of the room, with its lights on when visitors came.

Spotlight on practice:

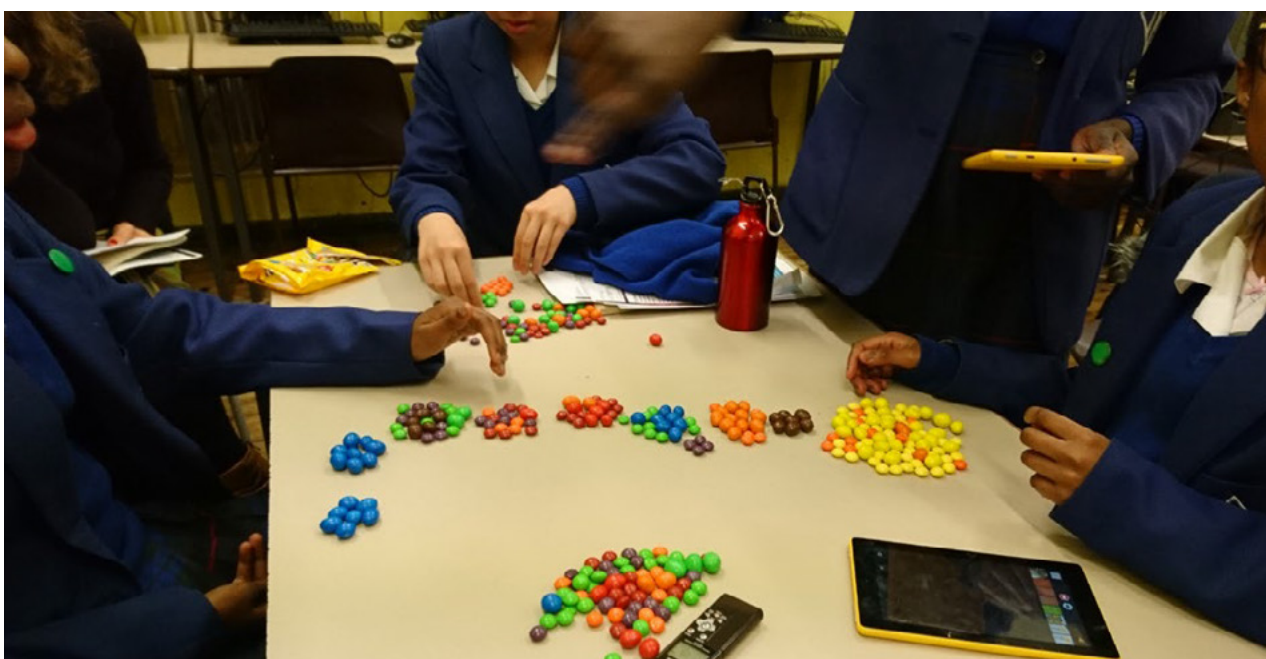
Cole and Madison's examples of established and developing practice (UK)



Cole, an educator at the community zoo, acknowledged the importance of not shying away from potentially challenging conversations, such as **“not being afraid to say the word Black or gay.”**

Cole shared with us how often, in his experience, people would be reluctant to put a label on people, saying “people would whisper things to me, like ‘he has two mums’”. In response, Cole advocated for the importance of destigmatizing how we talk about race and sexuality. During the week-long zoo program, Cole gave witness to young people’s difficult experiences, such as school bullying, economic hardship and religious discrimination.

Critically Being With can be a challenging practice for a novice educator and/or for educators who may not have personally experienced marginalization. During an after-school STEM club, Madison, a young White woman educator, played a YouTube trailer for the film *Hidden Figures* (about Katherine Johnson, a Black woman computer scientist). When one of the Black young women participants realized that Katherine Johnson was Black, she exclaimed with surprise (**“Oh, she’s Black!”**). While the conversation moved to a different topic at the time, Madison later reflected on the significance of the moment and the **potential it had for the young women’s engagement with STEM and for disrupting oppressive norms**, particularly as she found out later that none of the young women had previously known of any Black (and female) STEM professionals. She noted in a later interview that she “would like to have gone back ‘cause that was a really, really lovely moment and I would have definitely encouraged them all to lead a discussion”. This moment also instigated a further shift in Madison’s practice as she admitted that “the [activities] they did were mainly about white women”. Following her moment of reflection, Madison decided to find out more about how to engage with issues of injustice in her practice, paying particular attention to how she might foreground intersections of gender and race and support young people to engage with injustice and representation in STEM.



How to use this practice: Reflect

Reflection questions

1. What are some ways in which you have created opportunities to Critically Be With the youth in your programs?
In what ways have you observed youth Critically Being With each other?
Were these moments spontaneous or planned for?
What structures and activities supported Critically Being With?
2. What challenges do you face in making space to Critically Be With youth? To support youth in Critically Being With each other?
What do you need to know about youths' lives and communities to more fully and critically be with youth?
3. What obstacles need to be addressed to support your enactment of the practice of Critically Being With?
Who would need to be invited to planning sessions and after-session reflections?

How to use this practice: Act

Things to do

1. Off-Task Amazing

Make sharing ideas that may seem “off task” a normal part of your program so youth can comfortably express their thoughts and share their experiences.

Off-Task Amazing is when you notice a youth is “off task” but when you look closer you also notice they are doing something amazing that everyone can learn from. Some strategies for sharing are:

- Think-pair-share
- Index cards/post-its on a poster
- Regular 5-minute start-of-session and/or end-of-day youth report-outs

2. Attend to and discuss issues youth react strongly to, especially if those issues feel politically charged

For example, if youth fear fingerprints based on abusive law enforcement practices, make space to critically discuss uses of “objective” STEM tools to unjustly target communities of Color, etc.

3. Prioritize making connections between program activities and personal experiences and contexts by using program time to discuss:

- How youth engage with the daily session goals
- How youth see connections between peers' ideas, program experiences, and daily life (“How do we all feel about that idea? Why do we feel or think that way?”)

4. Take a “sensory inventory” of learning spaces

- How does the design of a space shape how youth feel? Knowing this will help to pinpoint often-overlooked stimuli that could become bummers, sources of irritation/frustration, or distractions for youth (machinery droning, boring grey color schemes, etc.)
- Ask youth to do a sensory inventory as well.
- Combine all that data and brainstorm solutions together to improve the learning space.

5. Model using questions to support critical reflection about session activity

“What challenging thing did I learn today?”; “What were my high and low moments of the day? Why?”; “What are curious questions I have that are lingering from today's experience?”

Additional tools and resources

Try out some “Talk Moves”

Talk moves can help to create space and time for Critically Being With. Other moves can be used to ask for youth to unpack their critical ideas and practices so that they can be made public and expanded.

Create space and time for Critically Being With

- “If you could make today’s activity (or this program) different, what would you change?”
- “What was your biggest challenge in design/ making projects? Why?”
- “How do your projects connect to your life or someone else?”
- “What connections did you make with today’s activity [or this program] and your life?”

Ask for youth to unpack their critical ideas and practices

- “What are some things we do here that help you feel like you belong? What are some things you wish we would do?”

- “That is powerful. So you mean that?”; “Oh, so your point is this?” [Writing down youths’ ideas on the white board]
- “So what does Nila’s story about racism tell us about our projects? Like, how could this help us with our projects?”

Example tools from educators

- **Reflection notes:** Incorporate (into your daily practices) noticing and recording the instances, conversations, and actions that call for changes in discourse, norms, and practices.
- **Creating a space to share critical noticing** (e.g., posters, post-its) in which youth express their thoughts, questions, and critiques, which will continuously be discussed and referred to across sessions.
- **Conversation group with other educators:** Engaging with other educators to collectively reflect on the moments in which youth called for changes in power relationalities and/or raced narratives and reimagining how they would support youths in their future program sessions.

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Guide to Youth Bids

Critically Being With involves foregrounding the present reality of youth. This means pausing to actively listen to youth lived experience, and then moving to more fully center, make space for, and honor it. This shifts relationships and insights by humbly moving towards common ground with youth.

What are youth bids? Youth take actions to prompt and seek attention from educators and peers. When youth make a bid to be with us critically, they seek to share their experiences and perspectives more honestly or deeply.

This guide provides:

- One example of how to enact the Core Equitable Practice (CEP) of Critically Being With as described in the Critically Being With Insights 2.6 document.
- Examples of how youth may seek to critically be with adults, drawing on our partner educators' implementation of informal STEM programs.
- Ways to notice these bids and readily respond to them in ways that value youth for who they are and what they bring to the learning environment.

Questions for Group Discussion

- How have youth had **opportunities to express** their lived experiences, including experiences of injustice? How has youth **expression disrupted normative habits** in my/our program? How have youth been **denied that opportunity**?
- How have I/we **responded to such bids**? Which **new learning outcomes**, if any, emerged from my/our response to bids for authority sharing?

Things to Keep In Mind

- Youth bids can require multiple responses at once. For example, youth bids to critically be with adults by sharing their lived experience can also require the core equitable practice of adults embracing youth humanity.
- This tool can be used alongside the Equity Compass tool to enhance discussions on youth bids goals and outcomes.

Why do youth make bids? Youth often actively seek to do the following:

- To **disrupt** the ways in which everyday knowledge and practice of STEM and schooling position students as deficient, or without power and authority.
- To **amplify** their already-present brilliant and agentic acts of everyday knowing and practice and to have their transformative potential made visible.
- To be **rightfully present** and legitimately belong as fully human in ISL.

Guide to Talk Moves

Critically Being With involves foregrounding the present reality of youth. This means pausing to actively listen to youth lived experience, and then moving to more fully center, make space for, and honor it. This shifts relationships and insights by humbly moving towards common ground with youth.

What are talk moves? Talk moves are the pedagogical moves that educators make to facilitate and scaffold engagement in ISL among youth without being the one doing all the talking or decision-making.

This guide highlights pedagogical moves to create and sustain an equitable learning community. It serves as one example of how to enact the Core Equitable Practice (CEP) of Critically Being With, as described in the Critically Being With Insights 2.6 document.

Questions for Group Discussions

- How have I/we sought to critically be with youth in my/our program -- calling caring attention to who they are and what they bring -- their feelings, ideas, histories, hopes and fears?
- Have I/we been more successful in critically being with some youth than others?
- What makes me/us uncomfortable with critically being with youth? Why?
- From my/our own experience, what talk moves have I/we used or experienced to support critically being with youth?
- What are some ways critically being with talk moves might be combined with other practices (e.g., embracing humanity)?
- What talk moves have I/we already used? Which do I/we want to add? Which ones will be the most impactful to critically be with youth? Which will be difficult?
- In the most recent lesson taught, how could I/we integrate these talk moves to transform who/what matters in STEM?

Things to Keep in Mind

This tool has been designed with partner educators. Themes include attending to youth narratives, valuing what youth value, and recognizing how youth work against injustice.

Some talk moves can work for multiple practices. For example, questions to critically be with youth may also work to embrace humanity.

This tool can be used alongside the Equity Compass tool to enhance discussions on talk move goals and outcomes.

Some of these talk moves may look like ones you are used to seeing, such as revoicing. However, **we call attention to when and how these moves are used to unsettle what/who matters in STEM and what expertise is and can look like.**

Examples of Talk Moves

Attending to narratives youth share about the conditions and contexts of their lives

Connecting to and making explicit systemic injustices

“What does [name]’s story about [important systemic issue] tell us about [lesson topic or investigation topic]? How could this change our original ideas about that issue/topic? What does that make us think more about?”

“I want us to think together about this more. Let’s talk about the reasons why [systemic issue related to topic] is so unfair. Maybe we should list the reasons you all share. [Looking at the list made together] How can we address these issues in our investigation/project/topic? Let’s make a new list of ideas!”

Revoicing Ideas Youth Share from their Lives

“That is powerful. So you mean that.....?”; “Oh, so your point is?”
[Write youth ideas down somewhere public, such as the whiteboard.]

Making space for youth-valued meanings, practices, and social futures

Soliciting Youth Desires

“What are some things we do here that help you feel like you belong here or belong in STEM? What are some things you wish we would do or you wish you could do? If you could make today’s activity (or this program) different, what would you change?”

Eliciting and Valuing Youth Connections

“How do your projects connect to your life or someone else you know? What connections did you make between today’s activity/program and your life?”

Supporting Youths’ Meaning-Making and Problem-Solving

“What was your biggest challenge in your project/work today/this week? Why? What could you try out to address that challenge?”

Recognizing how youth are already working to make visible & to disrupt injustices within and beyond the learning space

Asking youth to share thoughts and related experiences from their lives

“Does this connect to something you’ve seen before or heard about in the world? How? What does this make us think of or remind us of?”

“What might be some important risks related to asking someone these [e.g., genetic, forensic, biometric] questions?”

Valuing and revoicing youth connections and expertise developed through lived experience

“That’s a good point. Is it OK for me to share that with the rest of the group? Name] just shared something really powerful. Did everyone hear that? What an important point. Thank you for sharing your expertise from your family’s experience. That makes me think about [followup reflection question]. Let’s take a minute to turn to our partners and think about how we could address that, and what that could mean for our investigation/design.”



Embracing humanity



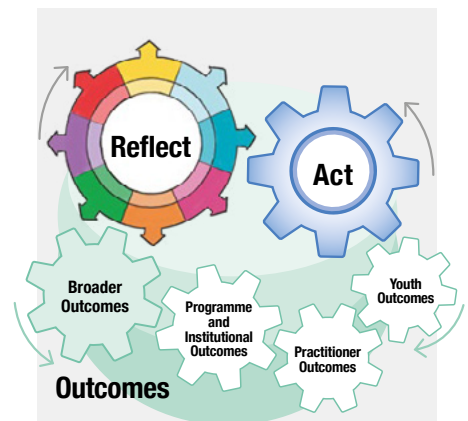
Embracing Humanity



YESTEM Insight #2.7

What is the issue?

- Many youths do not feel like their “whole person” is invited into informal STEM learning (ISL). Their feelings, experiences, histories, hopes, and fears are often not central to what happens in ISL. When people are denied their full selves in learning, their lives and histories are erased.
- This erasure can result from ISL experiences which center or reinforce dominant cultural norms in STEM. These dominant norms can position youth as outsiders. They can also limit the possibilities for seeing youth for who they are and want to be in ISL.
- Youth of Color, youth who are low-income, youth who are undocumented, and youth who speak languages that the larger dominant culture does not speak can face dehumanization on a daily basis.



YESTEM Model for equity in ISL

Please see yestem.org for the full model and related Insight documents detailing each component.

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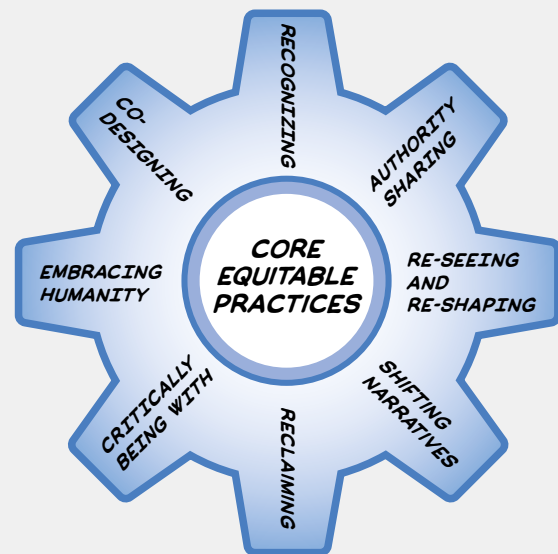
What is the practice?

The most powerful and socially transformative learning happens when people are supported in being their fully human selves¹. Learning is not only about what and how people think, but also about what and how people feel. Youth relationships, feelings, identities, languages, and cultures are all a part of learning. **Embracing Humanity** is a **relational and ethical practice** that values individual learners as fully human: **Who they are, not who they're expected to be**. This practice involves seeing humanity in others, our interdependence, and how each of these is shaped by context and histories.

There are many different ways ISL educators enact this practice:

- Planning for activities in ways that make space for youth to express themselves and to share and teach others about their strengths, stories and experiences. This can mean deviating from an original plan, because one cannot anticipate what youth may experience in the moment.
- Regularly investing time and energy into building emotional connections and relationships with youth, their families and their communities.
- Engaging in dialogic consciousness-raising conversations about the experiences that youth have in ISL, especially those related to erasure through white supremacy, heteropatriarchy, and economic exploitation.
- Supporting youth to comfortably feel and express the wide array of emotions drawn from multiple aspects of their lives and from their rigorous engagement in STEM (e.g., fear, uncertainty, not knowing).

Act



Embracing Humanity is a relational and ethical practice that values individual learners as fully human: Who they are, not who they're expected to be.

Visit yestem.org for more information and resources from our international research effort.

1. Freire, P. (1970). *Pedagogy of the oppressed*. New York: Continuum.

Spotlight on practice: JJ dancing with the joy of making it work (US)



During the Youth Action Council summer camp, youth were engaging in an e-textile backpack project. JJ wanted to stitch LED lights onto his backpack and program them to blink. The task was challenging in

many ways and caused JJ frustration. He needed to understand how circuits work, how to design the circuit to work as he had imagined, and how to sew the circuit so that it would consistently light up. When he struggled to get his circuit to work, he cried and then felt embarrassed for doing so. Educators noticed JJ's frustration, and legitimized it as part of his efforts and desire to realize the project he imagined. When JJ finally could light up his backpack straps, he spontaneously got up and danced wearing his lit backpack! Educators joined in the dance with JJ. Later, JJ helped his peers who were in the middle of the challenging task and encouraged them saying, **“you know I even cried, but if you know this (showing how to design the circuit on a paper), and just do like this, and keep doing it (showing how to sew).”** JJ kept helping his peers and exclaimed with them when they successfully got their project to light up.

Spotlight on practice:

Valuing Lara as a “whole person” in the STEM club (UK)

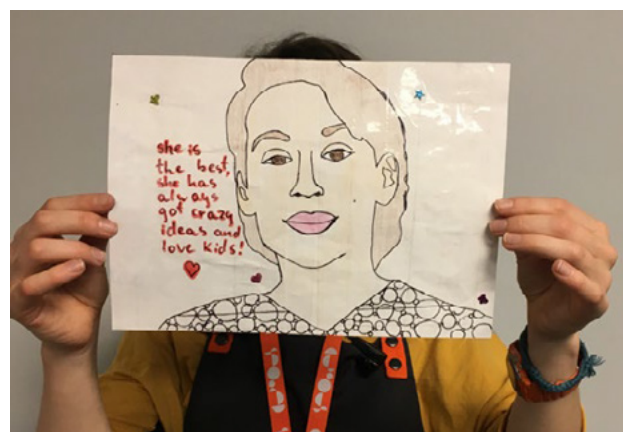
Lara was a 12-year-old girl who took part in an after-school outreach programme that was organized by a science center. Her family had recently migrated to the UK from Eastern Europe and Lara was working hard to learn English and navigate the English education system. During the initial after-school sessions, Lara was shy and appeared uncomfortable and disengaged from the activities. She frequently asked for explanations of specific English words that she did not understand. Lara also confided that she did not particularly enjoy science and STEM, and had found school a struggle in England.

Tessa, the educator from the science center who ran the sessions, noticed Lara's difficulties and **took time to regularly check-in with Lara one-to-one.** Tessa would often encourage Lara and other emergent bilingual youths to share key terms in their languages alongside the English version, thus seeing and valuing young people for who they are.

Tessa learned that Lara loved drawing and subsequently designed activities that would enable Lara to contribute her artistic skills, **deviating from her original plan.** Lara cautiously shared her artwork with Tessa, who praised Lara's work in front of the group and promised to exhibit the artifacts at the science

center. Over time, Lara became noticeably more comfortable during the sessions.

Tessa's practice of Embracing Humanity **allowed Lara to be a “whole person”** during the STEM club - she **regularly invested time and energy into building relationships** and celebrated Lara's skills beyond STEM. Tessa's efforts had a noticeable impact on Lara, who surprised Tessa at the end of the year with a beautifully drawn portrait of her. Lara spoke positively of her experiences on the programme during her final post-program interview.



How to use this practice: Reflect

Reflection questions

1. What are some ways you have created (or could create) spaces for embracing youth as fully human in your program/institutional spaces?
2. Which kinds of feelings, hopes, dreams and worries have you observed from the youth who engaged in your program, and how have you cared and embraced their being fully human?
3. Have you noticed moments when youth have been shut out or shut down because of who they are, what they care about, how they act or express themselves, and so on? How have you handled these moments?
4. What challenges may exist or emerge when you seek to enact this practice at your institution? Who would need to be invited to help you enact this practice in your learning space?

How to use this practice: Act

Things to do

1. Start the day by making space for youth to share feelings

(e.g., a quick thumbs up/down/sideways, time to share with you/group, etc.) Model active listening and supportive responses.

2. Spend moments with each youth as you walk around the room

Ask how they think about the ideas and how they are drawing on their available resources and expertise.

3. Create space and routine practices

For youth to engage in projects they love, take a break when they need to, and reflect (e.g., a “chill zone” corner).

4. Incorporate a variety of ways for youth to express their ideas

Support everyone in hearing a variety of ideas, not just from extroverts (e.g., small group work, write ideas down, etc.). Storytelling is an effective form for youth to share their human journeys of learning, doing, struggling, and succeeding!

5. Be open to expressing your own vulnerability

Show youth that you are open to recognizing and connecting with their humanity (e.g., joy, frustration, sleepiness, fun).

6. Design for joy in STEM

Consider inviting youth or community members to “co-plan for more joy” in program activities, bringing in different cultural ideas and perspectives.

7. Consider hosting inter-educator workshops

Learn from colleagues identifying and sharing cases where they tried to humanize youths’ learning experiences.

Additional tools and resources

Try out some “Talk Moves”

Talk moves can help to elevate and value youths’ contributions. Some moves create spaces to help youth share how they feel, are, and want to feel and be. Other moves create new possibilities to amplify positive emotions and experiences that help youth and educators feel embraced and acknowledged as human.

Create spaces to help youth share how they feel, are, and want to feel and be

- “How do we all feel about that idea? Why do we feel or think that way?”
- “Would you tell me about your day?”
- “Are there any moments in particular that you want to highlight?”
- “What do you think went well? What did you enjoy? What was challenging?”

Amplify the positive emotions and experiences

- “What do you want to share with others about today? What did you enjoy? Would you tell me more about how you enjoyed it?”
- “What are some things we do here that help you feel like you belong? What are some things you wish we would do?”

Example tools from educators

- **Chill zone:** Securing social/physically present space in which youth can feel comfortable to be themselves.
- **Circle time:** Ensuring time for youth to share their daily lives as part of daily practice.
- **Storytelling project:** Encouraging youth to express how they engage with STEM by incorporating their stories into individual/group projects.

About our project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people.

For the full range of Insights documents summarizing the project’s tools and resources, including Core Equitable Practices and Equitable Youth Outcomes Model, please see yestem.org

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Disclaimer

Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of NSF, Wellcome, or ESRC.

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Guide to Youth Bids

Embracing Humanity means valuing who learners really are, not who they’re expected to be. It involves seeing the humanity in others, our interdependence, and our contexts, histories, dreams, and emotions as important parts of us. It also involves recognizing how issues of power and oppression shape people’s full experiences in the world.

What are youth bids? Youth take actions to prompt and seek attention from educators and peers. When youth make an embracing humanity bid, they seek to be valued for how they feel and who they are, as fully human.

This guide provides:

- One example of how to enact the Core Equitable Practice (CEP) of Embracing Humanity, as described in the Embracing Humanity Insights 2.7 document.
- Examples of how youth may seek to have their learning spaces become more explicitly humane, drawing on our partner educators’ implementation of informal STEM programs.
- Ways to notice these bids and readily respond to them in ways that value youth for who they are and what they bring to the learning environment.

Questions for Group Discussion

- How have youth had **opportunities to have their humanity embraced** in my/our program because of who they are, what they have experienced and/or what they feel? How have such opportunities been **denied**?
- How have I/we **responded to such bids**? Which **new learning outcomes**, if any, emerged from my/our response to embracing humanity bids?

Things to Keep In Mind

- Youth bids can require multiple responses at once. For example, youth bids to have their humanity embraced can also require the core equitable practice of educator recognition.
- This tool can be used alongside the Equity Compass tool to enhance discussions on youth bids goals and outcomes.

Why do youth make bids? Youth often actively seek to do the following:

- To **disrupt** the ways in which everyday knowledge and practice of STEM and schooling position students as deficient, or without power and authority.
- To **amplify** their already-present brilliant and agentic acts of everyday knowing and practice and to have their transformative potential made visible.
- To be **rightfully present** and legitimately belong as fully human in ISL.

Examples of Youth Bids

Disrupting: Asking to be supported in expressing different emotions emerging in making

During the YAC session of making youths-designed STEM projects, frustrations were mounting as several youths struggled with the activity of the day. As was typical during YAC sessions, educator Addison had music playing in the When the song from Frozen, “Let It Go” began to play, several youths **immediately sprang out of their chairs to the carpeted area of the room and began to sing Let It Go with gusto, while dancing along.**

Within a matter of seconds, **everyone, Addison and other educators included, began singing and dancing too.** By sharing and releasing their emotions, and transforming them together with singing and dancing, youths were disrupting how the stress and frustration youths may experience in learning spaces were often viewed as negative and unproductive. They all **needed that moment of emotional release to let their in-the-moment project frustrations go** before they could move on with their projects of the day.

Bid: Getting carried away in song to express frustration

Response: Noticing the bid, supporting it, and even joining in with youth

Embracing humanity: Youth are supported in encouraging each other to regulate emotions

Amplifying: Wanting to share excitement of engagement and successful experiences in learning

During the DNA extraction activity in a Forensic program, **Diana shouted out** “Ms. Rose, look at this! This is my DNA strands. This is me,” and then **toured around the room** to see how her peers extracted their DNA strands.

Rose, the educator, **expressed her joy** when Diana approached her to show her DNA strands that appeared in her test tube. Rose stretched out her arms and said, ‘yay.’ She also **circulated the room vigilantly to find youths expressing joy and excitement.** She was attentive to seeing other youths who were expressing their joy so as to more actively **recognize and amplify the excitement** youths may feel in rigorous engagement in the DNA extraction activity.

Bid: Sharing joy

Response: Noticing bid, recognizing and valuing joy

Embracing humanity: Youth is supported in experiencing and sharing joy in science

Rightfully Present: Wanting it to be OK to feel feelings even when carried in from outside

At the beginning of the third day of a summer STEM camp that took place in the science center maker space, Samantha entered the space **saying she didn’t want to do anything** that day. She **moved directly into the chill zone**, a space created by youths to relax, reflect, and/or brainstorm.

Chris recognized this as Samantha’s bid to process feelings in the moment and take some time in a space where she belonged. **Chris let Samantha have time** in the chill zone while dropping by to let her know about what the daily activities would be.

After a while, Samantha came out of the chill zone and joined in her group table as usual. During the breaktime later that day, **Samantha came to Chris and shared** what happened in the morning at home. **Chris listened to her story and thanked her** for letting him know when she was not feeling willing or able to engage productively.

Bid: Communicating feelings that required a pause in engagement

Response: Recognizing a boundary and respecting it

Embracing humanity: Youth can experience emotions and still belong in a STEM work space

Reflecting:

- Which example of youth bids resonates with your experience?
- Share and add youth bids for embracing humanity that you have experienced.
- How might you respond to embrace the humanity of youth in your space?

Guide to Talk Moves

Embracing Humanity means valuing who learners really are, not who they're expected to be. It involves seeing the humanity in others, our interdependence, and our contexts, histories, dreams, and emotions as important parts of us. It also involves recognizing how issues of power and oppression shape people's full experiences in the world.

What are talk moves? Talk moves are the pedagogical moves that educators make to facilitate and scaffold engagement in ISL among youth without being the one doing all the talking or decision-making.

This guide highlights pedagogical moves to create and sustain an equitable learning community. It serves as one example of how to enact the Core Equitable Practice (CEP) of Critically Being With, as described in the Embracing Humanity Insights 2.7 document.

Questions for Group Discussions

- How have I/we sought to embrace humanity in my/our program -- who youth are and what they bring -- their feelings, ideas, histories, hopes and fears?
- Have I/we been more successful in embracing humanity with some youth than others?
- What makes me/us uncomfortable with embracing humanity of youth? Why?
- From my/our own experience, what talk moves have I/we used or experienced to support embracing youth humanity?
- What are some ways embracing humanity talk moves might be combined with other practices (e.g., recognizing)?
- What talk moves have I/we already used? Which do I/we want to add? Which ones will be the most impactful to embrace humanity with youth? Which will be difficult?
- In the most recent lesson taught, how could I/we integrate these talk moves to transform who/what matters in STEM?

Things to Keep in Mind

This tool has been designed with partner educators. Themes include making space to help youth share how they feel, acknowledging and amplifying experiences, and sharing adult feelings.

Some talk moves can work for multiple practices. For example, questions to embrace humanity may also work to critically be with youth

This tool can be used alongside the Equity Compass tool to enhance discussions on talk move goals and outcomes.

Some of these talk moves may look like ones you are used to seeing, such as revoicing. However, **we call attention to when and how these moves are used to unsettle what/who matters in STEM and what expertise is and can look like.**

EXIT PASS

Help us learn about how your day went!
You don't need to write your name.

**My educator knows me, and relates to me as a whole person -
a person with a particular family, who lives in a particular
place, with particular experiences and interests:**

YES

NO

HOW?

My educator treated me and/or cared about me like family.

YES

NO

HOW?

**My educator shared experiences today that were similar to
my own.**

YES

NO

HOW?



Authority sharing



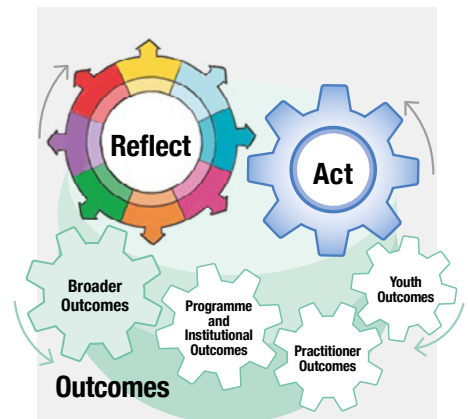
Authority Sharing



YESTEM Insight #2.8

What is the issue?

- Typically, in learning environments, the educator is viewed as the expert in their particular topic. They decide what knowledge is important to share with youth and how youth can demonstrate competency in taking up that knowledge. Practitioners have their own particular expertise, **but youth also bring valuable experiences and expertise to educational spaces.**
- **When authority is shared, youth have opportunities for their knowledge and practices to be centered in informal STEM learning (ISL).** Youth are viewed as experts because of who they are and what they know.
- Western science has been culturally grounded in White, Western, masculine worldviews and may not reflect the worldviews of all youth.
- Valuing youth knowledge and practices helps to de-center traditional Western epistemology. When new, more egalitarian authority structures are created, whose knowledge and experiences matter (and how and why) is expanded.



YESTEM Model for equity in ISL

Please see yestem.org for the full model and related Insight documents detailing each component.

How to cite this publication: YESTEM Project Team (2021). YESTEM Insight 2.8: Authority Sharing. yestem.org



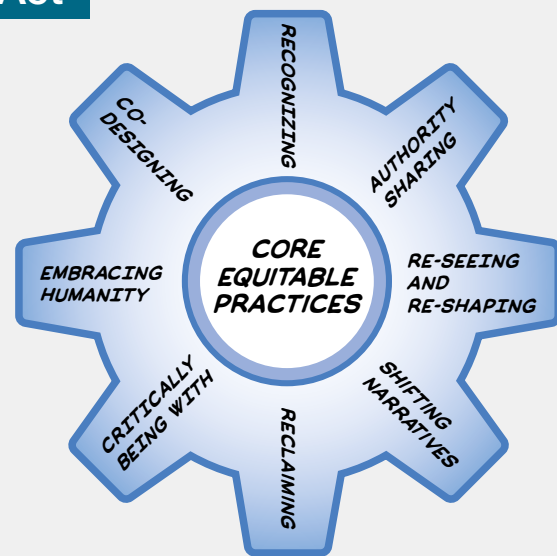
What is the practice?

There are many different ways authority is structured in informal learning environments. These include: the **roles** educators assign to themselves and to youth; what “counts” as valuable **input and forms of participation**; **how expertise and accomplishments are represented** in a space visually and discursively.

Authority Sharing involves **supporting youth in using their expertise to educate others**, whether that be other youth or the adult educators themselves. The practice of Authority Sharing involves the stance that youth have powerful ideas and experiences that matter in learning and doing STEM.

Beyond giving youth the opportunity to be an expert/authority in the traditional Western science sense, Authority Sharing also means giving up the centrality of Western science and supporting new forms of authority that bridge/merge and/or challenge traditional forms.

Act



The practice of Authority Sharing challenges views of practitioners as sole authorities. Authority Sharing supports youth in seeing how their lived experiences and expertise matter in STEM.

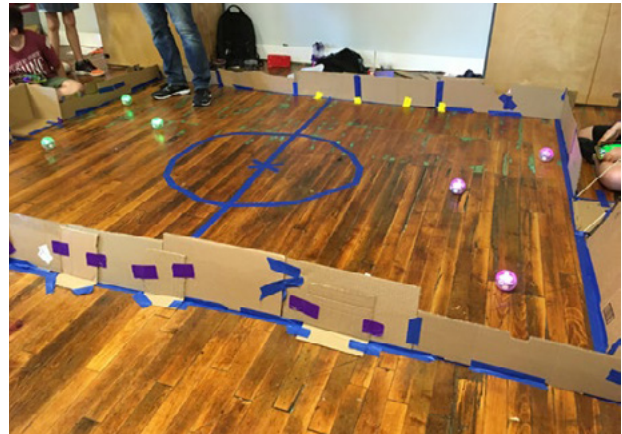
Visit yestem.org for more information and resources from our international research effort.



Spotlight on practice: Sphero-robot game (US)

During summer camp, educator Chris noticed youths' excitement in programming the sphero-robots. He said to the youths: "I found you really liked Spheros. How can we make Spheros be our design activity?" Youths brainstormed many ideas, and came to agreement on the idea of playing a soccer match with the Spheros. Chris leveraged the youths' ideas and interests to reorganize camp activity to support youths in designing, building and playing Sphero soccer. Youths moved throughout the room building walls and goals, testing ideas, trying new ones, and sharing their discoveries with each other.

Chris took on a support role for youths as they designed and played their Sphero game. He reflected: "That was my big highlight of today, where the kids got to run the show more or less. I kept trying to – I kept getting so amped up that I wanted to get in and be like, but Natalie's like, "Mr. Chris, you keep interrupting me." I'm like, "You know what? You're right. I'm sorry." [Chuckles] I got told to step back, I think, which was fantastic. I got to just be on the perimeter trying to make sure Spheros were charging so that when one died, I had one to replace it."



Chris' decision to support youths in re-designing the camp reflects the practice of Authority Sharing. He turned over the ownership of the activity itself to the youths. He also supported the re-design of the camp activities. Both of these actions helped to redefine what it meant to do STEM and to be recognized as an expert. When youths (or their parents) entered the camp room, they were greeted with the new soccer arena, youth-authored rules for participation, and decorations.



Spotlight on practice: Innocent leads a STEM club session (UK)

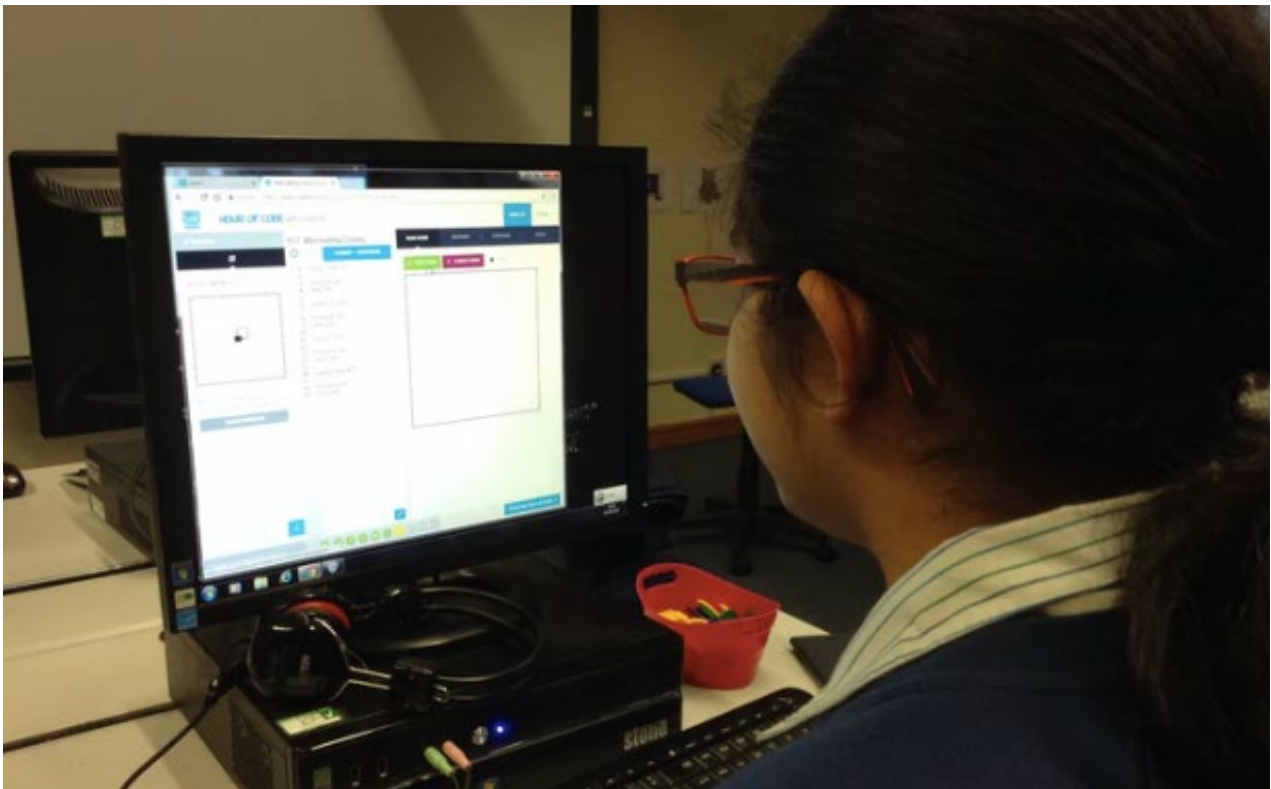
Innocent was a young Black woman who lived in London and attended a weekly after-school STEM club run by a social enterprise working with young women. The club sessions generally started by showcasing a female STEM professional and were fairly typical of many STEM clubs in that they tended to follow a prescribed curriculum and were led by a facilitator. Innocent was usually disengaged, chatting to her peers and paying little attention to the activities.

At the end of one session, one of the facilitators, Bobbi, noticed that Innocent had not been very engaged that day and decided to do things differently. **Bobbi shared authority by asking Innocent if she might be prepared to lead the next club session** that focused on Black computer scientists who had contributed to space exploration. By doing so, Bobbi disrupted the usual practice of an adult facilitator leading and steering the content and learning.

The following week, **Innocent led the session with competence and confidence**. She stood in front of the group and confidently introduced the topic of space and the Black women who worked in space science and computing. After the group watched a YouTube clip about the film *Hidden Figures*, Innocent led a discussion about the film and the role of the Black women in computing –

a topic she appeared to be particularly passionate about. This passion was evident in her follow up interviews after the program had ended, when she spoke about how “it’s usually men, especially in the Western world, so knowing that women can do it as well is really empowering to little girls like us, it makes me feel better”, adding that STEM “it’s usually, predominantly, a White career”.

There seemed to be a greater amount of student talk about science during the session that Innocent led - more so than the research team had observed in any of the other club sessions. We felt that this change was related to the shift in the power dynamics, when Innocent (rather than an adult practitioner) led the session and facilitated the group discussion. Bobbi’s invitation to Innocent to lead the session was an attempt to shift adult-youth power relations towards centering and supporting youth agency. We noted that Innocent herself also participated more vocally and actively in this session and that, as a group, the young women raised questions and shared ideas more in this moment compared to previous club sessions.



How to use this practice: Reflect

Reflection questions

1. How are youth encouraged to enact authority in your learning space? What roles are they given or are they supported in creating?
2. What are some ways in which you have created (or could create) spaces for youth to try out new ideas and ways of doing things?
3. What obstacles could be addressed to support youth authority more broadly at your institution? Who would need to be invited to that planning session?

How to use this practice: Act

Things to do

1. Youth as Experts

The educator does not have to be the only expert in the room. Youth bring their own knowledge and experiences to spaces. Find ways to learn about and recognize youth expertise. The youth who watches Discovery Channel may be knowledgeable about animals. The youth who bakes may be skillful in helping peers measure during experiments. The youth who hunts with family may know ecosystem interactions and seasonal changes. All expertise can be recognized and valued. When do you take opportunities to position youth to share the expertise they have?

2. Showcasing

Is your program space a place where youth see their expertise displayed in powerful and sustained ways?

3. Noticing and flexibility

What opportunities do you take to notice what youth bring to lessons/activities each day? Consider strategies that elicit youth interests and experiences so that you can adapt activities to include their interests.

4. Environments where everyone is a learner

How do you work with youth and position yourself in activities? Educators are not the only ones who teach. We are just the ones who are typically recognized as teaching. Youth learn from the educator, but also from each other. Educators also learn from youth. What strategies can you use to reposition everyone as a leader?

5. Youth relationships

Who are the youth in your program? Are they youth from the same school or neighborhood who know each other? Do the youth in the program not know each other?

Sometimes being recognized as an expert in particular ways can be negative, depending upon how peers take it up. Keep in mind your relationship with youth and how much you know about their relationships with peers.

Additional tools and resources

Try out some “Talk Moves”

Talk moves can help to elevate and value youth contributions. Some moves create spaces to help youth share their expertise. Other moves show value to and connections among practices/ideas youth already contributed.

Creating spaces to help youth share their expertise

- **Prompting Youth for Further Participation:** “What do others think about the ideas we have so far about how we might use our robotic arms to help clean the room? What would you add or change to our list of ideas?”
- **Asking for youth expertise:** “Does anyone know how to sew?”; “Would any of you help me lift my fingerprints?”
- **Think/Pair/Share:** “I want everyone to have a chance to think about their own ideas first and share them with a friend first.”
- **Changing the direction of lessons based on youth ideas/questions:** When a youth asked, “but what if [the idea different from what the educator just said]” The educator, acknowledging the point the youth made, “Oh! I didn’t think like that but

that totally makes sense! Thanks for that point. Would you share your idea how we can [reflect the youth idea]?”

Valuing and connecting to practices/ideas youth contribute

- **Revoicing:** “Timmy has a great idea. He said that we should put the greenhouses by the southside windows in our room. Timmy did you want to tell everyone why you thought that?”
- **Valuing youth artifacts:** “Thanks. I learned that I could do like what you do.”
- **Valuing youth ideas/questions:** “Thanks for asking that. Your question reminds me that I”

Example tools from educators

- **Help board:** A poster where youth add their questions which is used to support youth in sharing their expertise with one another.
- **Tips & techniques share outs:** Time for youth to share the day’s discoveries with the group to support sharing youth expertise.
- **Showcasing:** Providing youth with space and time to share what they have created and learned.

About our project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people.

For the full range of Insights documents summarizing the project’s tools and resources, including Core Equitable Practices and Equitable Youth Outcomes Model, please see yestem.org

This material is based upon work supported under a collaboration between the National Science Foundation (NSF), Wellcome, and the Economic and Social Research Council (ESRC) via a grant from the NSF (NSF grant no. 1647033) and a grant from Wellcome with ESRC (Wellcome Trust grant no. 206258/Z/17/A).

Disclaimer

Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of NSF, Wellcome, or ESRC.

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Guide to Youth Bids

Authority Sharing involves supporting youth to use their expertise to educate others, including other youth and adult educators. It requires the stance that youth have powerful ideas and experiences that matter in learning and doing STEM.

What are youth bids? Youth take actions to prompt and seek attention from educators and peers. When youth make an authority sharing bid, they seek to share their knowledge, expertise, and perspectives.

This guide provides:

- One example of how to enact the Core Equitable Practice (CEP) of Authority Sharing, as described in the Authority Sharing Insights 2.8 document.
- Examples of how youth may seek to share authority, drawing on our partner educators' implementation of informal STEM programs.
- Ways to notice these bids and readily respond to them in ways that value youth for who they are and what they bring to the learning environment.

Questions for Group Discussion

- How have youth had **opportunities to have authority** in my/our program because of who they are, what they have experienced and/or what they know? How have youth been **denied authority**?
- How have I/we **responded to such bids**? Which **new learning outcomes**, if any, emerged from my/our response to bids for authority sharing?

Things to Keep In Mind

- Youth bids can require multiple responses at once. For example, youth bids to share authority by presenting their expertise and knowledge can also require the core equitable practice of educator recognition.
- This tool can be used alongside the Equity Compass tool to enhance discussions on youth bids goals and outcomes.

Why do youth make bids? Youth often actively seek to do the following:

- To **disrupt** the ways in which everyday knowledge and practice of STEM and schooling position students as deficient, or without power and authority.
- To **amplify** their already-present brilliant and agentic acts of everyday knowing and practice and to have their transformative potential made visible.
- To be **rightfully present** and legitimately belong as fully human in ISL.

Examples of Youth Bids

Disrupting: Asking to take leadership

During a robotics camp, educator Chris **was hosting a daily wrap-up** in which youth share knowledge and skills used to build and code robots. **Brittany asked, "May I lead the discussion?"**

Chris noticed Brittany's question as a bid for taking the leadership in the discussion. He answered by physically moving a step back from the front. Chris **trusted** that she would facilitate the discussion in a meaningful way. As **Brittany facilitated** the discussion, she freely used the whiteboard to **publicize what her peers were sharing**, which were the tips and skills they developed and used. Brittany **encouraged her peers to come forward to showcase** their artifacts. How **Brittany led the discussion taught Chris** ways to share authority by making sure to visibly honor everyone's ideas.

Bid: Asking to take a leadership role

Response: Noticing the bid and agreeing, stepping back

Authority Sharing: Youth takes on leadership role and includes peers as experts too

Amplifying: Sharing expertise and knowledge from home

During a maker camp, **Lukas** approached educator Chris and **shared his experiences** in woodwork saying, "I love making things with wood. **My uncle taught me how to drill.** I went to his garage and cabin to help with woodwork. You should be really careful, but I like it." **Demonstrating** to Chris how to drill, he noted what his peers should know as beginners.

Chris **recognized** Lukas sharing experiences and demonstrating skills as a bid for amplifying the expertise that matters for making with woods, which come from Lukas wanting to help his peers handle the tools safely while being confident that youths can do it. Chris **solicited Lukas' help for working with his peers**, particularly those who were working with drills and wood cutters for the first time. Lukas patiently peer-taught and **Chris learned from how Lukas encouraged his peers** drawing from his awareness of which struggles peers might encounter in woodwork and how such struggles can be overcome.

Bid: Sharing past experience and relevant expertise

Response: Noticing bid, recognizing and valuing expertise, facilitating sharing of expertise

Authority Sharing: Youth draws from expertise to teach peers, provides insights for adult

Rightfully Present: Wanting to legitimately belong in ISL space as just who they are

During a DNA extraction activity in a Forensic program, educator Chris was talking with youth about genetic diversity and commonality among different living organisms. Then, **Tiffany challenged** Chris, stating matter-of-factly and with confidence, "Let me be frank. I feel uncomfortable. **How would you respond to those who would not agree with evolution?"**

Chris **immediately revoiced** Tiffany's question for her peers and **thanked her for** raising the question. Chris **recognized** her question as a bid for getting to be her whole self, including her religious identity in this space. While acknowledging different explanations for the reproduction and development of living organisms, Chris helped Tiffany and peers attend to the idea that DNA's structure and function made it useful as evidence in forensic investigations to identify individuals. Listening to Chris's explanation in detail, **Tiffany nodded and said**, "I think basically you made me understand that, though there will be something I want to know more."

Bid: Sharing a question based in youth identity

Response: Revoicing question, taking time to discuss, as a group, multiple explanations

Authority Sharing: Multiple ideas and ways of thinking as legitimate, valuable, worthy of discussion

Reflecting:

- Which example of youth bids resonates with your experience?
- Share and add youth bids for authority that you have experienced.
- How might you respond to share, disrupt, redistribute, or restructure authority in your space?

Guide to Talk Moves

Authority Sharing involves supporting youth to use their expertise to educate others, whether other youth or adult educators. Authority Sharing involves the stance that youth have powerful ideas and experiences that matter in learning and doing STEM.

What are talk moves? Talk moves are the pedagogical moves that educators make to facilitate and scaffold engagement in ISL among youth without being the one doing all the talking or decision-making.

This guide highlights pedagogical moves to create and sustain an equitable learning community through sharing, disrupting, and restructuring authority with, for, and by youth. This guide serves as one example of how to enact the Core Equitable Practice (CEP) of Authority Sharing, as described in the Authority Sharing Insights 2.8 document.

Questions for Group Discussions

- How have youth had opportunities to have authority in my/our program because of who they are, what they have experienced and/or what they know? How have youth been denied authority in ways that reproduce power asymmetry?
- Have some youth been granted greater authority because of who they are and how their experiences and cultural knowledge may more clearly map onto science?
- What makes me/us uncomfortable with sharing, disrupting, redistributing, and restructuring authority? Why?
- From my/our own experience, what talk moves have I/we used or experienced to support authority sharing, disrupting, redistributing, and restructuring?
- What are some ways authority sharing talk moves might be combined with other practices in ISL (e.g., recognition)?
- What talk moves have I/we already used? Which do I/we want to add? Which ones will be the most impactful to share, disrupt, and restructure authority? Which will be difficult?
- In the most recent lesson taught, how could I/we integrate these talk moves to transform who/what matters in STEM?

Things to Keep in Mind

This tool has been designed with partner educators. Themes include elevating youth voices, soliciting youth voices, being vulnerable, and responsiveness.

Some talk moves can work for multiple practices. For example, questions to explicitly recognize youth expertise may also work to promote youth authority.

This tool can be used alongside the Equity Compass tool to enhance discussions on talk move goals and outcomes.

Some of these talk moves may look like ones you are used to seeing, such as revoicing. However, **we call attention to when and how these moves are used to desettle what/who matters in STEM and what expertise is and can look like.**

Examples of Talk Moves

Elevating Youth Voice

Revoicing & Expanding Youth Relationships and Multiple Forms/Sources of Expertise

"[Name] told a wonderful story about his grandmother teaching him to sew. **Do you want to share more** about the things she made?"
 "Who can restate Shamille's idea in their own words about animals in a flood model?" ["When her cousin's house flooded, they had to get the cats out too."] "Shamille, **is that what you were thinking?**"

Valuing alternative approaches, and artifacts in-process

[When youth make different design decisions than the educator]:
 "Ariel! I like the way you cut it. That's much easier than the way I told you." "**Oh, that worked too!** How did you make that part?"

Creating space to pursue "off-task amazing" moments

During a fingerprinting activity, youth began a spontaneous role play with one stating they had found another's fingerprints connecting her to a crime. The accused youth protested that her prints were in the room because it was *her* room. Another youth jumped in saying she was a lawyer and the accuser needed to show stronger evidence.
"Let's all continue with this role play. **Who else do we need?** A judge? Jury? What do we think about the evidence presented?"

Soliciting Youth Voice

Prompting Further Participation

"What do others think about the ideas we have so far about how we might use our robotic arms to help clean the room? **What would you add or change** to our list of ideas?"

Asking Youth to share reasoning, including on topics that do not immediately seem relevant or familiar

"Maddie, **can you say more** about that? **How** did your light up leash help the dog and dog walkers who tested it out?"

Create spaces for youth to lead by eliciting youth ideas via wait time, think/pair/share, etc.

"I want everyone to have a chance to think about their own ideas first and share them with a friend first."

Asking for and centering youth expertise

"Does anyone know how to sew?" "Would any of you help me lift my fingerprints?"

Vocalizing Vulnerability

Verbally acknowledging no one knows everything and we're meant to learn together

[When an educator makes a mistake regarding a project] "Oops! I am so sorry. **I actually don't know** how to do that. **Let's find out together!**"

Responding in the moment

Changing the direction of lessons based on youth ideas/questions

[When youth bring new ideas]: "Oh! I didn't think about it like that but **that totally makes sense!** Thanks for that point. **Would you share your idea** how we can [reflect youth idea]?"

EXIT PASS

Help us learn about how your day went!
You don't need to write your name.

<p>My ideas mattered in class today:</p> <p>YES</p> <p>NO</p>	<p>I felt proud of my work today:</p> <p>YES</p> <p>NO</p>
<p>How my ideas mattered (Circle all that apply):</p> <p>My teacher used my idea(s)</p> <p>My peers used my idea(s)</p> <p>I used my idea(s)</p> <p>Other (How?) _____</p>	<p>I had a chance to work on something I wanted to today:</p> <p>YES</p> <p>NO</p> <p>What I worked on: _____</p>
<p>I felt my ideas and work were noticed by others today:</p> <p>YES</p> <p>NO</p>	<p>Someone said something positive about my work today.</p> <p>YES</p> <p>NO</p>
<p>Who noticed? (Circle all that apply):</p> <p>My teacher</p> <p>My peers</p> <p>Other(s) (Who? _____)</p>	<p>Who said something positive? (Circle all that apply):</p> <p>My teacher</p> <p>My peers</p> <p>Other(s) (Who? _____)</p>



Equitable practice in action: Setting up and running an equitable youth board



How to set up and run an equitable youth board



YESTEM Insight

What is the Issue?

- Young people’s voices are often not included in the design of informal STEM learning (ISL) programmes and experiences.
- There is an increasing recognition of the value and benefits that come from working in participatory ways with young people, particularly with those from communities that are minoritised and excluded by society and by STEM.
- Youth boards (under various names, such as Youth Action Council, Youth Council, Direction Board, Youth Advisory Group, etc.) are one format of working in participatory ways with young people.
- It is important to think about issues of equity and social justice in relation to youth boards because approaches can range from tokenistic or even exploitative to meaningful and equitable.

In this insight, we bring together key ideas about how to set up and run a youth board in a way that is equitable, where dominant power relations are challenged and transformed, where young people are recognised and valued as partners, and where their contributions make a difference to the organisation, shaping its strategy and practice.

This document is intended for informal STEM learning practitioners, organisations and others thinking about participatory practice.

“Who knows young people better than young people themselves?”
(Practitioner)

How to cite this publication: YESTEM Project Team (2022). YESTEM Insight: How to set up and run an equitable youth board. yestem.org



Tips for setting up and running an equitable youth board

Before you start

1 Get a social justice mind set: Develop a sound understanding of what social justice and equity mean and entail. You might find it helpful to read, share and discuss resources such as the [Equity Compass](#) and [Core Equitable Practices](#).

2 Create a shared vision: Work collaboratively with others within and beyond your organisation to think about the purpose of the youth board. How might your organisation benefit from a youth board? What are the vision and goals of your youth board? How might you involve young people in establishing the vision and goals?

3 Get everyone on board: Bring the whole organisation with you so that everyone recognises the value and importance of the board. For a youth board to meaningfully represent youth voices, encourage innovation and drive changes, every department and staff at all levels need to understand and support the youth board. The whole organisation needs to value and take working with young people seriously.



Recruiting the youth board

4 Be proactive in your recruitment: Equitable recruitment takes effort and thought – a general advertisement is unlikely to reach and engage young people from communities that are traditionally under-represented in STEM and informal STEM learning (e.g., in relation to race/ethnicity, socioeconomic background, gender, dis/ability, gender identity and sexuality, etc.). Be proactive in how you get the message out – working with other local organisations and gatekeepers who are grounded in these communities can be useful. Listen and take advice on the channels and media that you use – one size rarely fits all! Consider offering a ‘taster’ or ‘find out more’ opportunity for potential applicants and their families.

5 Recognise the value and needs of board members: How will you recognise the value, time and work that the youth board put in? Will you pay or reimburse members for their time and travel costs? How will you support participation for a wide range of communities? Communicate clearly during the recruitment process what is provided and take advice on what support particular communities may need to be able to take part.

6 Encourage creative application formats: Make the opportunity as widely available and accessible as possible. Applications could be in different formats, not limited to a written form or a cover letter – for instance, applications could take the form of a short video.

7 Give feedback to unsuccessful applicants: Ensure a fair and transparent recruitment process and provide constructive feedback to unsuccessful applicants (direct them to future opportunities, where possible).

Tips for setting up and running an equitable youth board

Running the youth board

8 Welcome and care for youth board members: Provide induction and orientation process for new members so they feel welcomed. Provide training and support where appropriate. Ensure that everyone has a chance to get to know each other and understand their roles and responsibilities. Think about how to regularly 'check in' with board members.

9 Meet everyone's needs: Co-plan meetings and activities together with young people, at times suitable for them to attend. Put in place mechanisms to catch up on missed meetings. Provide practical support to young people to enable everyone to take part – such as providing refreshments, meeting travel costs, ensuring meetings are accessible to those living with disabilities, etc. Be proactive in identifying what else might be needed to support participation as needs can change.

10 Create safe spaces and practices: From the basics (e.g., health and safety, data protection, safeguarding) to more complex and sensitive issues around discussing inequalities and privilege and embedding issues of equity and social justice into everyday practice.


11 Work with young people: Ensure that board, roles, expectations and ways of working are co-designed, jointly agreed and clearly communicated. If the board want to have designated roles (e.g., Chairs, Co-Chairs, Treasurers) then work together to co-design the mechanisms to ensure that these are transparent and accessible.

12 Value everyone's voice and contributions: Create an ethos where all young people can share their ideas comfortably and feel that their contributions are being valued. Consider co-creating a 'code of conduct' together with the young people.

13 Make the board visible: Ensure that the Board has visibility and is included in public-facing materials of the organisation (while considering data protection and privacy of young people).

14 Give the board power and authority: Set up lines of accountability so that youth board's ideas and suggestions inform the wider organisation and can be actioned. The youth board should be connected to existing structures (e.g., a youth member is a representative to trustees, senior managers being mandated to act and respond). Provide time and space for board members' feedback to discuss improvements. If possible, give the youth board the resources they need in order to be effective (e.g., designated budget).

15 Make it count – support board members' futures: Provide ongoing support and development opportunities (e.g., support transferable skills, provide mentoring, direct young people to other to relevant opportunities).



"It's great when the zoo supports us, gives us a sense of pride in things that we've done and empowers us to do more."

Spotlight on practice: Youth Council at Knowle West Media Centre (UK)

Knowle West Media Centre, who run a range of programmes for young people, have long had a strong focus on equitable and participatory practice. For instance, they regularly sought young people's views and suggestions about the activities, to make sure the organisation is meeting the needs of the local young people.

Recently, the organisation decided to start a Youth Council to involve young people in a more formal and structured way. The young people were recruited from ongoing programmes, through being actively encouraged to come along to the Council meetings and share their views (See Tip #4: **Be proactive in your recruitment**). The Youth Council is open to everyone, and young people are free to drop in without having to commit to the participation long-term – this way, the practitioners are able to ensure that a broad range of voices is represented. As Dot, one of the practitioners, put it: “having an open-door policy allows us to hear more voices”, adding that such approach has helped them be more equitable and not exclude young people who might not be able to commit long term.

As young people join the Youth Council at different times, the facilitators ensure that everyone feels welcome. Facilitators make sure that the young people feel they are allowed to be there, even if they have not been there before, using ice breaker activities at the beginning of the sessions and ensuring that everyone has names and pronouns on their badges (See Tip #8: **Welcome and care for youth board members**).

The Youth Council would discuss things like activities for the next term's programme. With some suggestions being more feasible to realise than others, the practitioners ensure that all of the ideas are heard and responded to (See Tip #14: **Give the board power and authority**). For instance, while it is not always possible to accommodate every suggestion, it is important to hear and address these, which includes talking to young people about why some ideas might not be feasible at the time and what else they might be able to do instead.

“Young people have really good ideas; they are inspiring to talk to. This makes our work easier and more enjoyable.” (Practitioner)

Over time, the Youth Council has become a permanent and visible feature of Knowle West Media Centre as well as within the wider local community (See Tip #13: **Make the board visible**). The group has been instrumental in informing the themes that guided the activities, such as the focus on the environment, mental health and wellbeing, and celebrating the community. The facilitators also agreed that, overall, working with the Youth Council has made their work easier and more enjoyable – and they feel more comfortable that they are indeed responding to the needs and interests of the community. Young people, too, felt that their contributions were making a difference.



“Being part of the youth council means that young people are able to make a difference.” (Youth Council member)

Spotlight on practice: Youth Action Council at the Impression 5 (US)

Impression 5 Science Center noticed that they were losing participation in programmes among youth ages 12 and up. They were also concerned that the membership of the science center did not reflect the demographics of their city. The membership was whiter and more affluent than the city itself.

The leadership team discussed many different ideas for how to foster interest in the Science Center for older youth and youth of colour (See **Tip #2: Create a shared vision** and **Tip #3: Get everyone on board**). One idea they had was to build a new makerspace so that older youth could work independently on projects they cared about. As they began to plan for the makerspace, they knew that if the space was to be attractive to youth, they needed to include them authentically in the design process (See **Tip #14: Give the board power and authority**). Center leaders paused the design process until they could get a Youth Action Council, or YAC, up and running.

Designing and recruiting for the YAC involved many intentional steps. Several planning sessions were held among various stakeholders in the Science Center community and input was also sought from parents. Once the YAC was in place, Science Center educators worked with youth to co-plan activities and experiences.

Center leadership also sought to ensure the YAC reflected the city's diversity, racially and economically. In addition to publicising the new YAC on the Center's social media to garner interest, educators also reached out to community organisations and school districts

to get the word out. Center membership was offered to the families of YAC members. Bus passes and help with organising transportation was provided to those youth who needed it. (See **Tip #4: Be proactive in your recruitment**).

When the makerspace was completed, the Science Center organised a grand opening to recognise the young people's work (See **Tip #13: Make the board visible**). In a speech delivered to the press and supporters, YAC member Jay gave the following speech:

“ The YAC is a group of kids who want to inspire other kids on making. We are a group of 9-year-olds and up. We had many meetings to help design activities and give feedback. We also gave ideas for what the space needed to look like - VERY COLORFUL! We designed the room to be a place where we can be inspired, and have fun. When we started this off this was just a room full of dust. We built the space for other kids to innovate and be creative. ”

The YAC's work extended beyond the design of the makerspace as youth brought in new ideas and concerns. For example, they challenged the Center to become less male and less white, and to incorporate more signage, imagery and experiences that reflected their lives and interests. These challenges led to new YAC projects, such as the design of the Katherine Johnson room (See **Tip #11: Work with young people**). This work involved conversations about racism and experiences of discrimination, which made some YAC members uncomfortable. Micaela, who led many of these conversations, ensured that everyone was listened to and heard, and that the group was respectful and empathetic to different experiences and perspectives (See **Tip #10: Create safe spaces and practices**).



“ You need to make sure the activities allow kids to solve the problems they care about, and that we feel like we can solve those problems here. ”

(Youth Action Council member)

About the YESTEM project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people (1,873 in the UK and 910 in the US).



Additional resources

- See [YESTEM Insight 1: The Equity Compass: A Tool for supporting socially just practice](#) and [YESTEM Insight 2: What are Core Equitable Practices in informal STEM learning?](#)
- Watch a short film about the [Direction Board at Hanwell Zoo](#)

We want to thank young people from four youth boards who contributed to and reviewed this insight:

- Direction Board at Hanwell Zoo (UK)
- Youth Council at Knowle West Media Centre (UK)
- Youth Action Council at Impression 5 (US)
- Youth Teen Leaders at the Boys & Girls Club of Lansing (US)



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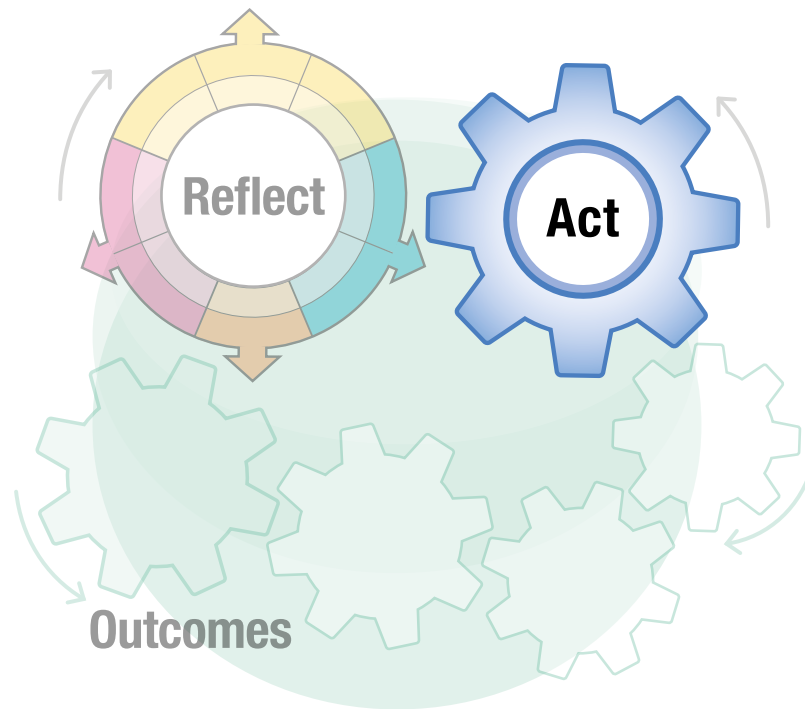
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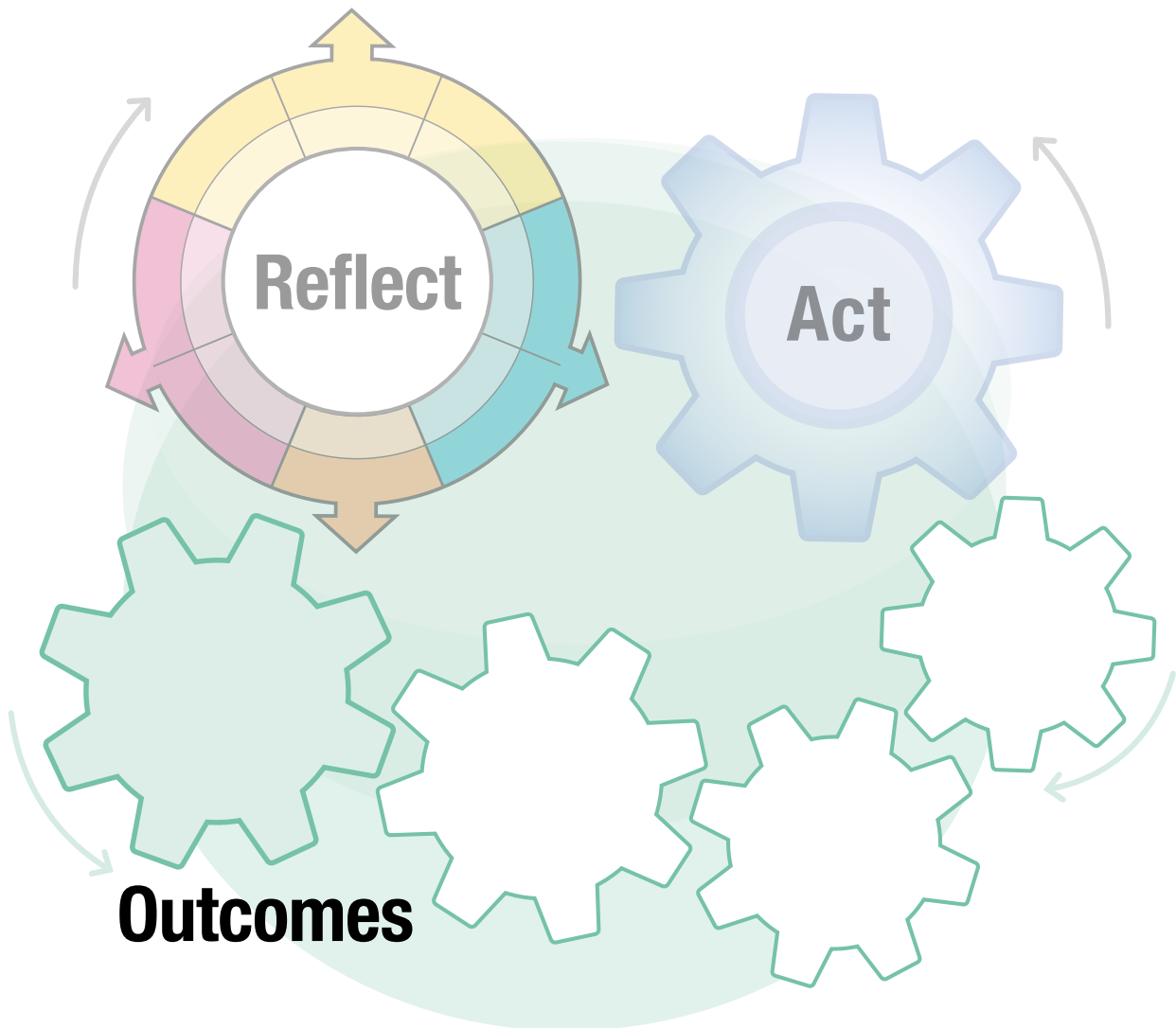




For more resources related to the Act part of the YESTEM model, please see yestem.org

- Translations

OUTCOMES





Equitable Youth Outcomes Model for informal STEM learning

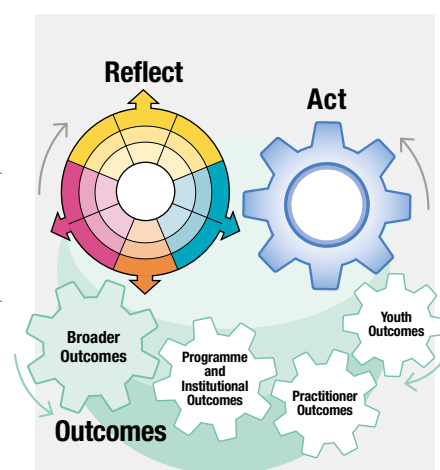


YESTEM Insight #3.1

What is the Issue?

- Young people can derive a range of positive outcomes from taking part in informal science, technology, engineering and mathematics (STEM) learning.
- Evidence shows that informal STEM learning (ISL) participation often reproduces dominant relations of power and privilege. In other words, **outcomes from ISL are not always equitable.**
- Thinking about young people’s experiences in ISL from an equity perspective is important if we want to challenge social inequalities and better support all young people, but particularly those whose experiences are adversely shaped by intersecting social inequalities, such as racism, sexism and social class.

This YESTEM Insight explains our Equitable Youth Outcomes Model for ISL, intended for ISL researchers, practitioners, organisations and funders. **The model can serve as a tool for recognising equitable youth outcomes from ISL participation, for reflecting on current practice and for planning further opportunities that best support such outcomes.**



YESTEM Model for equity in ISL

Please see yestem.org for the full model and related Insight documents detailing each component.

How to cite this publication: YESTEM Project Team (2021). YESTEM Insight 3.1: Equitable Youth Outcomes Model for informal STEM learning. yestem.org



What are Equitable Youth Outcomes?

Many practitioners and organisations think about the kinds of outcomes young people generate through ISL participation in terms of enjoyment, fun, learning, socialising, and skill development.

While there are many frameworks available to evaluate ISL outcomes, there is little to help practitioners assess the extent to which outcomes are equitable.

Positive outcomes tend to be easier to come by for young people from dominant groups, while young people from minoritised¹ backgrounds experience injustices that impact the extent to which they feel respected, valued and represented in ISL, how far they are supported to feel that they belong in ISL in ways that are true to themselves and affects the outcomes of their participation.

The focus on equitable youth outcomes helps to 'cut through' generic outcomes data to identify outcomes with a greater equitable potential.

While a programme might support a range of positive outcomes for young people, this focus can help you identify and critically question those that are reinforcing positive STEM outcomes and experiences for privileged young people versus those that are supporting equitable outcomes for young people from minoritised communities.

The model focuses on what makes particular outcomes equitable. We frame equitable youth outcomes as those that **challenge, disrupt and transform unjust dominant power relations and practices** through ISL participation, and those that **meaningfully support young people from minoritised groups in gaining positive outcomes**, feel welcome and have a sense of ownership and 'rightful presence'² within an ISL setting.

Equitable youth outcomes can be individual and/or collective; they both support the individual young people and transform unjust power relations in support of new patterns of participation and engagement.

¹ We use the term 'minoritised' as a shorthand for individuals and communities who are minoritised by dominant culture/society. Using 'minoritised' rather than 'minority' puts the emphasis on the systemic issues and structures that are failing to sufficiently recognise, support and value some people. People can be minoritised within a particular society depending on their race/ethnicity, gender, socioeconomic background, dis/ability, sexuality and other social axes. We acknowledge that labels are always imperfect and provisional and can vary in meaning and interpretation over time and between contexts, e.g., internationally, across different professional sectors, communities and between researchers, practitioners and young people.

² By 'rightful presence', we refer to young people being welcomed into the ISL community, where their discourses, practices, knowledge and lived experiences are powerful resources for meaningful engagement. The framing of rightful presence underscores how young people have long been engaged with science, whether this is recognised by those in power or not. See Calabrese Barton & Tan (2020). Beyond equity as inclusion: A framework of "rightful presence" for guiding justice-oriented studies in teaching and learning.

The Equitable Youth Outcomes Model for informal STEM learning

- The Equitable Youth Outcomes Model for ISL uses the Equity Compass, which we developed with YESTEM ISL practitioners to reflect on and develop equitable practice. The Equity Compass helps us consider which outcomes are more and which are less equitable, through applying four main ways to think about equity.
- The model is organised by Question starters (corresponding to the Equity Compass areas) that practitioners could use to identify equitable youth outcomes.
- **The model does not provide a prescriptive, definitive method for capturing equitable youth outcomes.** Rather, it provides a framework and guidance for how different dimensions of equity could be applied to consider outcomes (whatever outcomes you might be recording for your programme or activity). To illustrate how this could be done, we apply the Equity Compass to consider four types of outcomes that we focused on in the YESTEM project: STEM capital, STEM identity work, Agency+ and STEM trajectories.
- **Equitable youth outcomes can be identified through qualitative and quantitative data.** See the two Spotlights below with examples of what data practitioners might collect to identify equitable youth outcomes.



The Equitable Youth Outcomes Model for informal STEM learning

- Start by thinking about the Equity Compass dimensions and the practices they highlight. Then consider 'so what' by working with the question starters and endings from the Equitable Youth Outcomes Model for ISL to reflect on practices in your context.
- In the next step, think about 'how do we know' – what data you might already have (or could collect going forward) to identify equitable outcomes.
- Finally, consider 'now what', setting priorities for collecting and using data and further developing your practice to support equitable outcomes.

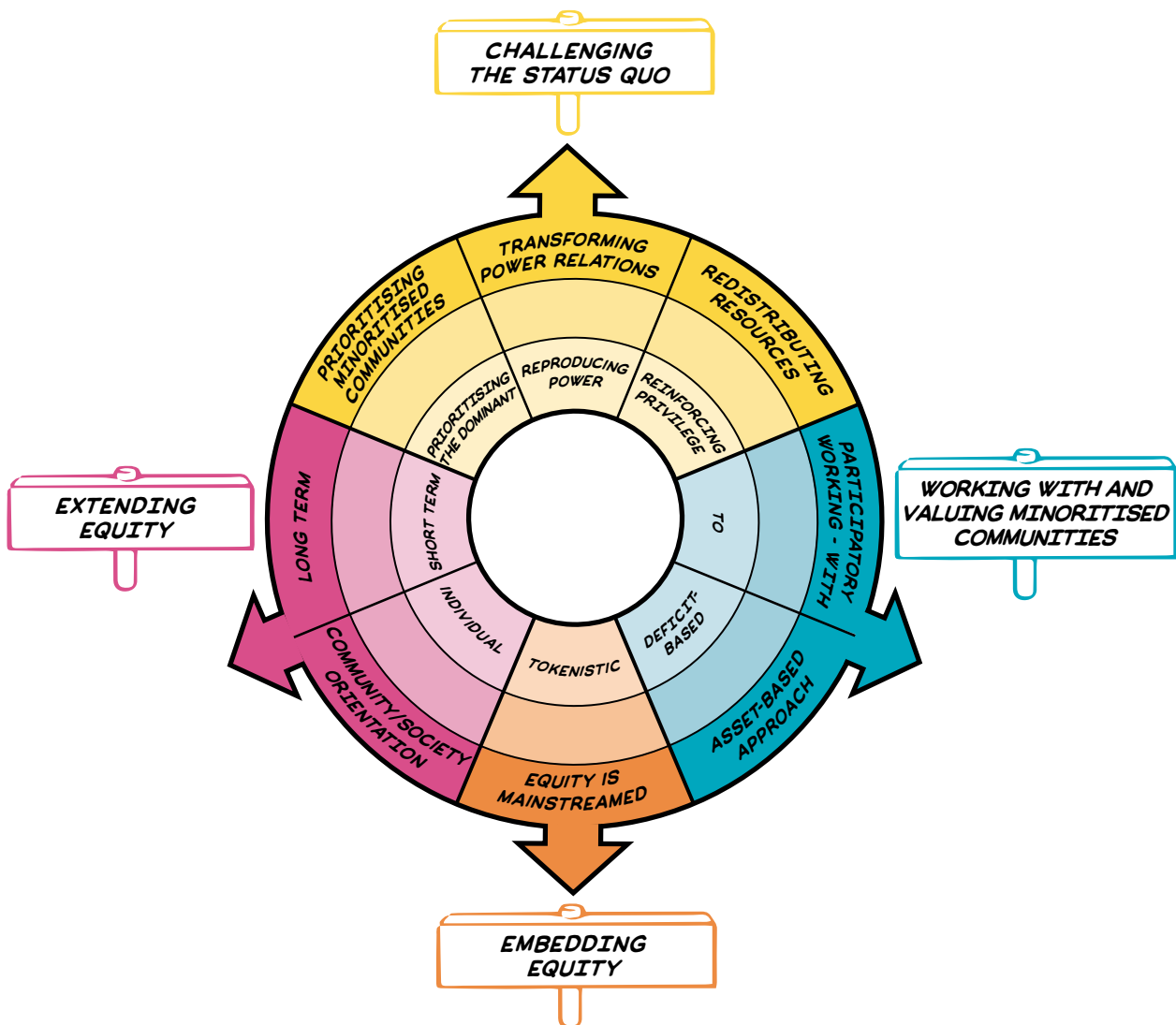


Figure 1: The Equity Compass

The Equitable Youth Outcomes Model for informal STEM learning

QUESTION STARTER (corresponding to the Equity Compass area)	YOUTH OUTCOMES			
	STEM CAPITAL	STEM IDENTITY WORK	AGENCY +	STEM TRAJECTORIES
<p>To what extent was the status quo challenged, so that youth ...</p> <p>CHALLENGING THE STATUS QUO</p>	... experience ISL as disrupting and transforming what counts as STEM (beyond traditional content, skills and practices)?	... experience ISL as disrupting and transforming who counts in STEM (beyond traditional representations)?	... have opportunities and support to use STEM to challenge injustices and 'make a difference' through their contributions?	... feel supported towards socially just life trajectories?
<p>To what extent have ISL practitioners worked with and valued minoritised communities, so that youth from these communities ...</p> <p>WORKING WITH AND VALUING MINORITISED COMMUNITIES</p>	... feel that their knowledge, skills and experiences are recognised, valued and expanded?	<p>... feel that their identities/ histories/ communities are valued and represented?</p> <p>... have a sense of ownership and belonging within ISL and STEM?</p>	... feel that they have authority and are being heard?	... feel supported in their desired life trajectories, in STEM and beyond?
<p>To what extent has equitable ISL practice been extended, so that ...</p> <p>EXTENDING EQUITY</p>	<p>... equitable youth outcomes are sustained over time (long-term)?</p> <p>... ISL supports not only individual but also wider equitable outcomes (e.g., for others, community, society)?</p>			
<p>To what extent has equitable ISL practice been embedded, so that...</p> <p>EMBEDDING EQUITY</p>	... equitable youth outcomes are prioritised across the whole ISL organisation?			

Spotlight on practice: Identifying equitable youth outcomes at a community zoo (UK)

Cole runs educational programmes with young people at a community zoo and wanted to use the model to inform how he collects data, reflects and then refines his **holiday programme**.

Prior to his involvement with the YESTEM project, Cole would typically record outcomes from his sessions using a short exit survey that anonymously asked about things like the enjoyment of the activities ('How much did you enjoy the activity?'). Cole admitted that the evaluations often resulted in "hearing what we wanted to hear" because the "topic that we're talking about is quite exciting and it is fun." On reflection, Cole told us that the equity focus was implied but there was little data to understand if the programmes supported equitable youth outcomes, or not, or even moving in the right direction.

Considering the Equity Compass, Cole decided to rethink his approach to collecting data and making claims about outcomes for the new holiday programme for young people from low-income families. For instance, Cole planned to keep **observational records** during the sessions and follow up with individual participants about their outcomes and whether the programme activities lead to 'making a difference' and support wider outcomes. Committed to challenging the status quo, Cole also intended to lead a **group discussion about what and who counts as science** (which he anticipated would contribute to data about how the programme is helping to challenge dominant views about what it means to do science and be a science person).

Cole found it difficult to know the extent to which programmes were supporting minoritised young people. He planned to improve this by i) **collecting key demographic data alongside other evaluation data**, and ii) analysing the data by paying attention to **how outcomes might differ between young people**, and the extent to which the programme was supporting minoritised young people (and thus redistributing resources rather than reinforcing privilege). Cole decided to keep an exit survey, but revised the items by adding questions that would help identify equitable outcomes, such as relating to participatory practice and the asset-based approach (e.g., 'I was able to make a contribution during the programme. '; 'I felt heard.').



Cole reflected on how a stronger focus on equity has helped the zoo embed an equitable stance in everything they do, ensuring that supporting equitable practice is at the heart of the zoo's practice.

"As conservation educators we always label our stuff as for everyone: everyone's welcome, ... but, in practice, it's not always this way. So, by achieving these equitable outcomes, meaning that we have to proactively do something from when we're designing the programme to when we're marketing the programme and allocating spaces, delivering the programme and then evaluating the programme, at each step of the way, it's our actions that are going to affect how equitable the programme is and, therefore, the outcomes."

Spotlight on practice: Identifying equitable youth outcomes from a Youth Action Council (US)

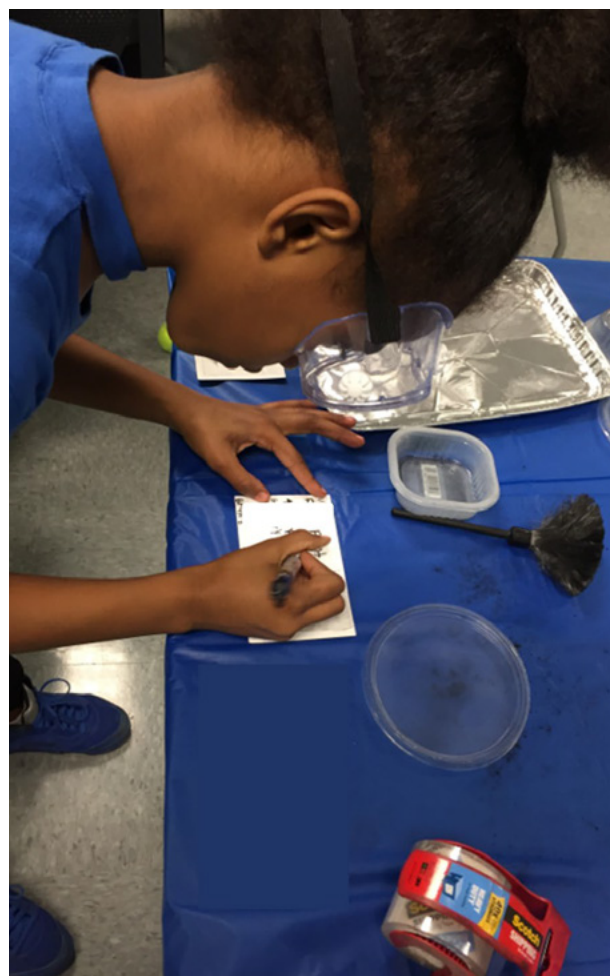
Chris has worked with a group of young people via the Youth Action Council (YAC) programme at a Science Centre. Together with his colleagues, he was keen to use YESTEM tools to examine youth outcomes from an equity perspective.

He recorded outcomes from the YAC sessions through i) **collecting the artifacts** that young people generated during the sessions, ii) **engaging in conversations with young people**, asking about their experiences and suggestions for the session activities, and iii) using exit surveys that asked about the enjoyment and challenge of the activities ('What did you enjoy and why? What was challenging and why?') and relevance of the activities to their lives ('How do your projects connect to your life?').

YAC involved several young people from minoritised backgrounds (Black, lower socioeconomic backgrounds) and Chris was keen to record how outcomes they gained compared to more privileged (White, wealthier) young people. For instance, Chris paid attention to not only what outcomes young people were gaining, but also who was gaining the outcomes, to ensure that minoritised young people are supported.

Chris used these outcomes data he collected from every YAC session to inform his planning of the next YAC sessions. For example, he designed an activity in which youth were encouraged to design and create posters that would showcase their interests and talents in science and making. This activity was designed drawing **on his reflection on the outcomes data** where he identified that some of the participating young people did not feel that they were able to share their interests during the session and did not always feel that their contributions were being heard.

Chris' practice also illustrates that outcomes do not need to only be collected at set points, or at the end of the programme, but that practitioners can engage in dialogue with young people throughout their participation (through what we called moment-to-moment engagement with youth outcomes). For instance, during the aforementioned poster activity,



several young people criticised Chris' instructions (e.g., 'It feels like schoolwork.', 'We don't wanna do this!', 'You write all this stuff, and in the end it doesn't really matter.'). which Chris interpreted as young people feeling that the session is done 'to' them rather than meaningfully created 'with' them (reflecting participatory approach) and that they felt that their work was not recognised (their assets not being valued). Chris acknowledged the critique as valuable evaluation insight, and acted upon it immediately to improve the session toward becoming more participatory, inviting youth to be the organisers and co-producers of the ISL activity.

The Equitable Youth Outcomes Model: Worksheet for recording equitable outcomes

Use this worksheet to map out what you know about equitable youth outcomes in your setting, what evidence you already have and what further evidence you need to answer the questions. You can use the worksheet to map equitable outcomes in a programme over time. You can use the model to plan equitable outcomes into your practices (formative evaluation), as you go through a particular programme (on-going evaluation) as well as at the end of a piece of work (summative evaluation).

QUESTION STARTER	YOUTH OUTCOMES	WHAT EVIDENCE DO I ALREADY HAVE?	WHAT FURTHER EVIDENCE MIGHT I NEED?
<p>To what extent was the status quo challenged, so that youth ...</p> <p>CHALLENGING THE STATUS QUO</p>	<p>... experience ISL as disrupting and transforming what counts as STEM (beyond traditional content, skills and practices)? [STEM capital]</p> <p>... experience ISL as disrupting and transforming who counts in STEM (beyond traditional representations)? [STEM identity work]</p> <p>... have opportunities and support to use STEM to challenge injustices and 'make a difference' through their contributions? [Agency +]</p> <p>... feel supported towards socially just life trajectories? [STEM trajectories]</p>		
<p>To what extent have ISL practitioners worked with and valued minoritised communities so that youth from these communities ...</p> <p>WORKING WITH AND VALUING MINORITISED COMMUNITIES</p>	<p>... feel that their knowledge, skills and experiences are recognised, valued and expanded? [STEM capital]</p> <p>... feel that their identities/histories/ communities are valued and represented? ... have a sense of ownership and belonging within ISL and STEM? [STEM identity work]</p>		

The Equitable Youth Outcomes Model: Worksheet for recording equitable outcomes

QUESTION STARTER	YOUTH OUTCOMES	WHAT EVIDENCE DO I ALREADY HAVE?	WHAT FURTHER EVIDENCE MIGHT I NEED?
To what extent have ISL practitioners worked with and valued minoritised communities so that youth from these communities ...	<p>... feel that they have authority and are being heard? [Agency +]</p> <p>... feel supported in their desired life trajectories, in STEM and beyond? [STEM trajectories]</p>		
To what extent has equitable ISL practice been extended so that ...	<p>... equitable youth outcomes are sustained over time (long-term)?</p> <p>... ISL supports not only individual but also wider equitable outcomes (e.g., for others, community, society)?</p>		
To what extent has ISL practice been extended so that ...	<p>... equitable youth outcomes are prioritised across the whole ISL organisation?</p>		

Ideas of evidence to collect



Who might use the Equitable Youth Outcomes Model and how?

Informal STEM learning practitioners and organisations

- The model is designed to be used alongside existing formative, on-going and summative evaluation tools to support a focus on equity.
- The model can also be used as a reflective tool to help support equitable practice (together with the Equity Compass) when planning programmes, exhibitions, staff development and so on, to support opportunities for enhancing equitable youth outcomes across different institutional practices.
- Use the model to help foreground the issues of equity when thinking about and planning for young people's outcomes from ISL, particularly in working with minoritised communities.

Funders

- Funders could help by supporting meaningful and complex approaches to evaluation and project reporting that take equity seriously and recognise the complexity of evidencing equitable outcomes.
- Support long-term investment in young people, ISL practitioners and ISL institutions to help support the achievement of equitable, consequential outcomes for all parties.

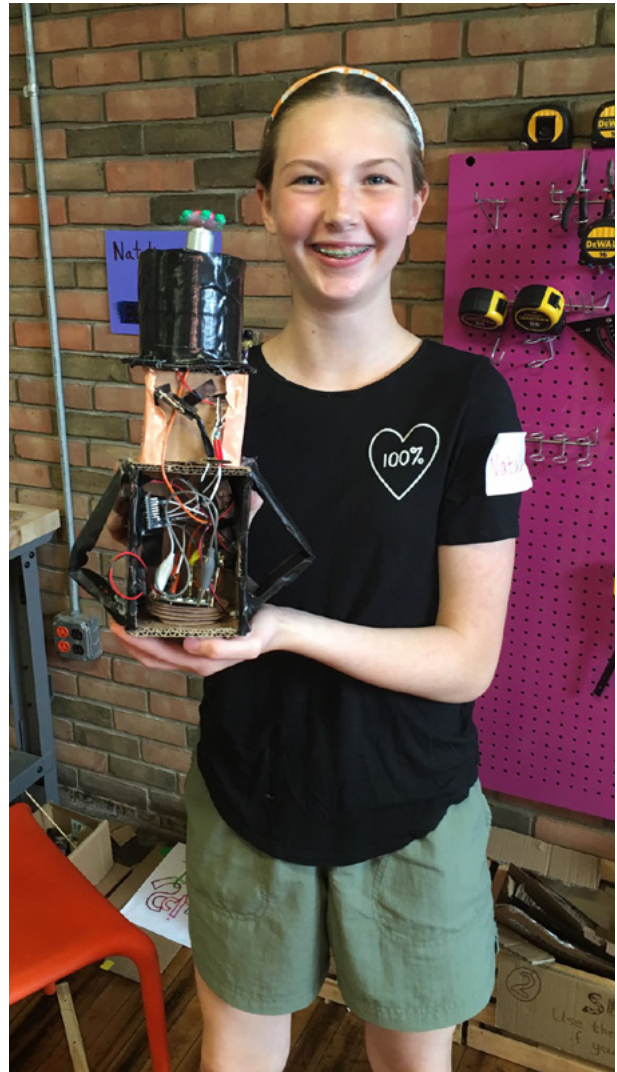


About the YESTEM project

- Over four years, our project involved researchers, ISL educators and young people working in partnership to develop new understandings and insights about how ISL might better support equitable outcomes for young people aged 11-14 from minoritized communities.
- Our project partnership involved data collection in the UK and the USA with partners in two science centres, two community STEM clubs, a zoo and a digital arts centre.
- Overall, 260 young people and 30 practitioners took part.
- In the wider project we also conducted surveys with 2,783 young people (1,873 in the UK and 910 in the US).

Additional resources

- See [YESTEM Insight 1: The Equity Compass: A Tool for supporting socially just practice](#).
- Click [here](#) to see a 2-minute animation explaining the Equity Compass.



This material is based upon work supported under a collaboration between the National Science Foundation (NSF), Wellcome, and the Economic and Social Research Council (ESRC) via a grant from the NSF (NSF grant no. 1647033) and a grant from Wellcome with ESRC (Wellcome Trust grant no. 206258/Z/17/A)

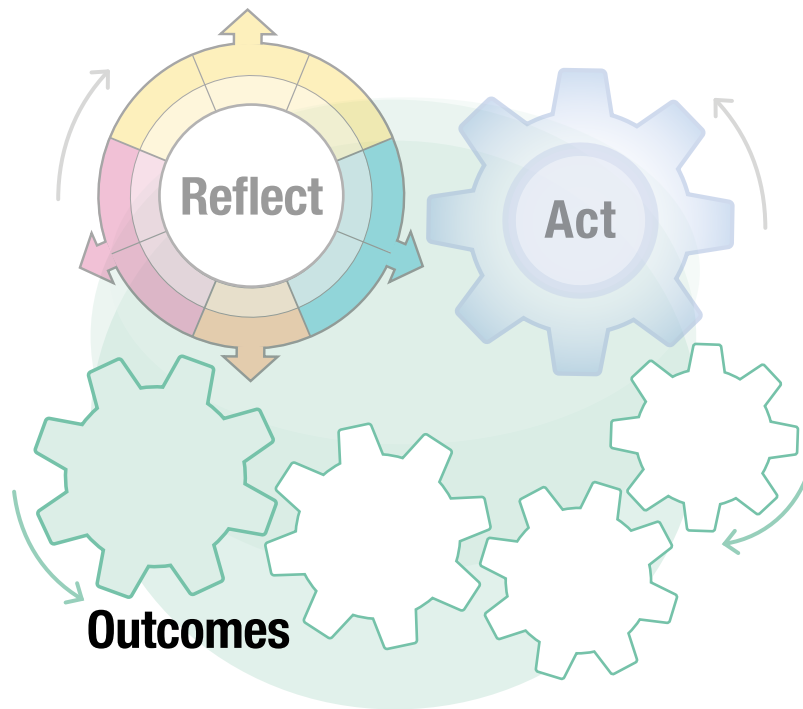
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For more resources related to the Outcomes part of the YESTEM model, please see yestem.org

- Translations

The resources in this pack were co-developed by academic researchers and informal STEM learning practitioners.

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