Innovative Higher Education (2018) 43:475–490
https://doi.org/10.1007/s10755-018-9444-0

Building a Community of Transformation and a Social Network Analysis of the POGIL Project

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Published online: 4 October 2018

Abstract

Communities of transformation work to achieve deep, transformational change in higher education teaching practice. This case study of The POGIL Project follows the development of a community of transformation principally focused on the propagation of effective teaching in STEM. We describe the origin of the community, elucidate the emergent decisions that shaped its growth, and offer a social network analysis of the connections between change agents that have been deeply engaged in the growth and development of the POGIL community. The case provides concrete examples of how the features of a community of transformation, most particularly the community network, can be intentionally fostered. We discuss the implications for STEM education reform in light of the case analysis.

Keywords Communities of transformation · STEM education reform · Social network analysis · Communities of practice

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While extensive research has documented the effectiveness of evidence based instructional practices in science, technology, engineering, and math (STEM), including active and inquiry-based learning, widespread adoption of these practices has been elusive (Freeman et al., 2014). In order to accomplish a shift toward increased use of evidence-based practices, systems and structures that can work to influence the practice of many instructors are needed. We suggest and believe that broad implementation of innovations requires a social movement or mutual adaptation approach which can foster deliberation and networking (Kezar, 2011). Similarly, communities that "provide opportunities for faculty members to interact with others as they explore new assumptions and try out new approaches to teaching… in an environment that simultaneously provides challenge and support" are important for promoting change in STEM education (Austin, 2011, p. 13).

Recently Kezar and colleagues (Bernstein-Sierra & Kezar, 2017; Gehrke & Kezar, 2016; Kezar & Gehrke, 2015, 2017a, b; Kezar, Gehrke, & Bernstein-Sierra, 2017) studied several groups that successfully support STEM education reform. The study identified these groups as "Communities of Transformation" (CoTs). CoTs resemble communities of practice in that the members "share a concern, a set of problems or a passion about a topic, and …[they] deepen their knowledge and expertise … by interacting on an ongoing basis" (Wenger, McDermott, & Snyder, 2002, p. 4). However, CoTs have features that go beyond those of typical of a community of practice. In particular, a CoT is described as having 1) a compelling philosophy, 2) a living integration of the philosophy to create a new world of practice, and 3) a network of peers to break isolation and brainstorm revisions in practice. Each group Kezar studied was made up of hundreds of community members spread across multiple institutions and often multiple disciplines. Importantly, Kezar and colleagues (Gehrke & Kezar, 2016; Kezar & Gehrke, 2015) documented a host of positive outcomes that have emerged from the work of CoTs. In addition to directly improving teaching practice, there were other important benefits for individuals, departments, and institutions, which included feeling reenergized in one's teaching, recognition for one's pedagogical work, the development of leadership skills, curricular changes, and strategic planning for STEM education.

In order to realize a vision in which students regularly experience evidence-based teaching, we need to attend to strategies that will help propagate innovations, including work through CoTs. We need to understand how CoTs are formed and, ultimately, by what mechanisms their positive outcomes are achieved. While scholars have suggested that social networks between and among educators are central to collective efforts to improve education (Valente, 1995), insights gained from detailed studies of communities working to transform teaching and learning will help others interested in STEM education reform, as well as those in other disciplinary areas interested in teaching improvement.

In 2003 a small group of undergraduate chemical educators founded The POGIL Project, one of the communities identified by Kezar as a CoT (Gehrke & Kezar, 2016; Kezar & Gehrke, 2015), with the purpose of disseminating pedagogical practice and supporting faculty development in the implementation of Process Oriented Guided Inquiry Learning (POGIL; see www.POGIL.org). Teachers who implement POGIL are using guided inquiry (Karplus & Their, 1967) – a learning cycle of exploration, concept invention, and application – as the basis for carefully designed and intentionally facilitated classroom activities that simultaneously develop content knowledge and key process skills, including teamwork, communication, critical thinking, and problem solving. In a POGIL classroom students work in small, self-managed teams; and the faculty member is an active facilitator.

The POGIL Project was selected for study (Kezar & Gehrke, 2015; Kezar et al., 2017) on the basis of its long-standing success in STEM education reform as measured by scholarly

work documenting the effectiveness of POGIL in support of student learning and success (Lo & Mendez, in press). In Kezar's study, the nearly 900 participants drawn from the POGIL community, reported particularly high levels of gaining new skills and learning to be innovative in their teaching and professional work as a result of their engagement with The POGIL Project (A. Kezar, personal communication, 2016).

In this article we use a case study approach to explore one CoT, The POGIL Project, in order to understand how a CoT might be developed. We focused our investigation on the innovation of the CoT itself, with special attention to those individuals who have been engaged in the growth and development of the community and who acted as change agents for improved teaching and learning within and for the community. Common to all CoTs, these persons are the "core of individual volunteers that [sic] provide mentorship and ongoing communication with individuals who attend events" (Kezar & Gehrke, 2015, p. 19).

In addition to describing the development of the POGIL community as a CoT, we have undertaken a social network analysis. Social network analysis offers a lens through which to examine the extent and diversity of connections between change agents and the development of these connections over time. Researchers have reviewed the potential value of social network analysis for understanding change in STEM education (Kezar, 2014) and networks more generally for the flow of ideas leading to innovations (Pentland, 2014). Others have used the technique to understand networks within an academic department (Quardokus & Henderson, 2015), the diffusion of a pedagogical strategy (Foote, Neumeyer, Henderson, Dancy, & Beichner, 2014; Neumeyer, Foote, Beichner, Dancy, & Henderson, 2014), and follow-up support after faculty development workshops (Hayward & Laursen, 2018). Such analysis has not, however, been used to document the connections within a CoT. Using this approach is valuable because relationships formed within CoTs through peer-to-peer learning are an essential feature of a CoT (Kezar et al., 2017).

Using relevant history and the social network characteristics of The POGIL Project, we set out to address the following research question. How was The POGIL Project's network of change agents built and sustained over time? We describe the emergence of the network and discuss how decisions made by POGIL Project leadership supported the emergence of The POGIL Project as a CoT. The case provides a detailed example of how the design features of a CoT can be intentionally fostered (Kezar et al., 2017) and how such a community can provide opportunities for interaction and support for new approaches to teaching essential for STEM education reform (Austin, 2011). We discuss the implications for STEM education reform in light of the case analysis.

Methods and Approach to this Case Study

In order to gain general insight into how CoTs might be fostered, we selected a case study approach (Stake, 1995). The detailed analysis of the change agents in a single CoT aims to illuminate strategies for development of a CoT that may be generally applicable and to raise questions about CoTs for future research.

Case Study: The POGIL Project

The POGIL Project began as a National Science Foundation (NSF) funded project, and it was NSF-funded from 2003 to 2013. In 2011 The Project began operation as a 501c3 non-profit

organization, and it is now funded by contributions and other revenue sources. We examined the two NSF grant proposals that supported The Project for evidence of what was intentionally planned for. We reviewed the annual reports submitted to the NSF and consulted with staff and executive leadership of The Project to verify details related to pivotal moments in The Project's development. Finally, with three authors (Shadle, Lewis, and Minderhout) as long-time members of the community, we documented the development of The Project based on personal knowledge.

Social Network Data Collection

While there are multiple ways that people are connected within The POGIL Project, we focused on data gathering activity in two areas. First, The Project's faculty development workshop activity is a primary source of connectivity. For data collection purposes, workshops are defined as half-day to three day events at various national venues, at which facilitators lead groups of participants in exploring and experiencing the POGIL pedagogy. Workshop co-facilitation generates relationships between peers that advance the level of practice and result in strong ties between individuals. The second focus of analysis is attendance at the annual POGIL national meeting. We selected this event because it serves as an important signature event for the community (Kezar & Gehrke, 2015; Kezar et al., 2017) and because it provides an opportunity for change agents to connect with others and with the mission of The Project. It has been held annually since 2003, with annual attendance of between 32 and 77 individuals.

We extracted information about workshops, facilitators, and annual meeting attendance from each of the NSF annual reports (January 2003–March 2012) and from internal records kept by The POGIL Project for March 2012 through January 2014. Because we required an extended period of time for data analysis and interpretation, activity since February 2014 is not included. The first NSF grant that funded The Project began in 2003. A second grant began in January 2007, and modifications to recruitment of new members into the growing community were implemented beginning in 2008. We thus divided the data into two time periods: Phase I (January 2003–December 2007) and Phase II (January 2008–January 2014). During the full-time period of the study, 340 workshops were offered by The POGIL Project in the United States: 157 in Phase I and 183 in Phase II, serving ~4300 and ~5100 participants, respectively. Most workshops were facilitated by teams of two to six persons, and they were conducted throughout the calendar year. The larger facilitation teams were used for 3-day workshop events involving multiple tracks or concurrent sessions.

For the workshop facilitators, we identified the date of each workshop they facilitated and which national meetings they attended. This provided us with the date of each person's first opportunity to facilitate a POGIL workshop, marking their initial contribution to The Project as a change agent. Of the 114 change agents in the dataset, 41 were active in Phase I; and 109 were active in Phase II. There were 36 individuals who were active in both phases. We also coded each change agent according to membership in one of six U.S. regions: Northeast (NE), North Central (NC), Northwest (NW), Southeast (SE), South Central (SC), and Southwest (SW). After this coding, all data was de-identified. We did not analyze connections made through co-facilitation of workshops outside the U.S. or collaborative work on affiliated projects, such as the High School POGIL Initiative and NSF-funded projects targeted at specific disciplinary areas.

Social Network Analysis

We performed the social network analysis and created the network maps using UCINET 6 for Windows. We de-identified data for analysis and display, in accordance with Human Subjects IRB approval for this project.

We represent relationships from the social network analysis with double-headed arrows. While in some cases one individual in a pair was initially more experienced as a workshop facilitator, the co-facilitators represent collaborative, reciprocal relationships and reflect the commitment within The Project to cultivate an environment in which everyone contributes and learns from everyone else.

We investigated two characteristics of individuals in the network: degree centrality and betweenness centrality. Degree centrality is a useful measure of engagement with the network because it reflects direct contacts with other change agents. In our data set an individual's degree centrality indicates the number of different people with whom the individual co-facilitated at least one workshop. A degree centrality of n means an individual co-facilitated with n-1 different people. Its value does not reflect the number of times an individual co-facilitated with another individual; they might have worked with a first colleague once, a second colleague twice, and a third colleague six times, resulting in a degree centrality of four. The other characteristic examined in our study is betweenness centrality (the condition of being between). A high betweenness centrality value reflects an individual in the network who connects relatively distant parts of the network via a shorter path than if that individual were removed from the network. An individual with a high betweenness centrality connects people in different areas of the network and facilitates the flow of information, knowledge, and practice across the network.

Results: Building a Community of Transformation

Phase I –Change Agent Expansion

The POGIL Project was launched by six chemistry faculty members at four different institutions. Prior to 2003 they had been working for nearly a decade to develop and disseminate inquiry-based course activities through a variety of regional and national chemical education initiatives. Desiring to broaden the impact of their faculty development work, they combined efforts and submitted a successful NSF grant proposal.

For the first few years of The Project (Phase I, 2003–2007), the six founders and two others were the most active workshop co-facilitators. Figure 1 shows a social network map of these individuals and the strong connections between them. These eight people carried the most significant burden of the POGIL workshop facilitation during Phase I.

From the beginning, Rogers' *Diffusion of Innovations* (Rogers, 1995) informed The Project's dissemination plan. The expansion of faculty development efforts required additional change agents, which were defined by Rogers as an "individual[s] who influences clients' innovation-decisions in a direction deemed desirable by a change agency" (Rogers, 1995, p. 27). The Project sought to create new change agents who would help others explore and adopt effective teaching strategies by facilitating POGIL workshops. The Project adopted elements of Rogers' theory so as to develop change agents intentionally according to the scheme represented in Fig. 2. The

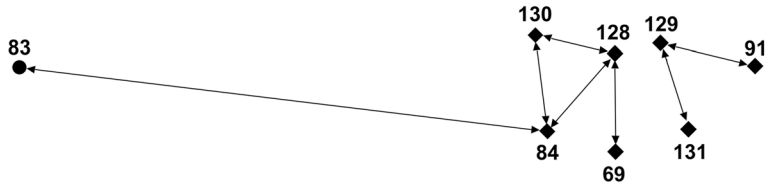

Fig. 1 Network map of The POGIL Project core change agents during Phase I (2003–2007). Double-headed arrows connect individuals who co-facilitated four or more events during the given time period. Change agents are coded by their home region: circle (NW), diamonds (NE). However, events took place all over the country. Numbers next to each change agent refer to the code for that change agent in the data set

Project's version of the "Innovation Adoption Model" shows the planned progression for individuals, from initial interest through adoption decision and beyond. New change agents would pass through each of the various stages and, with support, emerge as "Experts" (see Fig. 2) with knowledge, interest, motivation, and confidence to support the dissemination of the POGIL pedagogy. In this article we refer to those who progressed to be "Experts" as *change agents* for The Project. In this initial stage, the goal was simply to expand the pool of change agents.

POGIL workshops introduced aspects of the pedagogy by modeling the POGIL pedagogy itself. This was based on the assumption that the best way to understand the approach was to experience it. Workshop co-facilitators observed participants and identified those with the potential to become future change agents. These observations were, and still are, used to identify participants who grasp the nuances of the approach and appear to have the necessary

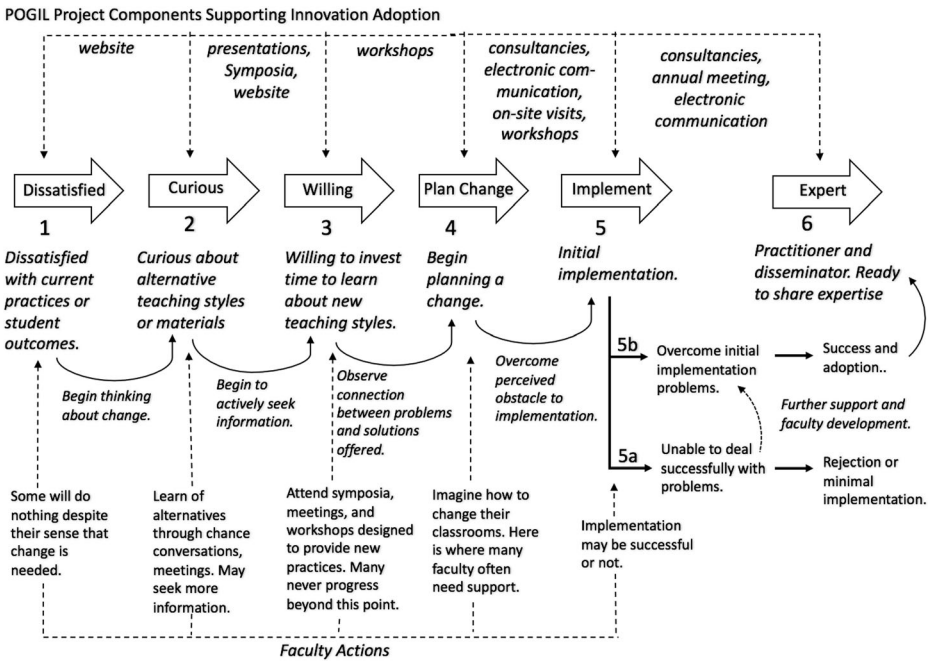

Fig. 2 Original plan for recruitment of new workshop facilitators for dissemination of the POGIL pedagogy

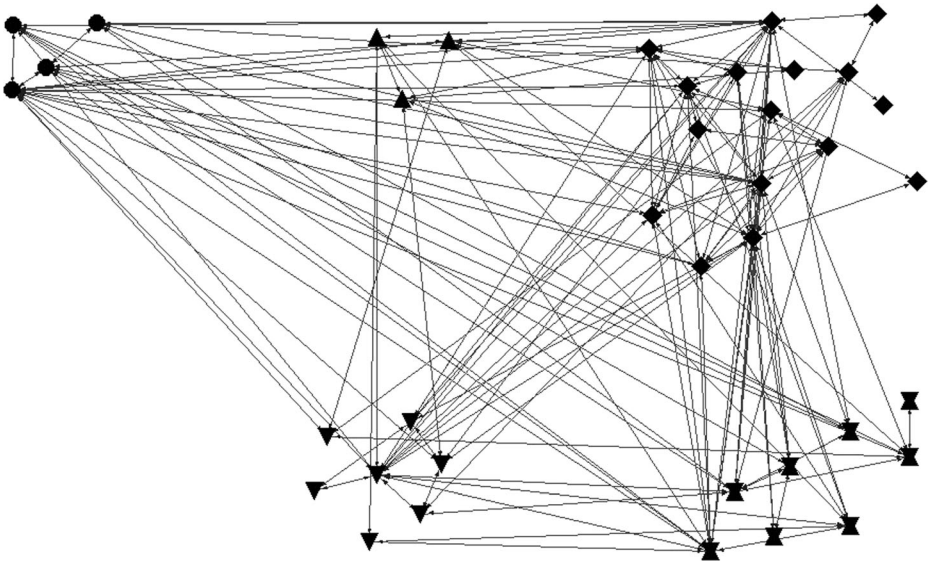

Fig. 3 Network map of The POGIL Project change agents during Phase I (2003–2007). Change agents who co-led one or more events during the given time period are shown, coded by region: Circle (NW), Square (SW), Up Triangle (NC), Down Triangle (SC), Diamond (NE), Hourglass (SE). Lines connect pairs of people who co-facilitated at least one workshop. Workshops were not necessarily facilitated in one's home region during Phase 1

interpersonal and leadership skills to make a good change agent. Between 2003 and 2010 those who were identified as potential new change agents were invited to co-facilitate future workshops as apprentice facilitators. These new change agents were assigned to mentors with whom they would co-facilitate and were invited to the POGIL national meeting. Because POGIL workshops are conducted using the POGIL pedagogy, in which assessment to improve performance for all is emphasized, workshop experience not only trained new facilitators but also improved facilitation skills both for future workshops and for one's classroom instruction. The approach explicitly invited new facilitators to provide more experienced facilitators with feedback and to participate in the assessment of the workshop overall. This collective assessment practice established a relationship of trust between co-facilitators, a necessary component of strong communities.

Efforts to increase the number of change agents were successful. By the end of Phase I, a total of 41 individuals were involved in facilitating workshops for The POGIL Project. Further, these individuals were connected in an emerging national network. Figure 3 shows a social network map of co-facilitation connections that developed during Phase I; lines in this map connect individuals who co-facilitated at least one time. Not surprisingly, more people are found in the northeast, since most of The Project originators were located there. However, the data show growth in all regions of the country except the southwest. Data also demonstrate that many co-facilitation connections are between individuals who lived in different regions.

Phase I - the POGIL National Meeting

Starting in 2003, in parallel with the work to develop new workshop facilitators, The Project also began hosting an annual working meeting. The primary purpose of the POGIL national

meeting was, and is, to move the work of The Project forward. During Phase I participation at the meeting was by invitation; all active and future facilitators were invited.

The national meeting served several important functions during Phase I. At the outset it focused on preparing facilitators for upcoming workshops and engaging these change agents in considering how The Project should move forward. By the end of Phase I and in response to ideas that emerged at previous meetings, the focus expanded to include additional purposes, including the creation of rubrics and the development of new workshops. Further, the national meeting reinforced relationships that had been developed in co-facilitation teams at workshops. A longstanding tradition leaves an afternoon of the meeting unscheduled for participants to engage in non-working activities together in an effort to support community building. By 2007 the POGIL annual meeting (PNM) was described this way:

> [The PNM] is designed to both move the project forward, and also expand and solidify a truly national POGIL community. The PNM does this by accomplishing important work for the project, and serving as a forum for communication between regions…[O]utcomes [at earlier PNMs] were conceived and executed by working groups of attending participants, not the senior personnel. In this way, the POGIL project works intentionally and effectively to build a community of POGIL practitioners, and to respond to the needs of that community. (Moog, Lewis, & Bunce, 2006)

Phase II – Building National and Regional Community

CoTs must evolve to support the growing and changing community (Kezar & Gehrke, 2017b). In 2007 The Project's steering committee decided to move beyond simply adding more individuals as change agents. Regional networks were envisioned to connect change agents and POGIL practitioners, both novice and experienced, within regions. Moving forward, The Project would focus on developing new facilitators within geographic regions because it would be cost effective to have facilitators to offer workshops and consult with new practitioners from within their own region. Further, bringing new, regional change agents into The Project would enhance a sense of a more localized community. Thus, The Project planned for six regional networks that would build community and contribute to further diffusion of innovation (Moog et al., 2006).

Starting in 2008 annual workshops for new practitioners were offered within each region, and co-facilitators were selected from within the region. The identification of new workshop facilitators proceeded as it had before with the intention that they would join the regional team. In 2010 the training of facilitators shifted from the earlier apprentice model to an annual three-day "Facilitator Training Workshop", which increased capacity and improved consistency.

Figure 4 shows the impact on the social network of efforts undertaken during Phase II (2008–2014). Compared to the results in Fig. 3, the data show an increase in the number of persons acting as Project change agents. Further, while there are many connections through co-facilitation that cut across regions, there is now a clear cluster of connections within each region.

Phase II - the POGIL National Meeting

In addition to work on the pedagogy and strategies for faculty development, work at the national meeting became more focused on building and sustaining The Project itself rather

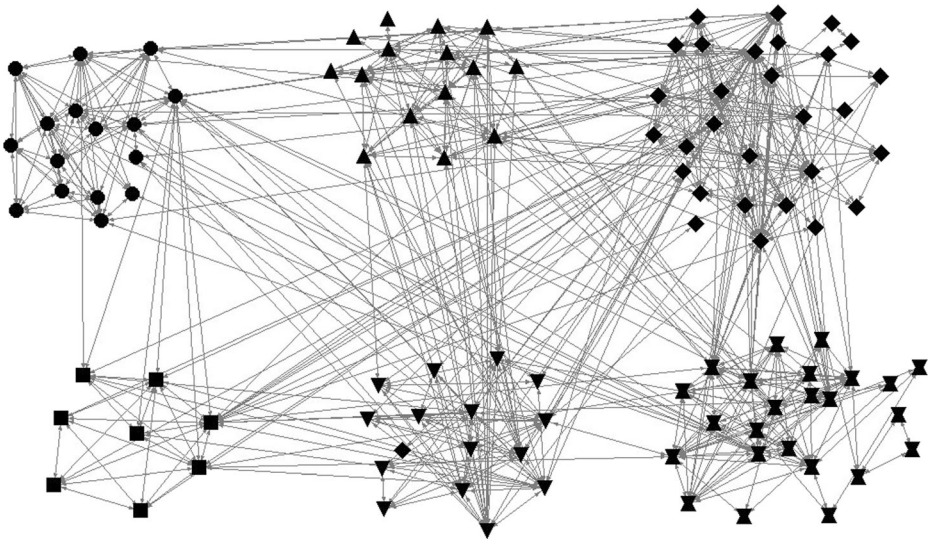

Fig. 4 Network map of The POGIL Project change agents during Phase II (2008–2013). Change agents who co-led one or more workshops during the given time period are shown, coded by region: Circle (NW), Square (SW), Up Triangle (NC), Down Triangle (SC), Diamond (NE), Hourglass (SE). Lines connect pairs of people who co-facilitated at least one workshop

than training facilitators. Examples include the vetting of a statement of *Mission, Vision, and Values* in 2009 and the development of a strategic plan for The Project in 2012. During Phase II the meeting began to provide explicit support for regional network planning. Participation in this meeting was by application and invitation. The focus shifted away from workshop facilitation training to broader issues of sustainability, a change which is reflected in patterns of attendance. During Phase I 93% of the workshop facilitators attended the national meeting, and 86% of meeting attendees were facilitators, with the other 14% comprised of those helping to support The Project in other ways. In contrast, during Phase II only 78% of the workshop facilitators attended the national meeting; and workshop facilitators comprised only 56% of the attendees. Most of the other 44% of attendees were involved in other activities designed to move The Project forward.

Network Comparisons of Phase I and Phase II

Those most active in co-facilitating workshops during Phase I were Project originators (See Fig. 1.). During Phase II we note a shift in those most active in co-facilitation. Figure 5 shows the change agents most actively engaged in co-facilitating workshops during this phase. The data show that a greater number of individuals meet a high threshold of co-facilitation in Phase II (16) than in Phase I (8); see Fig. 1. Most important, the individuals represented during Phase I (Fig. 1) are unique from those represented in Phase II (Fig. 5). This indicates that the founders of The Project successfully cultivated new individuals to serve as change agents. Further, the new change agents that emerged in Phase II are regionally connected, reflecting the intention to cultivate regional connections.

Degree centrality reflects the number of different people with whom an individual co-led at least one workshop. Table 1 lists the 10 change agents with the highest degree centrality over

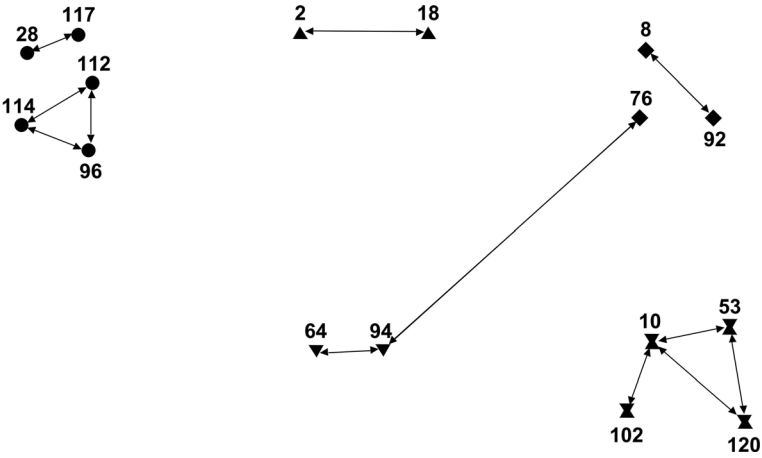

Fig. 5 Network map of The POGIL Project core change agents during Phase II (2008–2013). Individuals who co-led four or more events, coded by region: Circle (NW), Up Triangle (NC), Down Triangle (SC), Diamond (NE), Hourglass (SE). Lines connect pairs of co-facilitators. Numbers next to each change agent refer to the code for that change agent in the data set

the ~10 years represented in our data set. We note that the largest degree centrality for an individual is 42, which means that this individual has co-facilitated with 41 others. Comparing these 10 individuals in Phases I and II, the degree centrality of one change agent (130) was unchanged; one change agent (69) had a lower degree centrality; all others increased. This reflects the continuing activity of these highly active individuals, who served as co-facilitators with more persons in Phase II than in Phase I. Further, of the 10 change agents in Table 1, three individuals are represented in Fig. 1; and four individuals are represented in Fig. 5. The three remaining individual change agents represented in Table 1 did not co-facilitate four or more times with someone else, but had high degree centrality because of frequent co-facilitation with multiple different persons.

Betweenness centrality reflects connections of an individual with different parts of the network. Table 1 lists the ten change agents with the highest betweenness centrality over the

Table 1 Change agents with highest degree and betweenness centrality

Change agent code	Degree centrality			Betweenness centrality		
	Overall	Phase I	Phase II	Overall	Phase I	Phase II
84[a]	42	20	32	577	111	857
14	33	8	29	437	13	342
76[b]	32	8	26	446	15	448
53[b]	31	8	26	345	42	375
69[a]	30	20	16	392	131	135
17	29	16	19	285	60	187
102[b]	29	8	22	350	9	356
10[b]	28	12	19	431	35	235
115	25	10	20	378	8	333
130[a]	25	15	15			
108				410	2	361

[a] individual represented as core change agent in Fig. 1

[b] individual represented as core change agent in Fig. 5

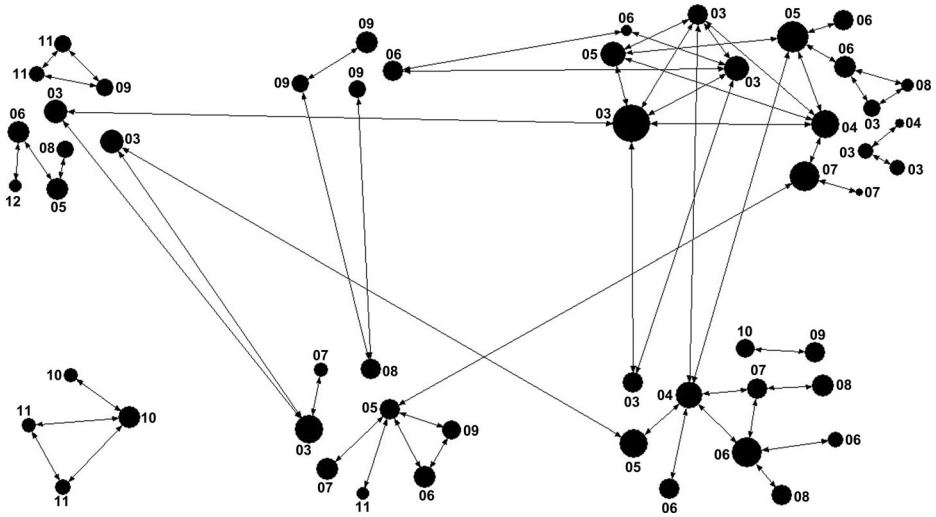

Fig. 6 Network map of The POGIL Project change agent and degree centrality during Phases I and II. Individual change agents are represented by circles. The size of each circle represents degree centrality of that individual. Placement of the circle on the diagram reflects the U.S. region that change agent calls home. The label of the circle represents the year the change agent began facilitating workshops. Double headed arrows connect change agents who co-led three or more events

~10 years represented in our data set, revealing those individuals who connect different parts of the network. Nine of the 10 individuals on this list are also in the list of those with high degree centrality, though not necessarily in the same order. By comparing these individuals in Phases I and II, we note that betweenness centrality increased for all of them. As the network grew to include more people, they served to connect more people across the network. There are 37 people in the dataset who have 0 for betweenness centrality, suggesting that, while they are connected to the network via a co-facilitation event, they do not connect different parts of the network and are generally only connected in their region.

To represent the changes in the network over time, Fig. 6 represents degree centrality and relationships between change agents in The Project based on activity between 2003 and 2014. The figure represents 46% of all change agents in the data set. (Those not shown co-faciltated fewer than 3 times with the same partner.) These data demonstrate that individuals began their work with The Project at different times and that new, well-connected change agents are still emerging close to a decade after the project was officially launched.

Discussion

Building and Sustaining the Network

Our central research question focused on how The POGIL Project's network of change agents was built and sustained over time. At the outset (2003), the founders of The Project did not specifically envision building a community; the original plan had focused on the recruitment and development of additional change agents to conduct the workshops necessary for broad dissemination. The case study and social network analysis in this study have detailed how The

POGIL Project went beyond these original goals. The newly recruited change agents built relationships through co-facilitation of workshops and attendance at the national meeting. The Project's goals then evolved to focus on supporting the growing community both nationally and at the level of regional networks. Over time The POGIL Project grew to embody the elements of a CoT.

Several aspects of the analysis merit further discussion because of their importance to sustaining the community. The individual with the highest degree centrality in the network over the 10 years represented in our data was involved at the beginning of The Project. It is not the case, however, that all founders built up the same level of connections through co-facilitation; and many individuals who joined the community later have emerged to have many connections in the network. This is important because it shows that the emergence of the network was not dependent on the founders sustaining a high level of co-facilitation activity over time. The network was built and community sustained by connecting new people to the network through substantive work supporting the mission of The Project.

The support of regional networks with regional facilitators fostered local connections between change agents and those new to POGIL. The connection of the regional networks to the larger community, as evidenced by the betweenness centrality of those in the network, allowed information and ideas to flow in both directions to and from those who are primarily connected at the regional level and fostered the dissemination of new practice and shared meanings. This kind of information flow is facilitated in networks with strong ties (Tenkasi & Chesmore, 2003) and has been fostered, in part, by connections supported through national meeting attendance. For the 114 change agents in our data set, eight attended POGIL national meetings with every other change agent; and sixteen attended with over 90 other change agents. The national meeting provided opportunities for people who did not co-facilitate workshops together to build relationships and trust and served as a significant opportunity for sharing knowledge within the community.

The change in degree centrality for the individuals most well connected in the network shows that it increased over time for nearly all of them. Thus, The Project successfully cultivated and supported persons who have sustained and/or increased their activity over time. The choice to sustain involvement likely derives from individuals benefiting from their involvement, an important requirement for successful communities of practice (Wenger et al., 2002). This choice is also consistent with findings across CoTs that even those who first encounter a CoT expecting it to be a "one-time interaction" leave with a "strong notion that they have a group of people that they could now contact related to their teaching" (Kezar et al., 2017, p. 234).

While this study has not focused on the role of leadership within The Project, the successful growth of new change agents did create the space for the leadership to guide The Project successfully rather than to continually present workshops. Furthermore, it allowed new change agents to assume more active roles within The Project, a defining feature of those involved in CoTs (Kezar et al., 2017).

Sustaining The Project has required an engaged group of change agents who are willing to do its work with little to no compensation. How is this achieved? While the answer to this question is not explicitly evident in our social network data, we believe a partial answer lies in the benefits that change agents garner through The POGIL Project as a CoT (Gehrke & Kezar, 2016; Kezar & Gehrke, 2015). Thus, we turn to the emergence of these features along with the development of the network.

The POGIL Project as a Community of Transformation

A CoT is described as a form of Community of Practice having 1) a compelling philosophy, 2) a living integration of the philosophy to create a new world of practice, and 3) a network of peers to break isolation and brainstorm revisions in practice (Gehrke & Kezar, 2016; Kezar & Gehrke, 2015).

Of these elements, the one with the oldest roots in The POGIL Project is the *living integration of the philosophy to create a new world of practice.* In the early stages the philosophy was implicit, but using the POGIL pedagogy as the primary vehicle for the faculty development workshops meant that participants both learned about the pedagogy and experienced practice reflective of the implicit philosophy modeled by facilitators. The "PO" in POGIL stands for Process-Oriented, which means that the pedagogy explicitly supports students' process skills. Facilitators work to emphasize process skills throughout each workshop. Teamwork and continual improvement are central to the facilitation of every workshop. The modeling of cooperative learning in workshops may have contributed to the emergence of the social network, as such interactions may "activate social network structures among participants" (Jippes et al., 2013, p. 402). Over time the workshop sessions have been modified in response to input from facilitators and participants, reflecting the importance of open dialogue in communities of practice (Wenger et al., 2002).

Change agents gain at least two benefits from involvement in the *living integration of the philosophy.* First, acting as a change agent for The POGIL Project improves one's own teaching through opportunities to discuss and reflect on teaching with others. Improvement in one's practice has been documented to be an important benefit of involvement in a CoT (Gehrke & Kezar, 2016). Such learning is more likely to be fostered by interactions with peers in a network than through prescribed vertical structures (Díaz-José, Rendón-Medel, Govaerts, Aguilar-Ávila, & Muñoz-Rodriguez, 2016). Second, The Project's openness to feedback allows change agents to see how their contributions matter and to feel connected to the big goals of The Project.

The *compelling philosophy* of The Project was articulated in 2009 when it captured what had been implicit by generating a statement of *Mission, vision, and values*.[1] The statement reflects the broad interest in improving teaching and learning and invites change agents to make a contribution to that improvement (Kezar et al., 2017). The importance of improving learning for STEM students is compelling to community members. This philosophy, combined with the skills that people gain in stimulating others to think about change, means that involvement in The Project cultivates leadership skills that can be applied beyond The Project (Gehrke & Kezar, 2016).

As noted, it was not the original intention of The Project to build a community, but it is now clear that The Project is characterized by "*a network of peers to break isolation and brainstorm revisions in practice.*" Consistent with the fact that POGIL pedagogy is based on socially mediated learning, The Project quickly evolved to attend to social relationships. The relationships built – through co-facilitation, regional connections, POGIL national meeting attendance, and other opportunities – have allowed The Project to foster a shared vision and commitment to improved practice. Importantly, once regional connections emerged, national connections and individuals with high betweenness centrality helped maintain coherence across The

[1] The statement of *Mission, Vision and Values* of The POGIL Project can be found at https://pogil.org/about-the-pogil-project/mission-vision-values.

Project. The "supportive and innovative space" of the community serves to "re-energize" people (Kezar & Gehrke, 2015, p. 24).

What does this case study and social network analysis of The POGIL Project reveal about how a CoT might be fostered? It provides a concrete example of how a mission or purpose, combined with an intentional recruitment plan, can expand the community. Further, the case demonstrates specific ways in which relationships can be built, thereby fostering the creation of shared knowledge, direction for ongoing engagement, and community (Wenger et al., 2002).

Implications for STEM Reform

It is now well recognized that effective dissemination of innovative teaching ideas requires more than just publishing or giving presentations about new ideas (Henderson et al., 2015). One major aspect of successful reform efforts involves communities. Studies have shown the importance of social networks for diffusion of innovation and cultural change (Valente, 1995; Williams et al., 2013) because effective networks provide the social capital to facilitate change (Kezar, 2014). Further, communities with the features of a CoT "are most likely to be useful in settings or domains where a deep or fundamental change in practice is needed or is already taking place" (Kezar & Gehrke, 2015, p. 20).

Over the years The POGIL Project has built community in ways that contribute to sustained changes to teaching and learning. In particular, The Project's impact on teachers and teaching emerges from its *network of peers to break isolation and brainstorm revisions in practice*, which is important because group membership facilitates adoption of new teaching practices (Valente, 1995). Workshop participants get the clear message that there is a community of persons ready to support them as they make changes to their teaching. In this way The POGIL Project builds and supports professional relationships and networks to "sustain the work of (reformed) teaching and learning and ultimately of change" (Valente, 1995, p. 1). Further, those involved as change agents in The POGIL Project are equipped to contribute at national and regional levels to changing teaching and learning, as well as doing so at their own institutions. (Gehrke & Kezar, 2016; Kezar & Gehrke, 2015). Change agents are empowered by the knowledge that they are connected to others in the community fostering changes in higher education. As STEM education reform efforts continue in higher education, those supporting these change efforts would do well to draw upon the example of The POGIL Project and other Communities of Transformation in order to intentionally foster the conditions in which faculty members can be both challenged and supported in examining assumptions about teaching, and learning, and exploring, and adopting new teaching practice (Austin, 2011).

Limitations and Future Research

Ours was a retrospective case study. Only quite some years into The Project did it become apparent that change agents were connected to and supporting each other, and not necessarily connected to the founders. As with any retrospective analysis, what we identified as important is viewed through the data that are available for analysis. Also, our primary analysis focused on connections made between workshop co-facilitators. People connect in other ways through The Project, including through service on the Steering Committee and work on affiliated activities. Thus, our analysis and discussion does not capture the full extent of the network.

As with any area of inquiry, this study raises additional questions. For example, what are the characteristics of those who developed high degree or betweenness centrality? What paths

did they take to become so central in the network? Another line of inquiry might investigate how this network is connected with others. For example, what is the relationship between this network and those within STEM disciplinary societies or within institutional networks? Finally, are some networked connections more important for influencing practice than others? If so, what is important for shifting practice? Future studies of The POGIL Project and other communities engaged in change efforts can explore these questions.

Conclusion

To spread strategies for enhancing teaching and learning practice, teachers need to feel supported in making change, and connections to a group of like-minded individuals helps provide this support. Our hope is that our case study and social network analysis of one successful community aids others in creating an effective dissemination plan through creating and building a Community of Transformation.

Acknowledgements The authors would like to thank Dr. Rick Moog for inspiring this study and the work of The POGIL Project and Marcy Dubroff for providing POGIL Project data essential for this work.

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