Hello!

Welcome to the spring issue of the Afterschool STEM Quarterly Research Review (ASQRR) on best practices in afterschool STEM programming. This publication from the Afterschool STEM Hub aims to provide you with the latest and most relevant findings from the field of out-of-school time (OST) science, technology, engineering, and mathematics (STEM) education.

Our publication mission is to review research covering a range of topics such as:

- How to design and implement effective afterschool STEM programs that foster youth engagement, learning, and interest;
- How to measure and evaluate the impact of afterschool STEM programs on youth outcomes, such as STEM identity, career aspirations, and academic achievement;
- How to support and develop the professional skills and competencies of afterschool STEM educators, such as content knowledge, pedagogical strategies, and facilitation techniques; and
- How to leverage the unique features and opportunities of afterschool settings, such as community partnerships, family involvement, and project-based learning.

March celebrated Women in History, and we are delighted to pay tribute to the women researchers and practitioners in the field. The 2024 Women’s History theme was “Women Who Advocate for Equity, Diversity, and Inclusion.” In this issue we review two articles aligned with that theme:

1. Gender equitable teaching practices in informal STEM education spaces, by Hughes, R., Schellinger, J., Billington, B., Britsch, B., & Santiago, A.

In this issue, we are also adding two new features:

- Researcher Spotlight – We interview XinXin Feng, a doctoral student at the University of Washington, who is studying youth-designed afterschool STEM spaces.
- Research on the Horizon – A preview of research currently being developed.

We hope that you will find these articles useful and informative for your own practice, research, or policy work in the field of afterschool STEM education. We also invite you to share your feedback, suggestions, and questions with us by emailing us at stemhub@afterschoolalliance.org. We would love to hear from you and learn more about how the Afterschool STEM Quarterly Research Review can support your interests and needs. Thank you for reading and subscribing to the Afterschool STEM Quarterly Research Review. We look forward to bringing you more high-quality and timely research in the next issue. Until then, happy reading and learning!

Sincerely,
The ASQRR Editorial Team – Anita Krishnamurthi, PhD, Leslie Brooks, DVM, MPH and Holly Miller, PhD
STUDY REVIEW

Gender Equitable Teaching Practices in Informal STEM Education Spaces


STUDY SUMMARY:
This article summarizes gender equitable practices for middle school girls in the last decade and addresses the disconnect between research and practice by presenting the findings in actionable steps for educators. The review evaluates research grounded in gender equity in STEM to identify key factors that influence the development of girls’ positive STEM identities and effective instructional strategies for building these identities. This work expands on the SciGirls Seven Strategies (SG7) literature review that was created in 2013.

RESULTS:
The authors identified six strategies that support girls in their development of positive STEM identities: (1) connecting STEM experiences to girls’ lives; (2) supporting girls as they investigate questions and solve problems using STEM practices; (3) empowering girls to embrace struggle, overcome challenges, and increase self-confidence in STEM; (4) encouraging girls to identify and challenge STEM stereotypes; (5) emphasizing that STEM is collaborative, social, and community-oriented; and (6) providing opportunities for girls to interact with and learn from diverse STEM role models. The review highlights that each of these strategies are important to develop positive STEM identities in girls and offers specific steps educators can take based on this research (summarized in the Implications for Practice section below).

CONCLUSIONS:
The authors emphasize that all of the six strategies identified should be used in tandem with each other to strengthen girls’ STEM identities. These strategies should be integrated as early as possible and are especially important during girls’ middle school years. Informal educators are key to facilitating these strategies, as afterschool programs offer unique opportunities to create safe spaces to disrupt STEM stereotypes. Because these methods require girls to pursue challenging problems, be inquisitive, and have the confidence to share their experiences, safe environments must be nurtured for these strategies to be successfully implemented. The authors also conclude that to fully support girls from diverse backgrounds, inclusion is not enough. We must also incorporate culturally responsive teaching and center girls’ lived experiences in the curriculum.

KEY TAKEAWAY:
Women and girls, especially those of color, are underrepresented in many STEM fields. Gender equitable practices for middle school girls are crucial in developing positive STEM identities to bridge the gender and racial gap in STEM. Effective gender-equitable teaching practices in informal STEM education include connecting experiences to girls’ lives, supporting problem-solving, empowering girls, challenging stereotypes, emphasizing collaboration, and providing diverse role models.

SAMPLE SIZE:
45 peer-reviewed articles from 2013-2018.

METHODS:
Literature review
STUDY IMPLICATIONS

IMPLICATIONS FOR PRACTICE:

■ Connecting STEM experiences to girls’ lives
  Focus on empowering girls by letting them direct the STEM activities. This allows them to bring their interests and assets of knowledge into the discussion. Educators can have meaningful conversations and listening sessions with the girls in their programs, providing space for the girls to explore topics they find relevant and meaningful to their lives and communities. In asking about their backgrounds, interests, and communities, educators can make the girls’ lives central to their understanding of STEM.

■ Supporting girls as they investigate questions and solve problems using STEM practices
  Educators can create open-ended STEM opportunities, allowing girls to use everyday language to make sense of STEM terminology. Creating this safe, accessible environment can help girls feel supported and confident in their attempts at new practices and terms.

■ Empowering girls to embrace struggle, overcome challenges, and increase self-confidence in STEM
  Frame mistakes and failures as opportunities to learn and encourage productive struggle. Educators can socialize the idea that a failed experiment is a normal part of the STEM process and leads to adaptive learning. The authors state that “To support girls through frustration, educators can ask questions that get at the process (e.g., how did you determine that answer, what other steps could you take) and praise girls for utilizing strategies and behaviors (e.g., persistence, challenge seeking) that they can control.”

■ Encouraging girls to identify and challenge STEM stereotypes
  Facilitate multiple ongoing opportunities for interaction with diverse STEM professionals. Highlight media that displays diverse STEM role models. Challenge the expectation that girls need to conform to quiet note-taking behavior and provide specific opportunities for them to ask questions, think out loud, tinker, take risks, and argue their findings and ideas.

■ Emphasizing that STEM is collaborative, social, and community-oriented
  Offering programs that integrate collaboration, relationship-building, and community responsiveness can enhance girls’ sense of belonging in STEM. Provide multiple and varied opportunities for girls to problem-solve together so that they feel comfortable sharing and negotiating their ideas. Share specific examples of how STEM fields provide opportunities to work together, help others, and give back to the community.

■ Providing opportunities for girls to interact with and learn from diverse STEM role models
  Allow girls to see STEM role models as multidimensional people with diverse lived experiences, to help girls expand their vision of what is both professionally and personally possible in their own lives. This should be done repeatedly over time via various means. Include role models who are supportive, engaging, and relatable. Educators can coach role models to conduct hands-on activities, be honest about their experiences in STEM, and discuss their personal lives outside of STEM.

IMPLICATIONS FOR POLICY:

Increase investments in research that go beyond typical academic measurements and get to the root of how we can increase diversity in the STEM workforce and community STEM literacy. For instance, prioritize and value funding research that focuses on the nature of the learning space that is created, not just what happens within the space. Incentivize researchers to explore the impact of culturally responsive teaching in both formal and informal STEM learning environments. Policymakers and the STEM talent industry can also enact programs and incentivize a system that encourages diverse STEM professionals to engage with informal STEM programs in meaningful and lasting ways. This might include paid time off work to volunteer with programs, student loan forgiveness for community involvement and mentoring, or other employer-valued benefits for contributing to a more robustly diverse future STEM community.
STUDY REVIEW
Infrastructural injustices in community-driven afterschool STEAM

STUDY SUMMARY:
Through the implementation of a social design experiment across three afterschool programs, the authors evaluated what infrastructural barriers hinder justice-oriented STEAM programs in afterschool education. With the development of new high-tech, low-cost projects in the afterschool programs, the researchers explored how afterschool community educators support young people historically marginalized in STEAM. The researchers worked with community educators, artists, and computer scientists to design new digital projects and develop technological curricula together. During the implementation phase of the high-tech, low-cost curricular designs, community educators were recognized as experts in designing culturally sustaining STEAM projects that contextualized the reasons STEM experiences were important for their community’s youth.

However, despite community educators being critical experts within the project, the educators faced job insecurity within the organizational infrastructures in which they worked. This created a barrier to sustaining the innovative programs that supported high-tech, low-cost-making projects. By engaging as partners with community educators, observing their programs, and codesigning community-driven STEAM activities, the researchers were able to not only appreciate the depth and breadth of community educators’ effort, but also highlight their work, which was often made invisible or devalued by funders. In doing so, the researchers discovered the paradoxes of afterschool STEAM infrastructure.

KEY TAKEAWAY:
In order for afterschool STEAM programs and activities to be just, inclusive, and community-driven, the field must prioritize not only how STEAM activities are done but also by whom and why. In serving communities of color, the design of these activities by community educators of color must be protected within the informal STEAM infrastructure for them to be sustainable. This requires being aware of paradoxes and contradictions inherent within the existing STEAM infrastructure and designing programs with the lived experience of youth and families that might not be currently represented. Developing community-driven projects in which STEAM is used to create more justice in the world is not enough. The field must also report on how this work is sustained, who sustains it, and how their expertise is valued in the process.

POPULATION:
Three afterschool programs serving working-class youth of color in the Western United States.

METHODS:
Social design experiment and qualitative analysis.
RESULTS:
The authors demonstrated how community educators work against limiting narratives to support humanizing spaces of learning for young people of color from working-class communities. For instance, community educators within the project were hesitant to design STEAM experiences that focused on restricted views of skill preparation for future tech careers because of the limits this would place on youth-driven and culturally sustaining possibilities. They also found that these educators were integral in designing adaptations that supported learners’ identities, expanded their technical skills, invited family participation, and managed space, budgets, and program values to deepen STEAM learning. Despite this, educators were often devalued within the organizations where they worked—either losing their jobs or being passed over for advancement—and were often left in unsustainable positions. While they were praised as essential for the programs’ success, their positions were institutionally underfunded, and their jobs were insecure. This paradox was the biggest threat to the sustainability of their programs.

CONCLUSIONS:
The work of centering justice and lived experience in community-driven STEAM is essential to creating spaces in which young people can build technology practices that are connected to their everyday lives and interests. These spaces hold the possibility of using technology in ways counterintuitive to corporate interests or the standardized narratives of STEAM. While the community educators were uniquely equipped to nurture these spaces, their work often remained invisible in the informal STEAM organizations that employed them. The authors use the concept of “infrastructural injustice” to define the challenges that afterschool educators face in developing community-driven STEAM programs that match the needs of youth. The authors conclude that investment in the design of new high-tech, low-cost projects is not enough. For the innovations to be sustainable and impactful, the infrastructure supporting them must include job stability for community educators, time for research and design, and new definitions of expertise that can allow community-driven STEAM projects to flourish.
STUDY IMPLICATIONS

IMPLICATIONS FOR PRACTICE:
In order to allow educators to sustain spaces for underrepresented youth so they feel a sense of belonging in STEAM disciplines, programs and policies must disentangle educators from the same unjust systems. For marginalized communities to lead community-driven STEAM initiatives, support for community educators, value of their expertise, and comprehensive respect for their labor are all essential in order to develop a more just STEAM infrastructure. The authors state that “The work to protect, reimagine, and redesign STEAM within communities is a full-time job done by people committed to listening and making room for new imaginations to take hold.” According to the authors, one tangible step programs can take is to develop a classification system that recognizes educators for their on-the-job development over or in addition to university degrees. Programs can also work to shine a light on and become aware of current infrastructural injustices and the work community educators are already doing to challenge them.

In addition to providing robust workplace support and respect for community educators, the authors suggest it is time for a narrative shift surrounding digital education equity. For instance, when promoting access to high-tech tools and deciding how technology gets used, the program design should take into account the context of young people’s lives, needs, and wants rather than continued augmentation of the narrative that “if youth of color from working-class families have access to technology, they will be individually lifted out of poverty and join the white-collar workforce.”

IMPLICATIONS FOR POLICY:
Justice-oriented community-driven STEAM requires investment. The key pitfall policymakers and funders can try to avoid is focusing solely on programs they view as scalable and limiting their understanding of program impacts to the current dominant narrative. Instead, policymakers need to invest in community educators’ visions for supporting community STEAM and design new professional pathways for community-driven STEAM to take hold. Second, policymakers can shift their definitions of equity in computer science education from merely “creating pipelines from low-income urban schools to high-profile corporations” to considering how technology education can “transform and empower communities.” To this end, when deciding to fund or support scaling digital education equity and technology programs, policymakers and funders can consider including flexibilities for contextualizing the program based on youth and community needs and desires.

RESEARCH ON THE HORIZON

Check out this preliminary outcomes report from research funded by the National Science Foundation! The research team at the Institute for the Study of Resilience in Youth (ISRY)—under the leadership of Dr. Gil Noam (PI), Dr. Patty Allen (Co-PI), & Virginia Andrews (Research Project Manager)—completed a systematic review of STEM learning and social-emotional development in out-of-school time to explore how STEM and social-emotional development can be better integrated. The manuscript is currently in development, so be on the lookout for its release soon!
RESEARCHER SPOTLIGHT

Researchers are focusing on the intersection of research and STEM, and it’s part of our mission to highlight and share their work with you. For our inaugural Researcher Spotlight in the Afterschool STEM Quarterly Research Review, we interviewed Xinxin Feng, a doctoral student in Learning Sciences at the University of Washington.

Xinxin, please tell us about yourself.
I am a PhD candidate in Learning Sciences and Human Development at the University of Washington. I have been designing community-based OST education programs for 14 years. I am curious about how educators can leverage young learners’ cultural resources in their STEM learning experiences across settings.

What is the focus of your research currently?
In the past year, I have been designing interventions in a makerspace that centers on the knowledge of young people and their communities. “Making” is positioned as an essential human need and creative activity rooted in the histories and experiences of diverse communities, and I organized a series of co-design workshops with young people and their families based on this assumption of making. Last summer, I started a similar investigation in an afterschool youth program that explores how young people come to identify with STEM as they engage in co-design in the program. I am presenting initial findings from the makerspace research at this year’s International Conference of the Learning Sciences in Buffalo, NY.

How did you become interested in OST?
I was born and raised in a closely connected community in a big city in China. Our people speak Cantonese, which was not taught in schools. Growing up, I preserved our language by speaking it and learned our rich culture from people in my community. My pursuit of education has been guided by this life experience, along with a genuine curiosity to understand how meaningful learning takes place outside of schools, as it did for me.

What has been most surprising to you in your research?
STEM can be learned and taught in various contexts that honor diverse cultural backgrounds and everyday practices. My interventions focused on bringing in new learning resources, such as histories or expertise shared by community members. To my surprise, students sometimes quickly took up these resources while making sense of STEM. It suggests the potential of embracing community practices as sources of deep knowledge in learning, which I will continue to explore in my current research involving much more complex STEM sense-making.

In your opinion, what questions should the research community be asking about the out-of-school time field?
I am interested in addressing the real barriers to participation in STEM through OST programs. OST programs have a unique capacity to tackle issues of equity in STEM, and as such, we should be deeply considering how best to support this by focusing on these three questions: How does OST support transdisciplinary STEM learning? How does OST address the needs and interests of diverse learners in STEM? Through the teaching of STEM, how does OST foster community engagement and build social capital within neighborhoods or communities?

What is something we didn’t ask you that you wish we did?
I would have liked to discuss the collaboration and interdisciplinary aspects of research in OST. Collaborating with community partners and engaging multiple stakeholders enabled the relevance of my research to the contexts of learners. Moving forward, while my background as a learning scientist provides valuable insights, I believe it is imperative to further address interdisciplinary collaboration in OST, particularly by involving researchers from various STEM fields.
We hope you enjoyed exploring this issue! Additional similar publications are listed below. Until our next issue, you can also read more about research highlighting the updated evidence of afterschool STEM in our research brief as well as explore evaluation summaries of afterschool programs in the Afterschool Alliance’s Impacts Database. You can also follow us on LinkedIn to learn more and stay up to date on what we are working on.

You can register for our upcoming newsletters and receive a copy of any articles that are not open access by completing this Google form.

ADDITIONAL PUBLICATIONS TO NOTE

