



Developing and Sustaining a Research Group: A Novel Approach to Onboarding Doctoral Students

Dr. Madeline Polmear, University of Florida

Madeline Polmear is a postdoctoral researcher in the Department of Civil and Coastal Engineering at the University of Florida. Her research interests include workforce development and engineering ethics education.

Dr. Denise Rutledge Simmons P.E., University of Florida

Denise R. Simmons, Ph.D., PE, LEED-AP, is an associate professor in the Department of Civil and Coastal Engineering in the Herbert Wertheim College of Engineering at the University of Florida. She holds a B.S., M.S., and Ph.D. in civil engineering and a graduate certificate in engineering education – all from Clemson University. She has over ten years of construction and civil engineering experience working for energy companies and as a project management consultant.

Dr. Simmons has extensive experience leading and conducting multi-institutional, workforce-related research and outreach. She is a leader in research investigating the competencies professionals need to compete in and sustain the construction workforce. Dr. Simmons oversees the Simmons Research Lab (www.denisersimmons.com), which is home to a dynamic, interdisciplinary mix of graduate researchers and postdoctoral researchers who work together to explore human, technology and society interactions to transform civil engineering education and practice with an emphasis on understanding hazard recognition, competencies, satisfaction, personal resilience, organizational culture, training, informal learning and social considerations. The broader impact of this work lies in achieving and sustaining safe, productive, and inclusive project organizations composed of engaged, competent and diverse people. The SRL is supported by multiple research grants, including a CAREER award, funded by the National Science Foundation (NSF).

Dr. Simmons is a former project director of the Summer Transportation Institute (STI) at South Carolina State University and Savannah River Environmental Sciences Field Station (SRESFS). Both programs were aimed at recruiting, retaining and training women and minorities in transportation, environmental science and engineering and natural resources-related fields of study. As SRESFS director, she led a board composed of 29 colleges and universities.

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Abstract

Starting in a new institution, degree program, and research group can be a challenging transition for doctoral students. Although department and university orientations cover rules, deadlines, and resources, there are often fewer formal opportunities to onboard new graduate students in research groups. As a result, students can experience difficulty with a lack of understanding expectations and responsibilities, lack of communication with their mentors, and lack of community with their peers. To address these challenges and formalize the development of a culture, a civil engineering research group at a public research-intensive university in the southeastern United States participated in a retreat. The retreat took place over five days prior to the start of the fall 2019 semester at an off campus location. The motivation for the retreat was grounded in John P. Kotter's Leading Change process to create organizational transformation and improve the onboarding experience of the new doctoral students and postdoctoral researchers. Given the high attrition rates in graduate education, the retreat was also designed to foster retention by integrating attributes of the Workforce Sustainability model.

The retreat was framed around four objectives: (1) build community, (2) communicate group norms and expectations, (3) develop individual strategic plans, (4) and introduce research skills. The retreat encouraged individual and collective reflection on goals, deliverables, and expectations. The experience was guided by the notion of *beginning with the end in mind* and, in this case, meant aligning individual professional development plans with that individual's long-term career goals and vision of the research group. The retreat was designed to construct a solid foundation on which to build individual and shared success.

This paper describes the eight steps in the Leading Change process and its application to the pre-retreat planning, retreat assignments and activities, and post-retreat. The Workforce Sustainability model will also be discussed to illustrate how the eight attributes support the sustained performance of a research group and how each was intentionally cultivated during the retreat.

Since self-reflection can help illuminate meaningful personal insights, each research group member was asked to submit written reflection on lessons learned, key takeaways, and outcomes from the retreat. Thematic analysis of the reflections revealed the value of the retreat in establishing connectivity and communication among members and creating an environment in which the doctoral students felt nurtured in their personal and professional development. This work details a novel approach to onboarding new members of a research group and aims to demonstrate the value of translating organizational change and workforce sustainability to academic environments.

Introduction

On an individual level, graduate education is a transformative time for engineering students' personal and professional development and on a broader scale, it contributes to the training of future innovators who contribute to the economic and intellectual prosperity of society [1]. This period fosters the skills and principles that support disciplinary stewardship [2]. When students

begin their graduate studies, they are acculturated in a university, department, discipline, and research group. Each environment provides opportunities for development and integration. Orientation activities can serve as an important first step in this integration. Most orientation efforts, and the research related to them, have focused on department and university-wide initiatives; however, the individual research group is where engineering graduate students invest most of their time and gain their training.

Background

There has been growing conversation around engineering graduate education in recent years [3], [4]. There are a number of drivers outside of academia and challenges within it that warrant a closer look at how the researchers, professors, and innovators of the future are being trained [5].

Socialization

The graduate experience involves both professional and personal development. Socialization is a common theory through which to understand the graduate student experience and involves the process of internalizing the norms of a group [6]. Socialization in this context is multi-layered because graduate students transition from newcomers into members of their department, university, discipline, and the broad academic community [6]. Orientation can contribute to socialization by easing students' transition and alleviating stress through academic and social integration [7]. Orientations most often cover topics such as policies, student services, computer facilities, libraries, health care, and academic advising [7]. Although these opportunities can provide valuable administrative information, they generally focus on department or campus activities. Orientation is rarely scaled or tailored to a research group, the unit in which graduate students spend the majority of their time and most of their learning and development transpires [8]. The research unit is especially salient in this context because research is the essence of the graduate student experience [5]. The structure, environment, composition, and size of a research group are highly variable and all of these factors can influence the personal and professional development of graduate students within them [9].

Challenges in graduate education

There are a number of social and academic challenges confronting engineering graduate students, including a lack of career preparation, clear expectations, performance feedback, sense of community, and opportunity for reflection [6]. Inadequate research preparation has also been cited as a challenge. As an example, most students in the Georgia Institute of Technology Environmental Engineering Program reported that they were not prepared for research when starting their graduate program and that they did not improve significantly during their first year [10]. In that study, students with undergraduate degrees in civil engineering felt particularly underprepared relative to their peers in environmental and chemical engineering. These factors can adversely affect graduate students' experience and degree completion. Such challenges have highlighted the need for further discussion and reform in graduate education. One such example was a workshop with graduate students, administrators, faculty members, and postdoctoral researchers that culminated in suggestions for engineering graduate education: (1) clarify expectations, (2) attend to the community, (3) organize the research group for mentoring, and (4) structure student development toward independence [8].

A civil engineering research group at a public research-intensive university developed a retreat to support socialization, address the aforementioned challenges, and integrate best practices in graduate education while also drawing on organizational change and workforce sustainability. The motivation, implementation, and outcome of the retreat are included in this paper.

Motivation

The retreat was rooted in two frameworks: leading organizational change [11] and sustaining the workforce [12]. These two frameworks complement each other to underscore processes for driving change in a group and supporting the people within it. All five members of the research group (one faculty member, two postdoctoral researchers, and two doctoral students) participated in the retreat.

Organizational change

The retreat coincided with the establishment of the research group. The faculty member who leads the group moved from a different university one year prior so August 2019 marked the starting period for two newly hired doctoral students and one newly hired postdoctoral researcher (a second postdoctoral researcher began in the group February 2019). As a result, the timing afforded the opportunity to establish a culture and initiate change in how graduate students are onboarded. The process for creating and leading change was anchored in John P. Kotter’s eight steps. These steps are summarized from [11] and shown in Table 1.

Table 1: Leading change process

Step	Definition
1. Establishing a sense of urgency	Understand the market and identify opportunities
2. Creating the guiding coalition	Assemble the team to lead
3. Developing a vision and strategy	Create the vision and steps to attain it
4. Communicating the change vision	Articulate the idea and have the coalition model it
5. Empowering broad-based action	Remove the barriers to change by changing the system
6. Generating short-term wins	Plan for and recognize improvements
7. Consolidating gains and producing more change	Develop people who support the vision
8. Anchoring new approaches in the culture	Connect individual behavior and organizational achievement

Workforce sustainability

This model was developed to improve workforce development in the construction industry through a mixed-methods approach that included semi-structured interviews with industry professionals and academics, a subject matter expert survey, and literature review. In this context, workforce sustainability is conceived as “a property of a workforce that reflects the extent to which the workforce can perform its desired function over a selected period of time” [12, p. 1]. Although created for the construction workforce, there are many common factors that make the model relevant for graduate education. Challenges reported in the construction industry

that motivated the development of the model are also prevalent in engineering graduate education such as the intense environment that induces emotional stress [13], high attrition [14], ever-evolving needs and demands [3], and challenges with diversity and retention [1]. In graduate education, like in industry, time and money are invested in recruiting the workforce but less attention is paid to retaining it and creating opportunities for it to thrive.

The model includes eight attributes that define a workforce and its level of sustainability. The attributes are displayed and defined in Table 2, which is summarized from [12].

Table 2: Workforce sustainability model

Attribute	Definition
Nurturing	Feeling of support and encouragement and receiving training
Diversity	Diversity and inclusion related to personal characteristics
Equity	Fair treatment and compensation
Health and Well-being	Physical, social, and mental safety and contentment
Connectivity	Connection to, and communication between, peers and management
Value	Feeling of value, respect, and recognition for contribution to the organization
Community	Camaraderie and cohesion in the organization and workforce
Maturity	Opportunity to gain responsibility, leadership, and competence

A key point of the model is that workforce sustainability entails hiring highly skilled individuals and creating an environment in which their foundational competencies are constantly nurtured and maintained.

Retreat

The following section details the retreat including objectives, schedules, and assignments.

Objectives

There were four primary objectives for the retreat, which were motivated by various components of the change process and workforce sustainability model, as shown in Table 3.

Table 3: Retreat objectives

Objective	Organizational Change	Workforce Sustainability
Build community	Step 2: create guiding coalition	Community, Connectivity
Develop individual strategic plans	Step 3: develop a vision and strategy Step 4: communicate the change vision	Maturity
Introduce basic research skills	Step 5: empower broad-based action Step 6: generate short-term	Nurturing

	wins	
Communicate group norms and expectations	Step 8: anchor new approaches in the culture	Value, Connectivity

These objectives were designed to leverage the theoretical frameworks while also addressing commonly cited challenges in graduate education. Firstly, the retreat aimed to foster camaraderie since lack of community can feel isolating for engineering graduate students [6]. Residing together throughout the retreat allowed the research group many opportunities to build community and connect: preparing and eating meals together, having casual conversations between sessions and at the end of each day, and participating in recreation activities.

Individual strategic plans were developed to serve as the starting point for career preparation since many graduate students do not feel sufficiently prepared, especially for careers outside of academia [1]. The graduate students were encouraged to think about where they sought to be employed upon graduation and to be mindful that more than a doctoral degree would be required to obtain employment. Guided conversation allowed them to think of the yearly activities they should consider undertaking. The strategic planning also extended to the broader vision of the research group. Part of the change vision of the faculty member was establishing an organization built on mutual benefit. By articulating visions and strategies on an individual and collective level, the retreat established how the two could be leveraged.

The introduction of research skills was intended to provide a baseline understanding of requisite skills. Those skills were self-assessed during the retreat so students could understand their own strengths and opportunities for improvement since many engineering students feel underprepared in regards to research proficiency [10]. The skills included quantitative analysis, qualitative analysis, writing, and graphic design. The postdoctoral researchers led these activities, discussions, and presentations. This format enabled the postdoctoral researchers to share their expertise and begin establishing a community of knowledge sharing. Having the postdoctoral researchers present also allowed the graduate students to see them as leaders in the research group and colleagues of the faculty member, a point that was reinforced throughout the retreat.

Finally, the retreat allowed for individual reflection and group discussion on expectations, which were formally documented after consensus was reached to mitigate concerns over a lack of clear expectations [6]. The expectations included research group norms and behaviors and the broader responsibilities of doctoral students and postdoctoral researchers. The group members were encouraged to consider what would be expected of them and what they expected from each other and the research experience. For example, some doctoral students are unaware of, and unprepared for, the business aspect of research when they enter their program. To sustain themselves, research groups have to acquire funding, produce deliverables, and recruit new members. The doctoral students were introduced to this three-part model of research (funding, disseminating, and recruiting) and how they are expected to contribute to it. Another expectation that was established during the retreat was scaffolding toward independence. Anecdotal evidence has suggested that doctoral students expect their advisors to provide everything they need for success and there can be frustration when this is not delivered. To this end, the discussion was designed to underscore the expectation that group members will take initiative, be accountable for their progress, and develop towards independence.

Schedule

The retreat took place over five days and was located in a rental house in a resort community that was two hours from campus by car. All members of the research group drove together and stayed at the house for the duration of the retreat. The faculty member who leads the group personally covered the cost of the rental car and house. Each person was responsible for his or her own food and prepared meals at the house during the allotted breaks.

A summary of the schedule is provided in this section to illustrate the topics and delivery formats.

Day 1: Introduction

Time	Tasks
2:00 PM	Depart campus
2:00 - 4:00	Introduction and ice breaker (in the car) [Activity 1] Team building/leadership development activity
4:30 - 5:30	[Presentation 1]: Introduce research background Pre-retreat assignment 1 [Question and Discussion]
5:30 - 6:30	[Discussion 1]: Introduce research paper Pre-retreat assignment 2
6:30 - 7:30	Dinner

Day 2: Group norms and individual strategic plans

Time	Tasks
8:00 - 8:30	[Discussion 2]: Discussion about group norms Pre-retreat assignment 3
8:30 - 9:00	[Presentation 2]: Group norms and lab expectations
9:00 - 10:00	[Question and Discussion]
10:00 - 10:40	[Presentation 3] Introduce active research projects
10:40 - 11:00	[Question and Discussion]
11:00 - 11:30	[Presentation 4]: Achieve a fulfilled academic career
11:30 - 12:00	[Discussion 3]: Achieve your academic goals
12:00 - 1:00	Lunch
1:00 - 2:00	[Discussion 4]: Assess and discuss quantitative skills Pre-retreat assignment 4
2:00 - 3:00	[Discussion 5]: Assess and discuss qualitative research skills Pre-retreat assignment 5
3:00 - 4:00	[Discussion 6]: Assess and discuss writing skills Pre-retreat assignment 6
4:00 - 5:00	[Discussion 7]: Assess and discuss individual strategic plan (sample CV) Pre-retreat assignment 7

5:00 - 6:00	Dinner
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Day 3: Introduce and practice research skills

Time	Tasks
8:00 - 9:00	[Presentation 5]: Enhance graphical design skills
9:00 - 11:00	[Hand-on Practice 1]: Create sample NSF poster Pre-retreat assignment 8
11:00 - 12:00	[Presentation 6]: Enhance PowerPoint designs
12:00 - 1:00	Lunch
1:00 - 3:00	[Hand-on Practice 2]: Create effective presentation
3:00 - 4:00	[Hand-on Practice 3]: Introduce lab website and update content
4:00 - 5:00	[Discussion 8]: PR and marketing Pre-retreat assignment 9
5:00 - 6:00	Dinner

Day 4: Introduce and practice research skills

Time	Tasks
8:00 - 8:30	[Presentation 7]: The path of PhD
8:30 - 10:00	[Discussion 9]: Prepare PhD study plan Pre-retreat assignment 9
10:00 - 11:00	[Presentation 8]: Conduct effective literature review
11:00 - 12:00	[Presentation 9]: Introduce quantitative data analysis software
12:00 - 1:00	Lunch
1:00 - 2:00	[Presentation 10]: Introduce qualitative data analysis software
2:00 - 3:00	[Discussion 10]: Understanding important skills of researchers
3:00 - 4:00	[Discussion 11]: Learning new skills
4:00 - 5:00	[Discussion 12]: Improving working productivity

Day 5: Wrap-up

Time	Tasks
8:00 - 9:00	[Discussion 13]: Enhancing leadership skills in academia
9:00 - 10:00	[Discussion 14]: Overcoming pressure in academic career
10:00 - 12:00	Drive back to campus

Pre-retreat assignments

All members of the research group completed pre-retreat assignments to encourage reflection and preparation prior to the retreat and optimize time together during the retreat. The assignments are provided below.

1. Prepare a 5-7 minute presentation with one PowerPoint slide on your research background
2. Discuss in 5-7 minutes one published paper that is related to your research interests
3. Develop a list of group norms and culture; define workforce development in one page with citations

4. Self-assess quantitative skills with inventory mapped to Bloom's taxonomy
5. Self-assess qualitative skills with inventory mapped to Bloom's taxonomy
6. Self-assess writing skills with inventory
7. Find sample CV of "role model" in an entry level job you desire and develop strategic plan with first semester and overall career goals
8. Develop a figure to depict one National Science Foundation-funded project awarded to the research group
9. Develop a one-page public relations and marketing plan
10. Develop PhD study plan with department and university milestones, deadlines, requirement, and paperwork

The assignments were submitted to a shared Google Drive with a deadline of five days before the start of the retreat.

Post-retreat Reflection

Reflections were solicited from each research group member one week after the retreat. The written reflections were collected and analyzed by the first author using a combination of deductive and inductive thematic analysis [15]. Components of the organization change process and workforce sustainability model were used as *a priori* anchor points to understand if the underlying motivations manifested in the experiences of the retreat participants. Additional codes were emergent in the data. The most salient themes are presented in this section to discuss the outcomes, impacts, and takeaways of the retreat.

Fostering personal and professional connectivity

With all of the research group members coming from different countries and states and just starting at the university, the retreat marked an important opportunity to bring the group together for the first time. All of the reflections expressed the value of the retreat in establishing personal and professional connections. One of the doctoral students noted,

This retreat provides a great opportunity for me to know the personality [of] members and communicate [with] them more easily. Because it was very awkward for me to talk with them in lab, but after the retreat it facilitate[d] my relationship with them.

The retreat offered an extended period of time without outside distractions or commitments to get to know each other. The retreat included formal opportunities, such as icebreakers and discussions, and informal opportunities, such as conversations over meals or around the pool that facilitated engagement. One of the postdoctoral researchers noted that "time can be the greatest commodity so it was a luxury to have the entire group together for five day." This concentrated time enabled interaction and community that would have been challenging to establish in the normal lab environment. The other doctoral student expressed the value of this opportunity by saying, "Overall, the retreat was one of the great experiences that I have ever had, especially with my academic colleagues."

Facilitating the transition through communication

Another pattern across the reflections was the importance of the retreat in establishing communication. Since everyone in the research group was new to their role and this institutional context, there were a number of pragmatic questions about the transition. Faculty members have a multitude of commitments that demand their time and attention during the semester. As a result, graduate students can feel limited in their access to, and communication with, their advisor and faculty are the primary agent of academic integration [14]. The structure of the retreat helped overcome this barrier by providing opportunities throughout the five days to ask questions. One of the postdoctoral researchers noted, “This format facilitated conversations that answered questions that would have otherwise taken weeks of emails and meetings to address.”

Communication was also important in establishing the norms of the research group. This proactive approach aimed to mitigate future issues stemming from difference in expectations. One of the postdoctoral researchers described the value of this process,

Oftentimes the assumptions, values, and behaviors that define a culture are unstated. This sense of ambiguity can lead to misunderstanding, conflict, and tension when members within the community come from different backgrounds, settings, and contexts that were guided by different norms. As a result, it is productive to establish norms from the beginning through a collaborative process that allows all members to contribute and ask clarifying questions.

The retreat was designed with the understanding that everyone is coming from a different cultural and academic background. It thus aimed to formulate a new research group culture that represented the convergence of various values and norms through communication channels that supported individual reflection and group feedback.

By expediting communication, the retreat also eased the onboarding process. One of the doctoral students remarked,

This retreat in fact push me forward I can say for two months. As a new PhD student, I was very confused with my PhD voyage at the beginning of semester. I think this confusion would last maybe for two months at least. But this compacted 5-day retreat really push me forward. After the retreat many things was clarified. I understood why I am here right now and where should I be in the “x” years. And I have a road map for my journey as a PhD student.

This theme suggested that the retreat was successful in meeting the objective of supporting communication and establishing norms and expectations.

Creating a nurturing environment

Creating an environment in which individuals feel encouraged and supported and have access to training and education is key to sustaining a workforce [12]. This personal and professional nurturing facilitates individual and group achievement. The research group members noted the creation of this environment as one of the retreat outcomes and that role modeling aided in its

establishment. One of the doctoral students noted this as one of the unanticipated effects of the retreat.

What really changed me was their lifestyle. If you live with someone that you want to become in the future, you gain a lot of benefits to mirror their lifestyles and their behaviors in treating problems and challenges, and also in celebration. I unintentionally had to wake up early, which is a good routine of living a life as a phd student... I observed [one of the postdoctoral researchers] listening to motivation audio/videos in the morning to get him encouraged throughout the day. [The other postdoctoral researchers] took good notes... in clear sentences with clear handwriting--which I am really bad at. [The faculty member] was good at pinpointing and critiquing ideas. She was sharp in processing ideas and generous in sharing ideas... [she] has a gift in mentoring and guiding. Whether she is born with this gift or learned through experience, I felt well coached and directed in my academic career.

Through sharing a house for five days, the retreat provided unique insight into the personalities and routines of each research group member. There were active and passive opportunities to learn from each other. The doctoral student described benefits from interacting with researchers at more advanced stages in their academic careers and gleaning lessons from observing them. This comment also speaks to the importance of mentorship in creating a nurturing environment.

The emphasis on mentoring in the research group was bidirectional. One of the postdoctoral researchers described that the retreat was helpful in understanding how to be an effective mentor to the doctoral students.

I noticed that our graduate students are very bright and agile, so the best method to mentor them is leading, nurturing, and celebrating rather than managing them...One important thing I learned from [the faculty member] is that the mentor should listen and prompt student... I understand now why people say the best leader is the last person [to] speak in the room. I also learned that any discussion should have a clear, tangible deliverables with actionable next steps and reasonable schedule.

Short-term indicators

Organizational change is a gradual and non-linear process. As a result, it is helpful to look for short-term indicators as signposts for progress. These short-term wins are visible, unambiguous, and related to the change vision and they provide evidence, offer positive feedback, and build momentum [11]. There were a number of signs that developed in the days, weeks, and months after the retreat that suggested positive change was being created and sustained. Examples of these short-term wins include:

- Willingness to learn and engage: all members of the research group demonstrated in the retreat that they were willing to participate and support the overall vision of the group. This momentum was maintained after the retreat as members scheduled meetings with each other to follow-up on retreat topics and pursue university resources to develop research skills that were introduced.

- Comfort with asking questions: the number of questions asked during the retreat was encouraging because it showed that people were already comfortable in the group setting. This created a precedent in which the doctoral students and postdoctoral researchers felt comfortable approaching each other with questions.
- Strengths and opportunities for growth: the research skills assessments from the retreat provided a baseline on the doctoral students' skillsets. After the retreat, the doctoral students showed initiative in addressing their skills gaps by registering for particular courses and meeting with their postdoctoral mentor.
- Strategic plans: the strategic plans that were developed during the retreat served as a blueprint for the semester. In the weeks following the retreat, everyone iterated their plans and developed deliverables matched to each objective. The performance of the doctoral students was evaluated based on these deliverables at the end of the fall semester.

Conclusions and Recommendations

The retreat was designed to onboard the first cohort of doctoral students and postdoctoral researchers in the newly established research group. As a result, it was intended that the research group would create the culture and knowledge to welcome future members without a recurring retreat. The initial onboarding established the guiding coalition of the research group so that each year when additional students join, they can be informally introduced into the already established organization.

Considerations for scaling

Faculty members and research mentors seeking to replicate or scale up this retreat should consider developing a vision for their research group. This vision will guide the objectives they seek to achieve broadly through their research group and, specifically through the retreat. The vision will inform the retreat location, duration, activities, and assessment. Creating a vision gives direction for graduate student behavior and helps provide inspiration. Vision needs to be clear to all participants and not buried in complicated language. The faculty member who developed this retreat was guided by the following vision for her research group:

- We will produce high quality work recognized and rewarded by scholars in our community and constituency we seek to influence.
- We will be the research group that high quality students seeking a PhD in civil engineering will desire to join.
- We will encourage one another and help each other meet goals and succeed.
- Graduates of our research group will be influencers in the public and private sectors and work in industry, government, think tanks, academia, and their own companies.

The vision should guide broad and specific objectives. The faculty member told the graduate students and postdoctoral researchers that the broad objectives of the research group are to recruit graduate students, disseminate research, and obtain funding to support our lab. The objectives help develop activities that begin to cultivate mindsets and actions to support the vision. The specific retreat objectives are noted in Table 3. As supported by the post-retreat reflection, aligning the objectives with the vision provided clarity to graduate students on links

between initiatives and objectives, reinforced norms of the research group, and helped participants develop an individualized plan.

The retreat location should accommodate the size of the research group and include meeting and socializing spaces. The duration should support completion of planned activities. While these seem like straightforward decisions, the location and duration have a large impact on the results achieved. The retreat was planned at an offsite location two hours from campus, for five days, and at the expense of the faculty member. Locations that require little or no travel for participants and that allow them to sleep in their own residence can successfully support a retreat. Such a location could also lessen or remove the expense of housing and transportation. However, participants may not achieve full immersion in the experience. Going to individual residences disconnects them from the group until they return the following day where activities to foster reconnection would be advised.

When deciding on the duration of the retreat, it may be feasible to plan a multiday retreat or a retreat planned for multiple, nonconsecutive days over a period of time. Again, realize that lack of continuity can negatively influence intended outcomes. The development of team building exercises may be helpful.

Finally, developing and executing an evaluation plan will help assess the outcomes of the retreat. For objectives that seem to be not well achieved, the faculty member can seek ways to achieve these outcomes using another method (e.g., mini workshops, readings, individual development strategies).

Conclusion

Graduate education is a formative experience for personal and professional development. In addition to being part of a department, university, and discipline, graduate students become members of research groups in which most of their time is spent and most of their training transpires. By framing the socialization process in organizational change and workforce sustainability, this research group sought to facilitate onboarding of new members and establish a self-sustaining culture that would nurture individual and collective performance. Indicators immediately after the retreat and in the following months demonstrated that the experience fostered community, facilitated communication, and established expectations that have supported the group moving toward their shared vision.

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