

Unified Voice and Group Agency: Developing Teams to Transform Engineering Education

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Unified Voice and Group Agency: Developing Teams to Transform Engineering Education

This research paper investigates how individual change agents come together to form effective and efficient teams. Improving equity and social justice within academic engineering requires changes that are often too complex and too high-risk for a faculty member to pursue on their own [1], [2]. These changes include the broad diffusion of culturally responsive pedagogies that emphasize the value of diverse backgrounds and cultural differences [3], active learning strategies to advance equity and improve the diversity of engineering students [4], and the incorporation of social justice into engineering education curriculum [5], [6]. The equitable transformation of engineering education on a broad, impactful scale requires not individuals acting alone, but change teams. We define change teams as coalitions of individuals engaged in organizational transformations.

Teams offer the advantage of combining a diverse skill set of many individuals, as well as bringing together insider knowledge and external specialist expertise [1], [2]. Team members can use each other as sounding boards, to debrief, and to work through challenges, which allows for the creation of new knowledge [2]. Implementing change via teams, rather than as an individual, disperses change agency and empowerment throughout the team, which can institutionalize change more deeply while countering resistance [1]. However, for teams to function effectively, they must overcome the challenges of internal politics, power differentials, and group conflict [1].

While there has been increasing research interest in teams invested in institutional change, few studies have looked at how individuals come together to effect change as a team [1], [7]. Yet, team formation and structure strongly influence both team functioning and the implementation of change [2]. Developing an understanding of how change teams form is critical for improving our ability to transform engineering education to be more equitable and inclusive. Here, we examine two key aspects of team formation: unified team voice and group agency.

Unified Voice and Group Agency

We define teams broadly as a group of individuals who are working together with a common purpose toward a collective goal [8], [9], [10]. Team formation is a process, and the team is not a fixed, static entity [7], [11], [12]. During the process of team formation, members co-create an interactive, shared definition of the team that includes a sense of solidarity with teammates [13], [14] and a shared vision for change [9],[11], [15]. Creating a unified team voice and developing a sense of group agency are critical mechanisms in the process of team formation [2], [9], [14], [16].

Unified voice refers to a team's shared commitment and sense of purpose and direction for their project [9], [14], [16]. One of the first steps of a change team is to establish a unified voice for their projects, as it is integral to every step of the change process that follows [2]. As Katzenbach and Smith [9] argue, teams need to then translate their unified voice into specific and measurable

performance goals and develop methods to assess their progress in order to achieve impactful outcomes. Clear goals facilitate communication and constructive conflict, where team members can focus on how to achieve (or change) their goals and focus on getting results [9].

To successfully achieve their collective goals, teams must also develop a sense of group agency. Group agency refers to the shared belief among team members of the team's ability to successfully perform tasks and achieve goals [16], [17]. Group agency is the result of team members perceiving their goals as attainable and their efforts as worthwhile [14], and is in part achieved through the cultivation of credibility. Credibility reflects the extent to which teams are respected by others within the institution [18]. Both external context and opportunities (e.g., a crisis situation) as well as internal processes (e.g., team decision-making) influence the development of group agency [14]. Team members must also trust one another enough to engage in risk-taking and clear communication [14]. Dugan and Reger [14] found that groups are less likely to develop a sense of agency when members are shut out of decision-making and their skills are ignored, suggesting the importance of sustained, collective negotiation. That is, teams have a better chance of achieving their goals if they draw from the strengths of all team members to develop group agency.

In this analysis, we explore the early stages of team formation as experienced by recipients of NSF Revolutionizing Engineering Departments grants (described below). Specifically, the research questions guiding this paper are:

1. How, when, and where do change teams develop unified voice and group agency?
2. What factors are most salient in the development of unified voice and group agency?

METHODS & DATA

Setting: Revolutionizing Engineering Departments (RED)

This analysis of unified voice and group agency emerges from our participatory action research with the NSF Revolutionizing Engineering Departments (RED) teams to investigate the change process within engineering and computer science higher education. The RED funding mechanism is designed to support awardees in creating systemic change both to advance equity and inclusion within educational environments and to improve the professional development of students with a focus on the middle years of college. NSF requires that teams are multidisciplinary, including instructional faculty, education researchers, social science experts or organizational change experts¹, and administrators (e.g., the department head or college dean). While the RED teams are composed primarily of faculty, many also include departmental staff, graduate students, and undergraduate students.

In addition to funding the RED teams, NSF has also funded RED Participatory Action Research (REDPAR), to support the work of RED teams and to conduct research with the RED teams on

¹ The NSF grant solicitations in 2014, 2015, and 2016 required the inclusion of a social science expert on each team. There was no solicitation in 2017, and in 2018 the solicitation requirement was modified and from then on has required an organizational change expert instead of a social science expert.

the process of change in academia. REDPAR is a collaborative project between practitioners at Rose-Hulman Institute of Technology (RHIT) and researchers at the University of Washington (UW). Our work as REDPAR investigates research questions related to systemic change projects while also supporting connections across teams and providing customized change-making curriculum. The curriculum is designed to cultivate RED team members as change agents and to support their efforts to transform their departments. Change agents are individuals who transform their organizations by implementing new processes and policies, facilitating behavior modifications, and attending to cultural norms [19]. To deploy the curriculum, we facilitate monthly virtual calls and an annual in-person meeting for the consortium of RED teams where team members work together on development activities. During these activities, the RHIT members of the REDPAR team provide customized curriculum designed to build the knowledge, skills, and abilities required to create change in higher education.

RED Teams

As of 2020, NSF has awarded 26 RED grants to 24 institutions. Awarded institutions include both public and private schools with student populations ranging from over 4,000 to over 67,000. While the currently funded projects range in scope from one department to an entire college, the majority of RED projects focus on one department and include the following areas: chemical, biological, civil, environmental, electrical, mechanical, computer, biomedical, and aerospace engineering, as well as computer science. All RED teams share overarching goals related to transforming engineering education, while teams' change-making processes vary. For example, one computer science-focused project from a large public institution integrates courses for undergraduates to develop industry-relevant professional skills. Another project at a smaller private institution mobilizes its focus on identity and inclusion by integrating experiential learning opportunities and implementing reflection portfolios for students to assess their own engineering identities.

Data Collection and Analysis

In the first year of their RED grant, each team is invited to participate in a baseline focus group with the UW researchers on the REDPAR team; in the third year of their RED grant, each team is invited to participate in a follow-up focus group. Focus group discussions are conducted via video conference and/or telephone call and last for approximately 60 minutes each. This paper utilizes data from the second and third cohorts of RED teams' baseline focus group discussions (n=12) and follow-up focus groups (n=13). The focus groups ranged in size from 2 to 10 participants, with an average of 5 participants. Baseline focus groups were designed to gather information on the initial stages of their change projects while follow-up focus groups discussed implementation of their plans, adaptations that were made, and the skills utilized to create change.

Focus group transcripts were loaded into Dedoose qualitative software; we applied open coding, selective coding, and theoretical coding [20], [21] to analyze the data. Throughout this process, memo-writing was used to identify emergent themes and explicate findings [22], [23]. The coding scheme includes the following parent codes: unified voice, group agency, organizational

character, emotional investment, interpersonal rapport, and role of the RED consortium. For the purpose of this paper, we focus primarily on unified voice and group agency, taking into consideration where and when codes within these two categories intersect with codes within the other categories as well as how the codes inform one another.

FINDINGS

Unified Voice

Our findings indicate that RED teams developed unified voice (i.e., a shared commitment, purpose, and direction) during the proposal writing process through the intentional selection of team members with shared commitments, and through continued dialogues after the grant was awarded. Unified voice was also strengthened through teams' internal avenues of expression which allowed them to come to a consensus on their group identity. Teams' sense of "groupness" was communicated to stakeholders through external messaging and the construction of a unified "we." Finally, some RED teams also indicated that participating in group brainstorming sessions, such as REDPAR-led activities at the annual consortium meetings, further developed their unified voice.

For many RED teams, the process of developing unified voice began in the proposal development stage, during which teams decide to what extent they will share responsibilities for developing the project. As one PI described:

Well, you know when you write a proposal, somebody has to take the lead. From the ideas that came out, let's say someone had talked about the importance of entrepreneurship, and I asked that person to submit a section, and I had to tone it down. One person talked about using a strand as a way of looking at competency, so I had him submit a section on that. So, it was mainly having people submit and write a particular section, and we try to make sense of it ... It was really collaborative.

Once someone took the lead, individual team members were called upon to contribute their expertise in shaping the team's proposal. A Co-PI from another team similarly said,

You know how it goes with proposals, right? One person needs to essentially champion it to make sure it gets done on time, but it takes a whole village, it takes 20 different people to come together, bring ideas to put the whole thing together.

By involving multiple people in the proposal development process, team members are able to contribute in a meaningful way to the overall vision for the project.

Some teams also touched on the importance of the selection process for their team members, especially in relation to the ways in which NSF envisioned the composition of teams. As one PI noted:

It was very difficult to understand the role of the social scientist and the role of education researcher, so we grappled with who were the right people on campus. So we really did a broad beam. We each talked to several different departments to look at the college in the

catalog, the department websites and looked at their expertise, tried to reach out to them... So that was really challenging, to figure out who would be the right person.

Because some teams were required to fill the roles of the social scientist and education researcher, they mentioned some difficulty in finding the “right” people. A PI from another institution similarly admitted that they did not have prior connections on which they could draw for team members, but once roles were successfully filled with individuals who had shared commitments and values, teams felt their projects were headed in the right direction. “We have the A team!” one PI expressed, “Now we are going forward. Everyone here brings an important contribution to the project.” The strategic selection of team members set the foundation for developing unified voice insofar as team members not only contribute their skills, but also share a sense of purpose and a commitment to the change process.

RED teams developed further a unified voice through ongoing dialogue about the vision of their change projects. One social scientist explained:

A lot of people in this department came to the field without still having degrees in it. [There’s] a lot of sense-making. What is this field and what are we doing? And really earnestly caring about designing something that will work for the long run and fit the departments. I think that’s giving people a forum for having this kind of conversation, because we are usually focused on research and grants and things like that and we’re less often coming together around these kinds of issues, and just generating a forum where people could say this matters a lot and this has a huge impact of our work on our field and on the world.

They went on to remark that they felt everyone on the team was “super interested and excited about generating a curriculum,” an indication of a commitment to a common goal. As this data suggests, team members benefitted from having an open forum for conversations dedicated to their visions for institutional change as this provides a space for individuals to gather around their shared commitments.

These negotiations around vision and common purpose led RED teams to come to a consensus among themselves about who they are as a team and to thus develop a unified voice. This then allowed for teams to communicate with and influence their department or school. For example, at the time of the follow-up focus group, one Co-PI described:

We now have values, a group of shared values that we didn’t have before...in our first retreat that we had that came about because of this initiative, we came up with a shared value statement for the department that all faculty contributed to and signed off on and bought into. So that, I think, certainly changed the context of where we are, almost spelling out what we value and how we want to operate.

This quotation indicates other faculty members’ involvement in shaping their department’s values statement, the inception of which was initiated by the RED team. By having clear shared commitments, teams could better communicate their values and align themselves with external stakeholders.

While it was important to involve faculty stakeholders, teams also conveyed a sense of “groupness” through their construction of external messages that distinguished “us” from “them.” In both baseline and follow-up focus groups, teams often identified themselves as distinct from (albeit, still aligned with) faculty stakeholders. “I think part of the revolutionizing is that faculty are going to resist and struggle, because they don't like change, generally,” said one PI, reflecting on the initial negative reactions to their team’s project. Another team’s PI mentioned how they approached engaging with faculty differently, noting:

We are a smaller department compared to the other RED teams. Even when we were writing the proposal, we made sure all the faculty had some kind of input, even though this is the core group that wrote the proposal...When we got funded, we were careful to tell them at faculty meetings what was going on with the study and what we are hoping they will do.

While this quote speaks to broad faculty involvement, the PI frames the team (“we”) as active subjects presenting their plans to the faculty (“them”) and setting expectations. Teams all expressed varying degrees of success in aligning with faculty, but consistently relied on “us vs. them” discourse. The above quotation also touches on contextual factors that shape the team’s organizational character. Team members from a “smaller department” may already have a positive rapport with other faculty, and this in turn shapes the way they frame themselves. As one team member expressed:

I think that we've been very careful to craft our message and make sure that we fully understand the story that we're telling...we're being very conscientious and very clear about the message that we're sending and getting that buy-in early.

The team wanted to present a cohesive message to faculty members to ensure buy-in. Relatedly, a social scientist at another institution said that their team “tried really hard to work with PR. We were very careful about the message that was crafted and what we wanted to send out.” These efforts to craft external messaging further developed teams’ unified voice.

Finally, some RED teams also spoke about the role of RED consortium activities for building their team’s unified voice. Multiple teams mentioned the usefulness of Engines and Anchors, a session held during the annual in-person meeting in which participants reflect on resources that will influence their projects and revise their goals. Active participation in coalition-building activities helped teams think of themselves as a unified group. As such, team members were encouraged to anticipate challenges and solve problems together, therefore further developing a unified voice.

Group Agency

In addition to unified voice, focus group discussions revealed the ways in which RED teams established group agency. Speaking to their internal trust, teams highlighted their prior working relationships, open and effective communication, and confidence in shared and individual expertise as integral components of group agency. While, as discussed above, teams built a unified voice by viewing themselves in opposition to those not on their team (e.g., faculty), they also aligned themselves with faculty and established credibility with external actors in order to

develop their group agency. Establishing credibility can help to ensure teams can reach their goals for departmental and/or institutional change.

RED teams developed their sense of group agency by building the trust among team members and recognizing each others' interpersonal and relational strengths. Many teams were able to draw upon prior working relationships that had already established a foundation of trust. For example, one engineering educator noted:

Within the team itself, I mean, a number of us have worked together in different capacities. I think there's a certain trust among team members, that...we're in this for us to try to have success and we want to work together on it. There is a camaraderie. I mean, I think we like working together for the most part...we have some fun on the project. I think there really are a lot of different skills that people bring. I mean, so [one of our team members] really is this meta thinker, meta observer, really adds value to the project. [Another team member] has been just invaluable.

As shown in this quote, the trust that came from prior working relationships was built on value alignment and knowledge of what skills each team member was bringing to the team. Another team's PI highlighted their team's prior collaborations as shaping their team's overall confidence, stating:

We have a great team. No conflicts so far. We all believe in what we are doing. Several of us had not worked together on a research project before, but we've been collaborating for a long time. We've worked on other projects together. We have immense respect for each other. Even if we disagree, we disagree respectfully.

As shown by this quote, confidence in the team was often linked to mutual respect grounded in prior working relationships.

RED teams also stressed the importance of unified voice for building a sense of group agency. One PI explained:

The most important thing here from my perspective as to what I've witnessed is for the first time, at least since I've been here, there really is a feeling of community and all kinds of things happening that were unintended and they're positive, because we're all talking together and we're listening and we're all contributing in different ways. Therefore, we are a lot smarter now than the time when we received the proposal. What we do, what we can do, what we can envision, what we can dream, what we can empower by engaging so many people... To me that rich space is now enabling us to do lots of things, even more than we imagined. That's been the most important thing I have seen. Aside from the proposal, the fact that we are committed to change, and having honest conversations, that in itself has brought an extreme value.

Here, their team established a "feeling of community" by engaging in dialogue to create within their team a shared vision for change. This in turn has resulted in a sense of group agency that is enabling them to do "even more than [they] imagined."

The above quotation also points out the value of “honest conversations.” Several teams linked their interpersonal rapport to open and effective communication. Emphasizing the importance of conflict resolution, one project coordinator said,

I think that the way the team has dealt, when conflict has risen...like you heard earlier we never really knew when conflict was coming or where it was coming from and sometimes it was strong, but it was addressed fairly quickly and in a way that respected the individual and understood where they were coming from and sharing more about the grant.

Another team’s Co-PI expressed that the diversity of epistemological positions (e.g., constructivists, positivists, ect.) within their team “has led to many conflicts and challenges in communicating.” However, rather than being a barrier, these challenges were described as “fascinating” and “humbl[ing],” and diverse perspectives were ultimately described as a strength.

A few of the RED teams also credited their PI with establishing effective communication within the team. Acknowledging the leadership style of their PI and how the team has grown together, one individual reflected:

As an outsider to [engineering], being involved in this project was the first time I saw [the PI] working as a leader within her department. Her style is very inclusive. She listens a lot... It’s a good team, we work well together. People are working on the aspects they are passionate about... The way we interact with each other and how we’ve managed to engage faculty--it’s not our project, it’s everybody’s project.

Through inclusive leadership, listening skills, and the distribution of responsibility, this PI has fostered a positive relational dynamic among team members. In turn, team members have built a shared sense of ownership over their change project.

Developing group agency meant having confidence in both their team members’ individual expertise and the collective expertise of the team. Individual team members were often explicitly mentioned by name and praised for their contributions. One PI called out the strengths of three individuals, saying:

That’s when [one of the Co-PIs], [our education researcher], and [our social scientist] come into play because I think [the faculty are] going to be more receptive to reaching out to them, talking to them, and also summarizing what students are thinking through the focus group meetings and they can bring back what the students are overwhelmingly saying. This approach is not working for the majority of the students and maybe that presents a strong enough reason to change.

Similarly, a social scientist at another institution said of their teammates:

[They] are not small actors in having created an environment where people felt like they could contribute and do interesting things. They’re understated heroes in that regard. They’re trusted, they’re respected, they’re occasionally hated, but that happens with any administration. People are confident in the ability of the individuals who are running this project.

As shown in these quotes, individuals were often quick to develop confidence in their team members who already possessed high credibility within their institution.

Credibility emerged as a significant factor for developing group agency as teams discussed their relationships with institutional actors. Several teams mentioned that they were able to successfully garner support from the Dean, while also identifying support from faculty, alumni, and advisory boards as relevant for creating change. “I can say for sure that our Dean is very interested,” one PI said, continuing:

He listens to the results of our work and would like to have some of our findings picked up by the departments...as we move forward, we will try to emphasize to all our peers what we're doing and how it could possibly benefit them. So we want to make sure that this is more widely used and benefits the whole institution.

All teams discussed their need to align themselves with faculty. “We have to listen to faculty to see where their comfort is with change,” a PI from another team explained, “You have to meet them when they are taking baby steps, and prod them to take a larger step in the future.” Even when faculty showed some resistance initially, as another PI said:

I think over time, as we have continued to work on it, and engage people, I've been pleased that...I think almost all faculty, maybe all faculty, care about student success. And maybe at different levels, but they care about student success.

Some teams also acknowledged how they incorporated faculty into their projects. For example, one team discussed how “having a different role for everyone in the long run will ensure that this project will touch every faculty member.” By finding shared values with department faculty and more intentionally including faculty members into the implementation of RED projects, teams could further establish their credibility.

DISCUSSION

We find that the development of a team’s unified voice often begins with proposal writing and continues through communication and messaging to external audiences. When members of RED teams did not collaboratively write the grant proposal, they found it necessary to devote more time at the beginning of their projects to develop a sense of shared vision for their project. For many RED teams, the development of a unified voice was further strengthened through external messaging, as they articulated a “we” in opposition to a “they” who have different values or interests [14], [16]. Developing a unified voice helps teams construct and communicate a cohesive understanding of who they are and work more effectively through challenges together.

In order to fulfill the NSF requirements for each team to include an education researcher and social science expert, some teams needed to look beyond their current and prior working relationships. In these instances, teams discussed the importance of finding individuals who had shared commitments and values to improving engineering education. While these individuals thus came to the team without a sense of trust established from prior collaborations, the strategic selection of team members set the foundation for developing unified voice insofar as team

members contributed not only their skills, but they also came into the project sharing a sense of purpose and commitment to the change process.

The interdisciplinary nature of the RED teams underlaid their efforts to develop a sense of group agency. For some of the RED teams, the inclusion of education researchers and social science experts on their teams gave the engineering team members new, increased exposure to these fields. RED teams found that creating mutual respect was foundational for working across disciplinary differences and productively working through disagreements. Internal avenues of expression, such as conflict or dissent, are integral to creating a cohesive voice [14]. Team members should feel they can express themselves within the group to establish a sense of unity. Within our focus group discussions, RED teams explicitly praised their fellow team members for their strengths and expertise and highlighted others' contributions. Specific words of affirmation can foster group agency as team members feel their individual skills and perspectives are valuable and necessary. When individuals are empowered in this way, they are more likely to perceive their goals as achievable [14], thus strengthening their group agency.

This paper is limited in scope as it does not capture the changes in unified voice and group agency over time. The authors are currently working on a longitudinal analysis on the same topic to address this limitation. However, our findings here suggest that unified voice may lead to the development of group agency. By building a unified voice, the RED teams built a sense of community and established patterns of effective communication. This in turn built their confidence in their ability to achieve their goals. As team members feel empowered in their individual roles and feel positively about their relationships with whom they are working, teams can more easily envision a path toward greater equity within their institutions. Interdisciplinary teams can increase their efficacy by learning from one another and leveraging networks that would not necessarily be otherwise available to them [17]. That is, by including members from outside of their core engineering departments, RED teams can benefit from alternative approaches to research, curriculum development, and program evaluation and connections to wider networks. Teams can have greater potential for long-lasting change if they are able to garner credibility through connections with a wide range of stakeholders. Further research is needed to investigate the potentially causal nature of the relationship between unified voice and group agency.

This analysis of the formation of teams for creating change in academia highlights the processes through which team members develop unified voice and group agency. Improving our understanding of the formation of teams that are advancing equity is fundamental to developing insights into how these teams can be equitable themselves. As Adrienne Maree Brown [24] writes, "what we practice at the small scale sets the patterns for the whole system" (p. 53). The transformation of engineering education to be a more equitable and inclusive space begins with the relationships within change teams.

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REFERENCES

- [1] R. Caldwell, "Models of change agency: A fourfold classification," *British Journal of Management*, vol. 14, no. 2, pp. 131-142, 2003.
- [2] J. R. Hackman and A. C. Edmondson, "Groups as agents of change," in *Handbook of organization development*, T. Cummings, Ed. Thousand Oaks: SAGE, 2008, pp. 167-186.
- [3] L. Long III. and J. A. Mejia, "Conversations about diversity: Institutional barriers for underrepresented engineering students," *Journal of Engineering*, vol. 105, no. 2, 2016.
- [4] E. J. Theobald, M. J. Hill, E. Tran, S. Agrawal, E. N. Arroyo, S. Behling, N. Chambwe, D. L. Cintron, J. D. Cooper, G. Dunster, J. A. Grummer, K. Hennessey, J. Hsiao, N. Iranon, L. Jones II, H. Jordt, M. Keller, M. E. Lacey, C. E. Littlefield...S. Freeman, "Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math," *Proceedings of the National Academy of Sciences*, vol. 117, no. 12, pp. 6476-6483, 2020.
- [5] C. Baillie, A. Pawley, and D. Riley, *Engineering and social justice: In the university and beyond*. West Lafayette, IN: Purdue University Press, 2012.
- [6] D. Riley, "Engineering and social justice," *Synthesis Lectures on Engineers, Technology, and Society*, vol. 3, no. 1, pp. 1-152, 2008.
- [7] K. Scheidgen, "Social contexts in team formation," *Historical Social Research/ Historische Sozialforschung*, vol. 44, no. 4 (170), pp. 42-74, 2019.
- [8] S. C. Hsu, K. W. Weng, Q. Cui, and W. Rand, "Understanding the complexity of project team member selection through agent-based modeling," *International Journal of Project Management*, vol. 34, no. 1, pp. 82-93, 2016.
- [9] J. R. Katzenbach and D. K. Smith, "The discipline of teams," *Harvard Business Review*, vol. 83, no. 7, pp. 162-171, 1993.
- [10] A. Olmstead, A. Beach, and C. Henderson, "Supporting improvements to undergraduate STEM instruction: An emerging model for understanding instructional change teams," *International Journal of STEM Education*, vol. 6, no. 1, p. 1-15, 2019.
- [11] A. Melucci, "The process of collective identity," *Social Movements and Culture*, vol. 4, pp. 41-63, 1995.
- [12] I. Vanaelst, B. Clarysse, M. Wright, A. Lockett, N. Moray, and R. S'Jegers, "Entrepreneurial team development in academic spinouts: An examination of team heterogeneity," *Entrepreneurship Theory and Practice*, vol. 30, no. 2, pp. 249-271, 2006.
- [13] R. Brubaker and F. Cooper, "Beyond 'identity,'" *Theory and Society*, vol. 29, no. 1, pp. 1-47, 2000.

- [14] K. Dugan and J. Reger, "Voice and agency in social movement outcomes," *Qualitative Sociology*, vol. 29, no. 4, pp. 467-484, 2006.
- [15] K. Doten-Snitker, C. Margherio, E. Litzler, E. Ingram, and J. Williams, "Developing a shared vision for change: Moving toward inclusive empowerment," *Research in Higher Education*, vol. 62, pp. 206-229, 2020.
- [16] K. M. Blee, *Democracy in the making: How activist groups form*. New York, NY: Oxford University Press, 2012.
- [17] H. van Emmerik, I. M. Jawahar, B. Schreurs, N. and De Cuyper, "Social capital, team efficacy and team potency: The mediating role of team learning behaviors," *Career Development International*, vol. 16, no. 1, pp. 82-99, 2011.
- [18] J. P. Kotter, *Leading Change*. Boston, MA: Harvard Business School Press, 1996.
- [19] F. C. Lunenberg, "Managing change: The role of the change agent," *International Journal of Management, Business, and Administration*, vol. 13, no. 1, pp. 1-6, 2010.
- [20] C. A. Hernandez, "Theoretical coding in grounded theory methodology," *Grounded Theory Review*, vol. 8, no. 3, pp. 1-13, 2009.
- [21] J. A. Holton, "The coding process and its challenges," in *The Sage Handbook of Grounded Theory*, A. Bryant & K. Charmaz, Eds., London: SAGE, 2007, pp. 265-289.
- [22] K. Charmaz & L. L. Belgrave, "Grounded theory," *The Blackwell Encyclopedia of Sociology*, 2007
- [23] L. B. Lempert, "Asking questions of the data: Memo writing in the grounded theory tradition," in *The Sage Handbook of Grounded Theory*, A. Bryant & K. Charmaz, Eds., London: SAGE, 2007, pp. 245-264
- [24] A. M. Brown, *Emergent Strategy*. Chicago, CA: AK Press, 2017.