

Board 241: Connected Learning Spaces Supporting Engineering Interest Development: A Case Study of Ego-Centric Network Analysis of Relationships

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Introduction

Unfortunately, it is not unexpected that young individuals who belong to underrepresented and marginalized communities have limited access to a diverse network of resources that support Science, Technology, Engineering, and Math (STEM) education, especially in areas like coding, innovative engineering, and project-based activities that are emerging. Studies on informal education outside of schools [1]–[3] have acknowledged that these learning environments can foster involvement in STEM, and their continuous programs across various settings, such as home, libraries, youth clubs, and museums, can be essential in initiating and maintaining interest in STEM [4]–[7].

In addition to lacking these types of engaging STEM offerings in-school, studies have documented a growing disparity in investments that poor and wealthy families make on enrichment activities [1]. It is in these enrichment activities in out-of-school settings where young people are most likely to find support for specialized interests and connect with peers and mentors who they identify with. Thus, lack of *social capital*, networks of relationships that provide access to resources and opportunities, limits access to STEM for youth from underrepresented groups and limits the potential for out-of-school organizations to address this growing gap between poor and wealthy families. However, there is growing evidence that increasing social capital can promote access for marginalized youth and can support STEM interest development [2]–[4].

The aims of this qualitative case study are to (1) investigate how Connected Learning out-of-school programs can build social capital for youth from underrepresented groups by analyzing the relationship between social capital, their program features, and interest and engagement in STEM, and (2) explore the use of ego-centric network analysis for this type of inquiry. For this case study, we focus on youth who expressed interest in studying engineering in college. Our research questions are: *What forms of social capital of underserved youth existed when participating in a connected learning STEM program? What social network changes appear during a period of over a year?*

Connected learning and supports for social capital in STEM

Social capital is an important support for young people's interest and persistence in STEM fields so the lack of it is a key reason why youth from underrepresented groups do not pursue STEM interests and careers. Youth from underrepresented groups are much less likely to have family, friends, and mentors involved in STEM fields and interests, and to encounter STEM role models who share their cultural identity [5]–[7], despite the fact that they benefit more than mainstream youth when they have positive mentoring relationships [8], [9]. Ricardo Stanton-Salazar's research focuses on the unique barriers that immigrant youth face in gaining access to high value social capital in the form of "institutional agents" like teachers and mentors. He stresses the importance of social ties and networks in structuring educational opportunity, because they are cumulative and convertible into varied forms of resources and support [10].

Other studies have investigated how student social networks influence educational outcomes such as integration and success in higher education [11]–[13], adapting well-established frameworks and methods from studies of community and professional networks (e.g., [14], [15]). While studies of social capital focused on youth networks and educational outcomes is still small, it is a highly promising and emerging focus area that extends a larger body of work documenting the importance of social capital for opportunity and access.

Out-of-school or informal learning environments can provide these supports for youth from underrepresented groups when these programs support relationships and activities centered on the youths' specific interests, affinities, and identities. These successful programs include the Digital Youth Network [16] and YOUmedia at the Chicago Public Library [17]. For the past decade, the Connected Learning Research Network (CLRN) has been refining measures of Connected Learning (CL) in out-of-school programs through qualitative case studies, and a longitudinal survey and interview-based study ([18],[19],[2]). The Connected Learning framework recognizes the importance of relationships for effective learning at the intersection of interest-driven activities, supportive relationships, and academic, career, or civic opportunities. Successful programs throughout the years have shown these common features: *sponsorship* of interest-driven projects [3], [4], [20], affinity-based *mentorship* [21]–[23], and *brokering* connections to other settings and resources. This investigation employs tools of network analysis to analyze the influences that out-of-school programs can have in building social capital for youth who may lack strong relational support in their home and community.

Method

Setting and participants

The Club, located in Southern California, offers guidance and assistance to underprivileged youths aged between 13 to 18 years, especially those from Mexican American communities. The Club exemplifies a connected learning space that mentors youth in discovering their interests and potential routes to STEM careers. Besides, The Club acquaints the youths with various technologies like photo editing software, 3D printers, virtual reality, and introduces them to supportive adult mentors. This case study focuses on two Latine youths, one male and one female who were involved in The Club during high school at the start of data collection in 2019 and attended college in 2022.

Data sources

Data comprises interview transcriptions of audio recordings from four interviews for each participant performed in the 2019, 2020, 2021, and 2022. The interview questions asked specific questions about a youth's social networks and their individual connections with people in that network. We use concepts of Ego-centric network analysis and sociograms to graphically represent the social network.

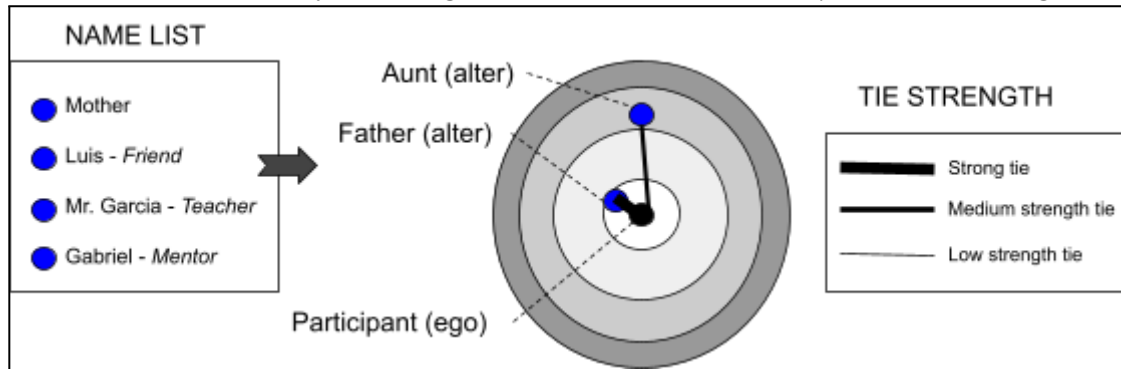
Analytical techniques

We analyzed the data using some of the techniques from Ego-centric Network Analysis [24], a subset of Social Network Analysis or Socio-centric Analysis [25]. While a full social network represents as many connections as desired for every member of a social context [25], ego-centric networks look specifically at a single individual (the “ego”) and their connections (“ties”) to other individuals (“alters”). We used the descriptions of the social supports of the youth mentioned in each round of the interviews to create sociograms (i.e., network visualizations) -- one for each interview. These sociograms illustrate the relationships of each of the youth participants with their named/identified support people.

During the last interview (in 2022), using Jamboard on Google (an online collaboration tool), we virtually co-constructed three sociograms structured onto concentric circles to represent the proximity of actors and the alter relationships to the youth participant (ego) from the names of people mentioned during each of the previous three interviews (i.e., 2019-2021). Figure 1 illustrates an example of a sociogram following this process.

Figure 1

Concentric Circles, a basis for creating an Eco-centric structural analysis within a sociogram



At the end of the 2022 interview, we had three sociograms per participant. For the analysis phase, we compared these three sociograms to identify (1) how (if) the closeness (position) and tie strength (relationships) changed, (2) the type of support that is provided by the alters and valued by the ego (from recorded narrative), and (3) the impact these changes may have had on the youth's continued interest in ingenuity and Connected Learning engineering education (from recorded narrative).

Preliminary findings

Preliminary findings show that besides the immediate family, the mentors in the out-of-school programs provided family-like support to the youth. Throughout their involvement in the STEM program, youth mentioned specific types of support with their individual interest-driven projects. In addition to ego-centric network visualizations of their social capital, we conducted a thematic analysis to summarize the types of support participants mentioned these out-of-school environments provided while centering their interests, affinities, and identities.

Through further comparison of sociograms, we expect to identify relationships within the social networks of each youth participant that supports STEM learning. It will also provide information on how types of support (e.g., instrumental, emotional) is distributed among members of the youth's social network. This data may also provide insight into the longevity of a youth's interest in engineering based on the number of people in their networks that engage with the same practices. A common interest with a closely-tied alter (e.g., friend) may also sustain youth participation in a skill or practice. I expect that close relationships that encourage engineering skills practice will be familial. I also expect that the sociograms will provide a way to quickly visualize youth social networks and will aid in further data analysis.

Implications and significance

By examining the link between social capital and informal STEM programs, this project will help launch a new line of research on how to broaden participation in STEM through

relational support. It will expand the field's understanding of the relationships between social capital and STEM opportunity, as well as expand our theories of broadening participation from an in-person and within-setting conceptualization to one that takes into account the movement of youth among settings and connections between settings.

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