

**Title:** Unearthing CROPS: A Systematic Literature review of Community-based, Reciprocal, Out-of-school Programs in STEM (CROPS)

**Abstract:** While many universities engage in out-of-school STEM programming with K-12 youth, there is a need for more large-scale research to understand such work. This systematic, integrative literature review utilizes a novel conceptual framework (called CROPS) to examine how research articles take up different components of out-of-school K-12 STEM programs between universities and communities. Findings from in-depth analysis of 16 published articles identify strengths and limitations of the articles around components such as purpose, methods, framings of community, and types of STEM subjects taken up in the programs.

**Aim:** The purpose of this study is to find and analyze published research articles discussing out-of-school K-12 STEM programs which involve partnership between university and community.

**Context:** Learning in out-of-school spaces constitutes a large portion of youth learning time, provides flexible learning opportunities, and can support learning in ways that classroom settings sometimes cannot or do not (Latchem, 2014; National Research Council, 2015). Additionally, there are inequities in the quality of and access to out-of-school programs for youth (Afterschool Alliance, 2021). Universities have a vast number of resources that, when utilized appropriately, can positively contribute to out-of-school STEM learning and work towards improving such inequities. In addition to out-of-school learning environments, injustices persist in STEM across K-12, higher education, and career spaces. People (especially of minoritized identities and communities) face inequities in persistence in STEM education, discrimination in STEM fields, and lack of systemic support in STEM careers.

In order to better understand these intersecting fields, a systematic integrative literature review (Borrego et al., 2014; Torraco, 2005) was conducted of recent published research articles. A novel framework is presented: **Community-based, Reciprocal, Out-of-school Programs in STEM (CROPS)**. A key foundation of this framework is to conceptualize programs in a holistic and equitable manner. Below is a brief description of each of the 4 elements:

- **Community:** This element focuses on programming and relationships centered *in* community and *with* community (as opposed to *on* or *for* community).
- **Reciprocity:** As a concept, reciprocity is not often articulated and/or studied in research articles involving K-12 out-of-school STEM programs. Centering reciprocity can create more equity-focused foundations for partnership and shift historic tensions and power dynamics between universities and communities.
- **Out-of-school:** these spaces present unique opportunities for learning to be creative, flexible, culturally sustaining, and supportive in ways that classroom settings may not.
- **STEM:** Science, technology, engineering, and math (STEM) are becoming increasingly prominent in our daily world as well as youth's daily curriculum. There are also countless inequities in STEM which need to be addressed to create more just futures for young people and adults alike.

The study aims to answer 4 main research questions:

1. How many articles have been published since the year 2004 and what is the purpose of each article?

2. How are each of the components of the CROPS framework taken up in these articles?
3. What is the methodological approach of each article?
4. What trends are there across these articles?

**Findings:** The results of the analysis are considered in 4 main parts, each corresponding to the research questions.

*1. Articles & Purposes:* 16 peer-reviewed articles were identified using a systematic process searching through academic databases. The search process looked for articles between 2004 and 2023 that were written in English and described programs in U.S. settings (i.e. no international articles or programs were included for this study). The purpose of almost all articles was to describe a program that was created and implemented, while also describing and/or analyzing other elements (e.g. demographic data, pre-/post-test learning data, perceptions of the program).

*2. CROPS Components*

- a. Community: Generally, the concept of community was not well-defined across the selected articles. Phrases such as “giving back to the community” were often used but were not described or contextualized in meaningful, detailed ways.
- b. Reciprocity: As a concept, reciprocity was not explicitly taken up in any of the articles. Even similar concepts such as mutuality were discussed infrequently and in a cursory manner.
- c. Out-of-school: The settings in which programs took place were usually universities or afterschool spaces. In both cases, there was a lack of clear detail around where programming took place (e.g. in classrooms, labs, community spaces, etc.).
- d. STEM: A wide variety of STEM topics were taken up in the articles. This was done through three approaches: holistic (e.g. “STEM” programs), interdisciplinary (e.g. a program focusing on engineering and physics), and singularly (e.g. a chemistry program)

*3. Methods:* Most articles used the “methods” section to describe their program, but often did so with little reference to other research literature around STEM programs, pedagogical theories, or design concepts, for example. A small sample of articles were very clear and detailed with their methods, though.

*4. Trends:* Two additional main trends were identified in the articles. The first is that youth participants were typically ages 10-18 and that often, undergraduate and/or graduate student volunteers held significant roles in the programs (e.g. mentors, instructors). Additionally, the articles described many types of engagement strategies such as activities, lectures, and presentations.

**Discussion and Implications:** The 16 research articles in this study presented a diverse array of approaches to, conceptualizations of, and analyses in out-of-school K-12 STEM programs. With respect to CROPS, out-of-school spaces and STEM subjects were taken up in myriad ways; meanwhile, community and reciprocity were concepts that lacked depth in their intention and discussion. Despite articles being peer-reviewed and published in research journals, many of the methods sections did not have research-based foundations for describing the design and implementation of their programs. These findings suggest that those authors may consider conducting and analyzing out-of-school STEM programs to be a less ‘rigorous’ form of research that does not require the same standards as “disciplinary” STEM research. More collaboration between disciplinary STEM scholars and education scholars may aid in changing this disparity in perspective.

**Author Information:** george schaffer (they/them) began their PhD at Drexel in 2022 working with Dr. Christopher Wright in the School of Education. george has a Bachelor's degree in Astronomy and Physics and a master's degree in Leadership in Higher Education (both from the University of Washington). Their academic work focuses on how universities and communities collaborate in out-of-school spaces to engage young people in science. Specifically, george's research agenda aims to improve such partnerships and promote more equitable, reciprocal forms of engagement to create better science learning experiences for youth and adults alike.

## References

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