

## Out-of-School Time: Divergent Learning, Divergent Opportunities

Barry Fishman (co-chair), University of Michigan, [fishman@umich.edu](mailto:fishman@umich.edu)  
Leslie Rupert Herrenkohl (co-chair), University of Michigan, [leslierh@umich.edu](mailto:leslierh@umich.edu)  
Nichole Pinkard (co-chair), Northwestern University, [nichole.pinkard@northwestern.edu](mailto:nichole.pinkard@northwestern.edu)  
Katie Headrick Taylor (co-chair), University of Washington, [kht126@uw.edu](mailto:kht126@uw.edu)  
Steve Cederquist, University of Michigan, [cedsteve@umich.edu](mailto:cedsteve@umich.edu)  
Xingjian Gu, University of Michigan, [xjgu@umich.edu](mailto:xjgu@umich.edu)  
Denise Jones, University of Michigan, [jonesdee@umich.edu](mailto:jonesdee@umich.edu)  
Jiyong Lee, University of Washington, [jyoungl@uw.edu](mailto:jyoungl@uw.edu)  
Lo Lee, University of Michigan, [lololee@umich.edu](mailto:lololee@umich.edu)  
Yolanda Majors, Hurston Institute for Learning & Development, [yolandamajors@hurstongroup.com](mailto:yolandamajors@hurstongroup.com)  
CaVar Reid, University of Michigan, [reidcav@umich.edu](mailto:reidcav@umich.edu)  
Alex Samuelson, Hurston Institute for Learning & Development, [alexsam@hurstongroup.com](mailto:alexsam@hurstongroup.com)

Andrés Henriquez (discussant), Educational Development Center, [ahenriquez@edc.org](mailto:ahenriquez@edc.org)  
William Penuel (discussant), University of Colorado Boulder, [william.penuel@colorado.edu](mailto:william.penuel@colorado.edu)  
Kylie Peppler (discussant), University of California Irvine, [kpeppler@uci.edu](mailto:kpeppler@uci.edu)

**Abstract:** This symposium presents an exploration of how three different out-of-school-time (OST) or informal learning contexts shape both the nature of learning opportunities and also potential future learning trajectories for the youth engaged in these OST activities. A goal of the symposium is to highlight both divergence and congruence across OST settings, highlighting the spectrum of learning opportunities and perspectives on learning across different contexts. Discussants will critique the work against the larger universe of OST/informal learning study in the Learning Sciences and invite the community to engage with this work towards developing common ways to describe learning in OST contexts.

### Symposium overview

Learning happens everywhere. Though much scholarship on learning focuses on formal or school-based settings, the Learning Sciences has long championed work on learning in out-of-school time or informal settings as well (e.g., Crowley et al., 2014; Halverson & Peppler, 2018; Lyons, 2018). This symposium explores learning in three different and divergent out-of-school time (OST) providers in order to highlight how purpose and context lead to different types of learning, and in turn how those differences can shape future learning opportunities. Such an exploration is important for several reasons. First, though there has been much excellent work focused on the design of OST activities, there has been less attention paid to documenting OST learning (Tai et al., 2021). Such documentation can be useful not only for learner use in future aspirations, but also for OST providers in making a case for their impact and for securing ongoing funding. Second, a better understanding of the learning within OST contexts and how that learning is valued by youth and families allows providers to tune their offerings to better serve their intended audiences. And finally, understanding and documenting learning in OST settings can help elevate its role in accessing future learning opportunities.

In this symposium, we aim to both clarify and problematize different aspects of OST learning. The symposium presentations strive to highlight tensions inherent in this work, including how to include a focus on assessment in informal learning without inadvertently “formalizing” it, how to create systems that sustain learning and development, and how to balance sometimes conflicting stakeholder values. Another way to consider this is to ask who “owns” learning, school or individuals/communities (Fishman & Herrenkohl, 2022)? Attempts to formalize learning tend to cast it in a school-based frame, whereas valuable learning often does not fit into formal frameworks or structures.

The three OST contexts represented in this symposium are all partners in the Mastery in Out-of-School-Time Learning, or MOST project, a study exploring the potential for documenting OST learning for future use in college admissions, job seeking, or simply further OST learning. The OST providers were purposefully selected for their differences. One is a university-sponsored college preparatory program designed to enrich learning for high school students in a particular region and prepare them for success in higher education. Another is a middle-grades coding program designed to enhance learner self-concept around computing. The third is a community-based program for mixed income, refugee and immigrant youth. To study learning opportunities in each of these OST contexts, researchers conducted interviews and focus groups with youth and families engaged in the

activities, and with the providers of the OST activities. The interviews and focus groups were transcribed and coded qualitatively to identify learning opportunities and other themes related to values, engagement, and similar topics. As part of this same project, researchers are also conducting qualitative interviews with college admissions personnel, with the ultimate aim of developing a transcript-like representation of learning that could play a role in the college admissions process. This symposium will not present findings from the college admissions perspective, though individual presentations will reference this work.

The symposium will open with presentations about the types of learning opportunities observed in each OST context, with cross-cutting discussion highlighting differences and how these differences are related to how we might report on learning in ways that are both valued by learners and which might be recognized by others seeking to evaluate readiness for future learning or work. After the three presentations, featured discussants representing a range of expertise in the study of OST learning will present commentary and critique, and then the conversation will be opened to all. This symposium is a space for interrogating a spectrum of informal learning contexts to consider how activities that differ along that spectrum are framed and understood by different groups, including potential consumers of information about youth OST learning. Our hope is that this symposium advances the field's thinking about how to frame and study learning in OST settings.

## **Wolverine Pathways: OST learning as preparation for college success**

Lo Lee, University of Michigan, [loloolee@umich.edu](mailto:loloolee@umich.edu)  
Denise Jones, University of Michigan, [jonesdee@umich.edu](mailto:jonesdee@umich.edu)  
CaVar Reid, University of Michigan, [reidcav@umich.edu](mailto:reidcav@umich.edu)  
Steve Cederquist, University of Michigan, [cedsteve@umich.edu](mailto:cedsteve@umich.edu)  
Xingjian Gu, University of Michigan, [xjgu@umich.edu](mailto:xjgu@umich.edu)  
Barry Fishman (co-chair), University of Michigan, [fishman@umich.edu](mailto:fishman@umich.edu)  
Leslie Rupert Herrenkohl (co-chair), University of Michigan, [leslierh@umich.edu](mailto:leslierh@umich.edu)

Wolverine Pathways (WP) is a supplementary pre-collegiate program that provides free college preparatory enrichment and advanced academic programming for 7th through 12th grade students in Detroit, Ypsilanti, Southfield, and Grand Rapids, Michigan. WP works to confront the barriers that limit the college and career aspirations of highly motivated students from under-resourced communities in Michigan, believing that every student deserves the opportunity to pursue a wide range of professional and academic pathways. Since its inception in 2016, Wolverine Pathways has served over 1,100 students in southeastern Michigan, has awarded over 200 full-tuition scholarships for the University of Michigan, and boasts an overall 90% matriculation rate to competitive four-year institutions for its scholars. The student body of WP is racially, ethnically, and socio-economically diverse, with over 80% being Black/African American and Latinx/Hispanic, and nearly 50% requiring free or reduced lunch. Additionally, over 30% of WP alumni are first-generation college students.

Youth involved in WP experience rigorous advanced coursework, success coaching, and individualized tutoring that sets them up for early college success. They explore career opportunities through internships, career days, and informational interviews with WP corporate partners, such as an automotive company and an IT organization. Participants have opportunities to explore the UM campus and take a summer course from UM faculty. They also gain a network of mentors, professionals, and peers who offer support and guidance on their academic journey.

Through the first round of conversations, we interviewed 24 youths and 10 WP alumni (current undergraduates). All interviews were audio recorded upon agreement and transcribed for later analysis. Following the qualitative content analysis technique (Hsieh & Shannon, 2005) and social moderation process (Frederiksen et al., 1998; Herrenkohl & Cornelius, 2013), we open-coded each document and created codes inductively. Each data source, including verbatim transcripts and interpretable content logs, was coded at least twice using qualitative data analysis software, Dedoose. When one document was finished with coding by two coders, the first and second coders would meet to discuss discrepancies in code applications and excerpts, reach a consensus, or agree to disagree. We also created memos throughout data analysis to record thoughts that may serve to inspire insight in later analysis.

Based on our data, we report four preliminary themes that illustrate how youth engaged in OST STEM learning. First, overall, youth found their participation in WP helpful in seeking college admission, exploring career interests, and gaining real-world experiences. One interesting point shown in the interviews is that although youth may not be willing to join the program at the very beginning when their parents asked them, they still regularly returned to WP because they would like to see and hang out with their friends there. Some youth were

also aware of the benefits brought by WP regarding college preparation. For example, Melanie, a senior in high school who has participated in WP since the sixth grade, explained why she chose to stay in WP for years:

Many of my friends dropped out of Wolverine Pathways around seventh or eighth grade, in one or two years. But I stuck around because I genuinely saw the potential in it. [...] I was fortunate enough not to have sports or anything to do. Plus, even people who didn't have sports just really weren't committed. I was committed because I honestly valued it enough to keep sticking to going because I liked it too. I got to be around my friends, and it was college readiness and all of the opportunities and benefits that come along with it. That's why I stuck around. (Melanie)

Second, other than being aware of the future, youth in WP also displayed a keen awareness of the world around them. This is especially true when youth expressed how they were able to connect OST learning to their everyday life and attach meaning to the learning experience. Relatedly, they touched on the value of sharing when they stated how they got chances to showcase their learning outcomes in a wide variety of settings and with different people. For instance, Tanya, a high school student, elaborated on how she seized opportunities to share what she learned both in formal schooling and outside of classes:

I'm a big supporter of connecting different assets in my life together. In school, if I learned something from Wolverine Pathways, and it applies to what I'm learning in class, I'll definitely raise my hand and talk about it, like the math stuff we learned. I'll even spout out random facts to my friends sometimes. [...] In Wolverine Pathways, we used to have an academic showcase at the end of every session where all of the scholars would come together and do a little group-project, final-project-type thing and present what they learned in the course for the entire session. I remember when I did in the pharmacology lab [...] at the end of the session, we came back with this giant poster board with all the stuff we learned and all the processes we did [...] The final presentation was a really great way for us to look back and see how much we actually learned. (Tanya)

The third theme we identified revolves around transferable skills that youth developed after joining WP courses. In particular, many youth brought up information and financial literacy and interpreted them as essential skills when asked about what they learned and found helpful in WP. By attending relevant classes in WP, youth developed practical knowledge on how to evaluate the credibility of information sources and realized they could begin managing their finances before college. This point and the mentioned two skills reflect the role of transferability in OST learning by which youth could apply what they acquired to various contexts beyond schooling. Tiffany and Lydia, both high school students who took part in WP for years, highlighted the breadth of WP programming and how it helped them grow:

I feel the things I get in Wolverine Pathways I wasn't getting in my regular academic regime - like the classes they were offering. I got financial literacy when I was in 6th grade. You don't even get econ until you are a freshman in high school. (Tiffany)

Wolverine Pathways really holds you accountable for your whole journey, like a big picture of where you want to be and what your values are. Like, they want you to go to them and get into U of M, but they're also like, "what do you want to do in life?" And like, "how do you get there?" And other soft skills like networking, researching topics online or fact-checking the news. So it really is a well-rounded resource base for you to discover ways to be a good person and be a competent student going into college. (Lydia)

The last theme we recognized, which can be considered an extension of our first theme on the significance of peers for youth, is the value youth placed on in-person learning in an OST setting. To youth participating in WP, their continual physical interaction with peers is a crucial factor leading to their profound engagement in OST learning. Accordingly, the lack of bodily interaction resulting from COVID, mainly causing the change from physical to remote learning, was regarded as unfavorable to a lot of youth. Melanie gave a great illustration of how she treated WP as a big family:

Before the pandemic, it was a very family-oriented vibe because we saw each other in person every day. It was very much giving family in Wolverine Pathways because we had songs; we

sang, like we had the good morning song, we had different songs. So I feel relationships, friends, and new friends I made were very valuable at Wolverine Pathways. (Melanie)

Furthermore, the disadvantage of remote learning is also mentioned by some parents who highly suggested WP add more physical events to increase face-to-face interaction between students. For instance, Wayne, a father whose two daughters are both parts of WP, noted that it would be “neat” if WP could “somehow facilitate a monthly potluck dinner in one of the dorms or something for the WP kids” that attended U of M. Wayne explained that this was especially true for those who went through WP virtually due to COVID because in-person gatherings would benefit youth to have some camaraderie and support during their first year of college.

Based on the preliminary themes above, we identified an emerging tension in documenting OST STEM learning. As shown by youth, what they learned through participating in WP is often unquantifiable. For instance, Melanie illustrated why she decided to be part of WP for many years, whereas she saw some of her friends dropping out. Here, we are able to recognize her perseverance and awareness of the benefit of OST learning as a way to prepare her for the future. In the case of Tanya, she expressed how she was capable of building connections between what she learned and, if applicable, knowing when to demonstrate her learning to people. We find this showcasing skill crucial in youth’s learning experiences in WP, though it may be difficult to appropriately capture in the current documentation system for college admission. Apart from Melanie and Tanya, the information and financial literacy skills described by Tiffany, which are also commonly shared by other youth, are critical abilities to be applied in everyday life. Nonetheless, since such non-academic skills are usually hard to assess using numerical data or a quantitative approach (Stasz, 2001), it can be a potential challenge to overcome in the documentation. In other words, how may we foreground the processual aspect of OST learning by treating it as multidimensional rather than one-dimensional to demonstrate its qualitative and interpretable value?

## “The spaces and places she’s in”: Digital Divas and the work of families forging a youth STEM identity

Nichole Pinkard (co-chair), Northwestern University, [nichole.pinkard@northwestern.edu](mailto:nichole.pinkard@northwestern.edu)  
Yolanda Majors, Hurston Institute for Learning & Development, [yolandamajors@hurstongroup.com](mailto:yolandamajors@hurstongroup.com)  
Alex Samuelson, Hurston Institute for Learning & Development, [alexsam@hurstongroup.com](mailto:alexsam@hurstongroup.com)

Evanston, Illinois, a community with about 35% of its public-school students qualifying for free or reduced-price lunch and almost 60% of its public school students identified as students of color (Illinois State Board of Education, 2020a, 2020b), has long been perceived as one of the wealthiest school districts in the nation. However, over the last several years, Evanston has garnered national attention for its large racial and socioeconomic achievement gaps (Rich et al., 2016) and its attempts to alleviate the systemic inequities that generate them (Belkin & Hawkins, 2020). While often discussed concerning the past, the impact of historical fiscal and policy decisions continues to mediate the daily lives of Black Evanston families, particularly those living in the historically Black 5th Ward, who have borne the brunt of the infrastructural changes used to integrate Evanston’s schools without integrating its neighborhoods. Consequently, 5th Ward families have had to exert more effort than other Evanstonians to access everyday learning activities from their home addresses, such as walking to school, going to the library, getting to and from sports or music practice after school, and talking about school with neighbors.

5<sup>th</sup> Ward families, in particular youth, have persistently been underrepresented in STEM programs and STEM-related careers partly because of educational and cultural norms and lenses that have led to *de facto* exclusion based on race, ethnicity, and class. For 5<sup>th</sup> Ward youth, such exclusion has led to limited access to Evanston’s “participatory culture” (Jenkins, et.al., 2009), where membership cultivates one’s willingness to engage in collaborative, STEM-related work, knowledge of how to manage information, self-direction of one’s learning, meaningful interaction with valuable tools, and the building of collective intelligence (ref. DYN). Long-term STEM-culture participation requires parents to discover their community’s STEM opportunity landscape and motivate their youth to participate in programming where they are most likely the minority (especially as kids get older). Often this results in ‘joining’ a program and entrusting their children’s STEM learning journey to that organization.

This presentation considers *how and why 5th Ward families (decision makers) understand and choose to participate in one Evanston STEM OST space, Digital Divas, as a learning opportunity for their children, specifically their middle-school-aged daughters.* Digital Divas is an OST program located in Evanston that engages middle school girls, especially those from non-dominant communities, in design-based engineering and computer science activities driven by a narrative story. The program supports girls to develop STEM identities by

participating in face-to-face and online spaces to design, create, and re-imagine everyday artifacts (jewelry, hair accessories, music) and activities (dancing and talking to friends) using collaboration techniques critique, circuitry, coding, and fabrication. Since 2013, over 300 girls have participated in core Digital Youth Divas in Chicago. Middle school girls involved in Digital Divas have demonstrated increased domain-specific content knowledge and development of initial interest in STEM.

We draw on data from three focus group interviews: one group of 6 Digital Divas, one group of 6 Parents, and one group of 3 program facilitators. In addition to insights into the STEM-based problem-solving capacities of Divas', our analysis spotlights several themes corresponding to the role of families in developing STEM-related identities, values, understandings, and engagement. One of these is "youth exposure vs. "youth opportunity." We characterize OST "exposure" to STEM as having fixed boundaries of time and space, where youth can experience a baseline introduction to general STEM skill sets, such as coding and 3D building and printing. Findings from family interviews indicate that while much of Evanston's OST STEM programming does a "phenomenal job" of exposing their child to activities grounded in STEM, such exposure is insufficient:

"There's a big component of the whole child. It's like, how can we include some other skills... You know? How do we bring in the leadership? How do we include life skills? And then how do we also get out of the exposure and go more into the opportunity"

Across each focus group, a tension emerged: "how do we turn exposure" of STEM skill development "into real opportunity" pathways that further specific development of skills.

Drawing on Jenkins and colleagues' (2009) idea of participatory culture, we characterize OST "opportunities" as participatory engagement across time, place and space where youth expand their knowledge as they move across spatial borders and boundaries, engage and expand upon pre-existing knowledge around something shared and valued, decode it in some way and make new meanings around it. Opportunity spaces, therefore, are youth-serving OSTs that provide practitioners, youth, and families with STEAM (science, technology, engineering, arts, and math) related engagement opportunities that are geographically available, socially equitable, youth access, and at the right learning level (Pinkard et al. 2020).

A second theme to have emerged was parents' emphasis on Divas' gendered identity development as a critical determinant of their child's involvement in programming opportunities throughout Evanston:

It's not easy to be a Black girl... It's the idea of identity and figuring out who she is in the space that she's in and being comfortable in all the different spaces that she's in.

For parents of Divas, positive identity, interests, and social skill development were greatly desired core outcomes of their child's engagement in STEM inquiry, engineering processes and other associative learning opportunities presented through their involvement:

What's most important is developing their love for science and different STEM identities in spaces where they can be who they are.

They are learning the scientific method, definitely learning this engineering design process, but they also learn how to create, how to bring their identity into the things that they do.

Fundamental to all points along a STEM opportunity pathway is the human capacity for curiosity –the desire to engage, to develop and extend knowledge and do what is meaningful beyond life's challenges, what is immediately accessible, evident, or within current practice. We argue that this desire for learning through participation in identity-affirming activities motivates Divas' families to prioritize programming that reaffirms black girl identity even over STEM programming, especially if the programming is in non-familiar spaces. resources in exploring what one can learn by seeing, thinking, and doing. Due to the historical disinvestment in the 5<sup>th</sup> Ward as described in the opening, Divas families, whose aspirations of a more equitable future for their daughters are predicated on reimagining the locations, allocation, and use of the resources they steward to create a more equitable learning ecosystem. We imagine that this more equitable learning ecosystem would be unapologetically tuned to facilitate the ability of Black families to seamlessly navigate and engage in Evanston's full spectrum of learning resources to support the intellectual, physical, social, and emotional growth and development of Black youth, toward their fullest potential.

## STUDIO: Designing OST STEM opportunities across stakeholder desires

Jiyoun Lee, University of Washington, [jiyoungl@uw.edu](mailto:jiyoungl@uw.edu)  
Katie Headrick Taylor (co-chair), University of Washington, [kht126@uw.edu](mailto:kht126@uw.edu)  
Leslie Herrenkohl (co-chair), University of Michigan [leslierh@umich.edu](mailto:leslierh@umich.edu)

“Culturally relevant learning” often describes the design ethic of OST STEM contexts (Moore et al., 2022). However, without essentializing participants’ cultures, ignoring intersectionality as an individual reality (e.g., Cabado et al., 2013; Gutiérrez & Rogoff, 2003), and considering the cultural heterogeneity of urban neighborhoods (and the young people that live there, Iloh, 2018), designing for cultural relevance can generate tensions between co-designers, stakeholders, and participants of different ages and perceived roles (e.g., Worker & Ching, 2016). In an OST neighborhood-based STEM program called STUDIO, young participants from Immigrant and/or refugee families (from across the globe), and their caregivers, described different, sometimes contradictory values and purposes for OST STEM programming. Young people valued joyful modes of STEM engagement too often obsolete in schools; several caregivers viewed *joyful STEM* as ancillary to programming that supports in-school achievement. These differing priorities from young people and their caregivers, as well as from funders and evaluators, create a tenuous design space for OST STEM educators.

### STUDIO program context

STUDIO is a research-practice partnership between the University of Washington (UW) and a family-serving organization situated within a HOPE VI housing development in a Pacific Northwest city. Youth in STUDIO are all youth of color from diverse cultural and ethnic backgrounds. Most youth are from South East Asian (13%), and East African (42%) countries of origin and identify as belonging to immigrant and/or refugee families. African American youth living in the area also participate in STUDIO. Our partnership includes organization staff, and university faculty, graduate, and undergraduate students working together to design, research, and facilitate project-based STEM curricula. Youth attend STUDIO sessions twice a week at organization facilities but also use the facility with families for other purposes (e.g. game night, community events) (Please see Herrenkohl et al., 2019 for more program details). Findings for this session come from a total of 15 interviews (4 undergraduate mentors, 5 facilitators, 4 youth, 2 parents), transcripts of which we open-coded. Coders at UW and UM met regularly to discuss common and site-distinctive codes across WP and STUDIO.

### The purpose of STUDIO

Interviews revealed that adult caregivers and youth have differing desires and purposes for OST STEM programming; organization staff who especially bear the largest burden of recruiting youth participants (with adult caregiver consent), do their work within and across these differences. Adult caregivers often viewed STUDIO as a supplemental program to school, and valued it as a place where their children can get STEM homework help, or experiences that would position them to succeed in schools and future jobs. Youth valued STUDIO because it provided different social and STEM learning opportunities from school. Hiroshi, one of the longest serving staff members in STUDIO with deep ties with residents in the community, clearly identified tension:

Parents want youth to participate in opportunities in whatever way that the parents believe will provide them an advantage in applications or scholarships, careers or for schools of secondary education for their youth. For youth, it is often around more soft skills, social navigation or life skills. And, it is often around exploring new opportunities that they normally would not be able to explore in school... Being able to provide those opportunities is definitely a balance, because we want to honor the parents’ goals and values as well, but also really want to see the youth for what they are and their own goals for success as well.

A parent of a STUDIO participant expressed this priority (identified by Hiroshi above) in her own words, saying, “STEM is the future; children are going to use STEM [knowledge] in the future, and it will help them to have better education, and a better future.” Hiroshi also shared that parents often approached him with requests to provide more homework help, and tutoring sessions within STUDIO time so that the youth can get support in subjects like math and science in school.

On the other hand, when youth were asked to share what they got out of STUDIO, most youth talked about learning within a community where they felt safe to develop their social skills, and “do cool things” with great company. Hiroshi extrapolated that youth want to learn about “life skills and soft skills” because they are anxious about going to college as first generation prospective students. As children of new immigrants in the

United States, youth often wondered whether college was the right fit for them, and craved opportunities to explore other interests related to STEM but often separated or obsolete in schools (e.g., computer science, arts-based engineering). STUDIO was one of the places youth experienced as providing opportunities to express their creativity. Youth reported that they “got to go outside the boundaries, and [do] fun things that they wouldn’t typically do in school,” and were also able to “grow as a community with friends and mentors who encouraged” their ideas and, “always welcomed them.” Hiroshi described an example of how an activity in STUDIO might differ from school:

While there may be opportunities in schools to do cooking as an elective class or as a club, sometimes there's not enough capacity for those classes or clubs or it's around recipes that the youth are not interested in. Youth have more voice, and choice in what they can or want to explore in our program than they may be able to at school.

### An example of culturally intersectional STEM programming in STUDIO

In this exchange, Hiroshi is referring to STUDIO’s online cooking program called World through Food (designed primarily by Jiyoung Lee). This program models for young people that STEM learning (and teaching) can foster and center aspects of care for one’s self and the community. Centering care in STEM programming was especially important during the early and highly uncertain months of the COVID-19 pandemic (Taylor, Lee, Riesland & Ikeru, in preparation). In World through Food, youth cooked food from world cultures and trends that they were interested in (like Dalgona coffee, a trendy drink in Instagram in 2020), and also learned how to make ethnic dishes that represented the participants’ diverse cultures (e.g. red beans and rice, Somali style pasta). Making and experimenting with Dalgona coffee on Zoom not only allowed youth to explore the chemistry behind sugar crystals supporting the structure of coffee foam, but also opened-up opportunities for interpersonal encouragement and support as they marveled at each other’s creations. Teaching each other about dishes from their families’ respective countries of origin provided young people an opportunity to express themselves and appreciate the stories of others. STUDIO activities intentionally highlight the layered and powered dimensions of STEM learning that include affect, aesthetics, and uncertainty. Students recognize these aspects as being absent in their in-school STEM learning.

### Conclusions

Co-designers of STUDIO cannot ignore the importance of adult caregivers’ desires for OST STEM programming for their children. Additionally, connecting to in-school STEM achievement (including how content is taught and tested) also drives funders’ concerns and assessments of the “efficacy” of the organization. However, we see that young people bring a different orientation to OST STEM programming. This orientation values learning in a community that is culturally intersectional and pursuant of current topics, questions, and trends with friends and adult facilitators; these STEM inquiries center cultural knowledge and heterogeneity. We see a failure to acknowledge youth desires in OST STEM programming as detrimental to participation (as in, young people will stop showing-up), but also as a missed opportunity to model STEM practices as un-settled (Vakil & Ayers, 2019), uncertain (Anthony-Stevens & Matsaw, 2020), and joyful. We hope the next step is to see evaluations for OST STEM programs (Stephenson Reaves et al., 2022) that “perpetuate and foster—to sustain—linguistic, literate, and cultural pluralism” (Paris & Alim, 2014, p. 88) and intersectionality.

### References

- Anthony-Stevens, V., & Matsaw Jr, S. L. (2020). The productive uncertainty of indigenous and decolonizing methodologies in the preparation of interdisciplinary STEM researchers. *Cultural Studies of Science Education*, 15(2), 595-613.
- Belkin, D., & Hawkins, L. (2020, October 6). Can School be ‘Antiracist’? A New Superintendent in Evanston, Ill., Has a Plan. *Wall Street Journal*.  
<https://www.wsj.com/articles/can-school-be-antiracist-a-new-superintendent-in-evanston-ill-has-a-plan-11601982001>
- Carbado, D. W., Crenshaw, K. W., Mays, V. M., & Tomlinson, B. (2013). INTERSECTIONALITY: Mapping the Movements of a Theory 1. *Du Bois review: social science research on race*, 10(2), 303-312.
- Crowley, K., Pierroux, P., & Knutson, K. (2014). Informal Learning in Museums. In R. K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (2nd ed., pp. 461–478). Cambridge University Press.  
<https://doi.org/10.1017/CBO9781139519526.028>



- Fishman, B., & Herrenkohl, L. R. (2022). Equitable Learning. In D. J. Peurach, J. L. Russell, L. Cohen-Vogel, & W. Penuel (Eds.), *The Foundational Handbook on Improvement Research in Education*. Rowman & Littlefield Publishers. <http://ebookcentral.proquest.com/lib/umichigan/detail.action?docID=6915572>
- Frederiksen, J. R., Sipusic, M., Sherin, M., & Wolfe, E. W. (1998). Video portfolio assessment: Creating a framework for viewing the functions of teaching. *Educational Assessment*, 5(4), 225–297.
- Gutiérrez, K. D., & Rogoff, B. (2003). Cultural ways of learning: Individual traits or repertoires of practice. *Educational researcher*, 32(5), 19-25.
- Halverson, E., & Pepler, K. (2018). The maker movement and learning. In F. Fischer, C. Hmelo-Silver, P. Reiman, & S. Goldman (Eds.), *International Handbook of the Learning Sciences* (pp. 234–245). Routledge.
- Herrenkohl, L. R., & Cornelius, L. (2013). Investigating elementary students’ scientific and historical argumentation. *Journal of the Learning Sciences*, 22(3), 413–461.
- Herrenkohl, L. R., Lee, J., Kong, F., Nakamura, S., Imani, K., Nasu, K., ... & Taylor, K.H. (2019). Learning in community for STEM undergraduates: Connecting a learning sciences and a learning humanities approach in higher education. *Cognition and Instruction*, 37(3), 327-348.
- Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277–1288.
- Iloh, C. (2018). Neighborhood cultural heterogeneity and the college aspirations of low-income students of color. *Children, Youth and Environments*, 28(1), 9-29.
- Illinois State Board of Education. (2020b). *Evanston Twp HSD 202 | Students*. Illinois Report Card. <https://www.illinoisreportcard.com/District.aspx?source=studentcharacteristics&Districtid=05016065004>.
- Jenkins, H., K. Clinton, R. Purushotma, and A.J.Weigel. (2009). *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century*. Cambridge, MA: MIT Press.
- Lyons, L. (2018). Supporting informal STEM learning with technological exhibits: An ecosystemic approach. In F. Fischer, C. Hmelo-Silver, P. Reiman, & S. Goldman (Eds.), *International Handbook of the Learning Sciences* (pp. 234–245). Routledge.
- Moore, E. M., Hock, A., Bevan, B., & Taylor, K. H. (2022). Measuring STEM Learning in After-School Summer Programs: Review of the Literature. *Journal of Youth Development*, 17(2), 75-105. <https://doi.org/10.5195/jyd.2022.1131>
- Nelson, R., Winling, L., Marciano, R., Connolly, N. et al., (2015) *Mapping Inequality: American Redlining in New Deal America*. <https://dsl.richmond.edu/panorama/redlining/#loc=9/41.9435/-87.7050&opacity=0.8&city=chicago-il&sort=45>
- Paris, D., & Alim, H. S. (2014). What are we seeking to sustain through culturally sustaining pedagogy? A loving critique forward. *Harvard educational review*, 84(1), 85-100.
- Pinkard, N., Martin, C. K., & Erete, S. (2020). Equitable approaches: opportunities for computational thinking with emphasis on creative production and connections to community. *Interactive Learning Environments*, 28(3), 347-361.
- Rich, M., Cox, A., & Bloch, M. (2016, April 29). Money, Race and Success: How Your School District Compares. *New York Times*. <https://www.nytimes.com/interactive/2016/04/29/upshot/money-race-and-success-how-your-school-district-compares.html>
- Smith, B. (2018). New Deal era housing discrimination in Evanston. *Evanston Now*. <http://evanstonnow.com/story/real-estate/bill-smith/2016-11-07/76291/new-deal-era-housing-discrimination-in-evanston>
- Stasz, C. (2001). Assessing skills for work: Two perspectives. *Oxford Economic Papers*, 53(3), 385–405.
- Stephenson Reaves, J. R., Likely, R., & Arias, A. M. (2022). Design Principles for Considering the Participatory Relationship of Students, Teachers, Curriculum, and Place in Project-Based STEM Units. *Education Sciences*, 12(11), 760.
- Tai, R. H., Ryoo, J. H., Mitchell, C. E., Kong, X., Skeeles-Worley, A., Almarode, J. T., Maltese, A. V., & Dabney, K. P. (2021). Gauging Informal STEM Youth Program Impact: A Conceptual Framework and a Measurement Instrument. *Journal of Youth Development*, 16(4). <https://doi.org/10.5195/jyd.2021.981>
- Vakil, S., & Ayers, R. (2019). The racial politics of STEM education in the USA: Interrogations and explorations. *Race Ethnicity and Education*, 22(4), 449-458.





**International Society of  
the Learning Sciences**

Worker, S. M., & Ching, C. C. (2016). Examining tensions among youth, adults, and curriculum as co-designers in 4-H STEM learning through design programs. Singapore: International Society of the Learning Sciences.

### **Acknowledgements**

We acknowledge the support of the U.S. National Science Foundation for this work through the AISL program (Award numbers 2114840, 2115326, and 2114738). The ideas in this work are the authors', and not necessarily those of the NSF or the authors' institutions. We also thank the many OST youth participants, families, and providers who contributed to this work.