

This column addresses aspects of lifelong learning for current students, alumni, and faculty. Examples of student and faculty activities that involve industrial practice and engagement as well as continuing education are welcome. These topics may not always lend themselves to the traditional scholarly format with formal assessment and extensive literature review but may be more editorial in nature. Submit papers through journals.flvc.org/cee, include lifelong learning in the title, and specify lifelong learning as the article type.

RETREAT TO ADVANCE: A LIFELONG LEARNING OPPORTUNITY FOR RESEARCH STUDENT DEVELOPMENT

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Team building activities constitute a common practice in professional settings; their benefits have been studied and are well-documented.^[1] Faculty and staff members often participate in departmental retreats or team-building activities to ensure cohesive group dynamics.^[2-5] However, student members of a research group (undergraduate, graduate, post-doctoral) focus primarily on their lab work and the progression of their research projects and may not understand or recognize the connection to the overall research thrust within the group. Group retreats offer a cooperative and collegial opportunity to build and maintain a healthy team dynamic, ultimately resulting in a more efficient research group.

Over the past seven years, the Genzer research group has self-organized and held bi-annual group retreats (Fall and Spring). Members of the research group help plan and implement the retreats, which take place at an off-campus location during weekends in May and October. By interacting outside the typical work environment, the students distance themselves from their lab work, which allows them to focus on building personal ties with their colleagues. The retreats comprise a combination of professional development exercises, research-based activities, and leisure time. We typically leave campus around mid-day on Friday and commute to a rented house on the beach or in the mountains of North Carolina, located a mere two-hour drive from campus, where we stay until mid-day on Sunday. While our group retreats are completely voluntary, attendance has been high due, in part, to the exciting location and the food/accommodations whose cost has been covered by the research advisor. For example, group attendance is higher when the retreats are



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held at the beach when compared with retreats located at someone's house locally. In the past, we have also rented a lake shelter (about 30 miles away from campus) to hold one-day fall retreats. While each student has a preference for the duration of group retreats, the end goal of increasing group technical knowledge and collegiality remains the same regardless of retreat duration. The retreats are open only to the members of the Genzer research group. Opening the retreat to students from other research groups, while tempting due to broader research collaboration, would make organizing the retreat logistically very challenging.

RETREAT STRUCTURE

Figure 1 displays an example of a typical weekend retreat schedule. The first night when we arrive at the house, we do not schedule any research activities. Instead, we use the time to cook dinner together; typically, international group members prepare dishes from their home countries. The experience of cooking meals together serves as a team-building activity by having everyone involved. Some of the most bond-forming experiences come as students instruct their colleagues how to make their favorite "home dish." Past recipes span origins including Korea, China, India, the Czech Republic, and El Salvador. We devote Friday evenings to leisure activities among the group members such as walking on the beach, watching sports events, playing board games, and even performing karaoke. This unstructured time helps to "break the ice" for fruitful interactions among group members, leading to the mentoring of younger students and general social interactions.

The first set of structured academic and professional development activities starts on Saturday morning after breakfast. Typically, there are two different activities (see Figure 1) lasting from 9 a.m. until noon. We spend the following three-hour break eating lunch and enjoying leisure time, including beach games with the group, hiking, etc. From 3 – 6 p.m., we participate in the second set of structured academic and professional development activities, with 6 p.m. marking the end of all structured events and the beginning of evening festivities. Evening events include preparing a group meal (typically grilling) accompanied by a group discussion. Meal discussion topics are championed by one of our group members and have, in recent years, featured a lively debate ranging from academic ethics to the philosophy of time. After dinner, we play a round of trivia (academic and social), which the research advisor prepares and coordinates, followed by unstructured personal time (often group games) for the students to enjoy.

Group Retreat Schedule	
Friday	
2:00 p.m.	Depart from campus
4:00 p.m.	Arrive at retreat location
6:00 p.m.	Dinner preparation and dinner
8:00 p.m.	Personal time
Saturday	
Sunrise	Breakfast
9:00 a.m.	Activity 1
10:30 a.m.	Activity 2
12:00 p.m.	Lunch and personal time
3:00 p.m.	Activity 3
4:30 p.m.	Activity 4
6:00 p.m.	Dinner and discussion
8:30 p.m.	Group trivia
9:00 p.m.	Personal time/fun
Sunday	
Sunrise	Breakfast
9:00 a.m.	State of the lab address/discussion
11:30 a.m.	Lunch/personal time/leave for home

Figure 1. A typical retreat schedule demonstrates time intervals for personal time and academic activities.

Sunday mornings start with breakfast, followed by a discussion about group business, which is affectionately known as the "State of the Lab" address. We use this time to debate pertinent lab issues (i.e., lab safety, lab cleanliness, group responsibilities, and group meeting schedules). Past discussions have also included a presentation from the research advisor reviewing the group history. Being able to see how the group has evolved throughout the years enables the current students to place a face to a name (or PhD dissertation) and allows them to feel more connected to the larger academic family. The second part of our Sunday morning activity often features a presentation from and discussion with a group alumnus/alumna. A past group member either attends the retreat or digitally connects with us to discuss his/her career path, reflect on his/her time with the group, and provide guidance to the current students. Hearing the "words of wisdom" from alumni automatically carries more weight and credibility than hearing the same thing from the research advisor. Each year we attempt to rotate among alumni who have been pursuing their careers in industry or academia.

PROFESSIONAL DEVELOPMENT AND ACADEMIC ACTIVITIES

Academic and professional development activities vary each year based on the needs of the current students in the group; a selection of previously successful activities can be found in Table 1. For example, a few years ago, several graduate students were simultaneously working on their first manuscript. Therefore, one of the academic activities focused on how to prepare a set of figures for publication and how to design a graphical abstract. Students prepare a set of figures before the retreat based on a common format. During the retreat, a roundtable feedback session provides students ample advice from the group. We also conduct activities where students practice the organization of scientific publications. The research advisor supplies students with a set of figures and corresponding figure captions from recent literature but does not disclose the order in which the figures appeared in the original published paper (i.e., the paper in question is not known to the students at the beginning of the exercise). We split students into groups, and each group attempts to “re-construct” the paper’s story (there is one set of paper figures for each group). Being given someone else’s figures and having to piece together a story and a set of conclusions teaches students the importance of figures in scientific

publications. It is always enlightening to compare the flow of the figures in the original paper with that constructed by the students. This organizational skill has also been useful when we ask students to conceive, develop, and write short research proposals. We divide the students into teams and give guidelines to construct a research proposal based on an original idea. Proposals include a project summary, project description, and a brief research plan. Each team presents the proposal to the entire research group (using a defined template, typically in PowerPoint), and the group collectively judges the quality of the proposed work based on previously set criteria.

In addition to writing activities, group members practice their oral presentation skills. Students develop a research poster before the retreat using a provided poster template (Figure 2). During one of the structured activities, we hold a mock poster session in which students deliver an “elevator pitch” about their posters to their fellow group members. The goal of this activity is for students to learn how to speak concisely about their work, a skill that is challenging to acquire and requires constant practice. All group members walk around the room and provide comments and suggestions for each poster by placing Post-it® notes with feedback on each poster. After the “poster session,” every presenter reviews the feedback to consolidate comments and address them publicly for the whole group.

TABLE 1
Selected activities demonstrate the range of previously successful events held during group retreats.

Activity Category	Activity Description
Academic	Students split into groups, and each group (~3 people) receives a set of figures with captions from a peer-reviewed publication, but not the publication itself. Each group attempts to “reconstruct” the original story (or develop a new one) by ordering the figures. The whole research group compares the students’ stories with the published paper.
	Students prepare and deliver a presentation about the assigned analytical technique the group currently uses (or plans to use in the future). Students split into groups, and each group receives a “mystery science problem.” Each group proposes a research plan of action to solve the problem utilizing the analytical methods discussed earlier.
	Students develop a graphical abstract (i.e. table of contents figures) for an upcoming publication of original research idea.
Professional Development	Students deliver two “elevator speeches” (< 3 min each) to the entire group. One speech focuses on a research project while the second speech discusses professional passions and skills (job interview).
	Students divide into groups, and each group develops a research proposal for a visiting student scholar (e.g., REU) based on an original research idea. The proposal includes a research plan and budget.
	Students develop a single PowerPoint slide (no animations) describing their current research. Students then use the slide to present key aspects of their research in a 2-minute soundbite.
Social	All members cook together to prepare meals for the group. Often, international members share favorite recipes from their home countries and have other group members assist them.
	Students organize sports (e.g. cricket, volleyball, soccer, frisbee)
	Students organize group challenges (e.g. egg drop, charades, bingo, trivia)

Another category of activities focuses on experimental planning and the use of various analytical techniques. To ensure clarity and consistency, all students use the same PowerPoint template to discuss benefits, drawbacks, material requirements, data analysis, etc. for a particular analytical technique. During the activity, each student delivers a brief presentation on a single experimental method the group currently uses (or plans to use). The principal investigator then divides the students into three to four groups assigning each group a “mystery science problem,” which requires the use of the experimental tools previously discussed. Each group attempts to solve the “mystery science problem” by proposing a set of experiments to be conducted based on both prior knowledge and the presented information.

Every scientific activity we practice during the group retreat is designed to hone a specific skill based on the need of our group at a given time. Every student approaches the retreat with individual goals while the group strives to accomplish a set of holistic goals. We often perform some activities before the retreat and conduct others during the retreat to maximize the use of our time. For additional templates and example retreat activities, please see <http://www.genzerlab.com>.



		Title Student Name			
Overview of Project Goals and Potential Impact					
Progress and Key Results			Current Work and Biggest Challenges		
Future Work and 'Big Ideas'					

Figure 2. Poster template provided to students before the retreat.

UNSTRUCTURED TIME

During the unstructured portion of our group retreats, the students spend their time freely. In recent years, group members have played board games, swam, played sports, hiked, or even sat on the deck of the house to enjoy a cup of coffee. Being outside the office and not confined to specific research tasks allows the students to find common personal interests and form friendships that can be challenging to foster within a lab setting. This is the very reason why we organize the retreat in an off-campus location. During the retreat, the students relax and do not feel as though they have to “perform” or impress. Once the students are comfortable with one another, they are more likely to be open during group meetings and research discussions or seek advice when faced with a common research challenge. In this setting, the group as a whole develops a more collegial and collaborative atmosphere as the senior group members enjoy sharing their experience while the younger students feel more engaged after participating. The group retreat is also valuable for the principal investigator who can observe the students perform in a setting that is different from everyday lab life. Figure 3A and Figure 3B show photographs from past retreats taken during both professional development activities and social activities, respectively.

THE EVOLUTION OF GROUP RETREATS

The benefit of having the students organize the retreats themselves is that each retreat is different. The students learn project management skills and take ownership of the retreats because the activities often originate from their ideas. We plan activities and locations based on the needs and schedules of everyone in the group. Each year a planning committee, comprising mostly three to four group members, organizes the majority of the retreat planning (i.e., discussing activity ideas, choosing rental houses, meal planning, etc.). Participation in this planning committee is completely voluntary and includes senior graduate students and at least one junior graduate student to ensure continuity throughout the years. This committee meets with the research advisor at least twice before the retreat to finalize all details and ensure the students and research advisor agree on the structure of each retreat.

For example, in recent years, the group was too busy during the Fall semester to break away for an entire weekend. To accommodate this, the group began having one-day fall retreat events. We hold these one-day “Genzer Olympics,” as the students call them, at a local lake and organize them mainly for leisure




Figure 3. Group members during retreats while participating in (A) academic/professional activities and (B) social activities.

activities and group bonding. We even hold an Olympic torch relay at the beginning of the day, but do not sing an anthem (yet!) The students play sports, grill food together, and participate in team-building events. These individual and team-based activities range from bingo (Figure 4) to an egg drop challenge earning their team points, which are tallied at the end of the day culminating in a medal ceremony. Some teams even go as far as choosing team names and theme songs. The winners receive a medal featuring a plexiglass disk with engraved photos of the group leader (Figure 3B). We organize the teams by pairing students with group members with whom they would not normally interact in the lab (e.g. a graduate student may partner with an undergraduate student whom they do not mentor). Breaking away from the lab for a day to spend time as a group completing bonding activities outside of campus accomplishes similar goals as the weekend-long retreats. The format of our retreats has evolved over the years, with the first retreat taking place back in 2012 at the advisor's house over a single day. The key is not the length of time for these retreats, but rather making sure that the students begin to recognize their fellow group members as teammates. However, we do recognize that our particular style of group retreats is best suited for a medium to a large research group.

ASSESSING IMPACT

Upon returning from group retreats, the students are more comfortable with one another. Students are more open to working as a team, whether this includes asking for presentation feedback, discussing experimental plans, or merely going for lunch together. Once any barriers break down among group members, the whole group is more likely to work as a cohesive unit. It also serves as a unique way for new students to immediately feel that they are a part of the whole research family. While this change in the group dynamic is difficult to quantify, it becomes qualitatively obvious during group meetings when students who were once silent become increasingly vocal after participating in group retreats.

While organizing the group retreats, we want to make sure that the events are continuously working for our group and that we are meeting students' needs. During the "State of the Lab address" on Sunday morning, we encourage the students to share their thoughts about what they found to be



Genzer Buzzword


B	I	N	G	O
Gradient	Kerr-Effect	Cartoon	Cute	Johnny
What if...	Interface	Wrinkles	ToF-SIMS	Surface
Orthogonal	Benchmark	Free  Space	2 nd (or n th) PhD	Folding
Origin	Bulk	Brush(es)	I wonder...	That's a good start...
I'm not a native speaker	Waazzzuup	Polymer	Networks	Thickness

Figure 4. Genzer group bingo played during group retreats.

beneficial during the retreat and what they think we should do to improve the quality and effectiveness of the event. We record extensive notes, and the planning committee for the next retreat takes this feedback into account so that the retreat format constantly evolves and incorporates feedback from previous years. We also send an anonymous poll and ask every member to voice his/her opinions and list activities they would like to see in future retreats. Both sets of feedback are crucial. It is important to ensure that students provide feedback before leaving the retreat so that the information is fresh in their minds. However, it is also valuable for students to have an anonymous route to provide more detailed feedback at a later date after they have had time to reflect on the previous event.

Figure 5 plots the results from a poll recently sent to both the current group members and group alumni who have participated in the group retreats over the years. We display the questions provided within the poll in the left portion of the figure and plot the responses as a percentage on the right. The feedback is generally positive. For instance, out of the 18 poll participants, 100% either agreed or strongly agreed that group collegiality and collaboration has improved due to the group retreats. In addition, ~94% of poll participants either agree or strongly agree that their technical knowledge and communication skills have improved as a result of their participation in group retreats. Figures 6A and 6B display the position the poll participants held during the time they attended the retreat as well as their current position, respectively. Although several undergraduate students have participated in previous group retreats, none chose to participate in this voluntary poll.

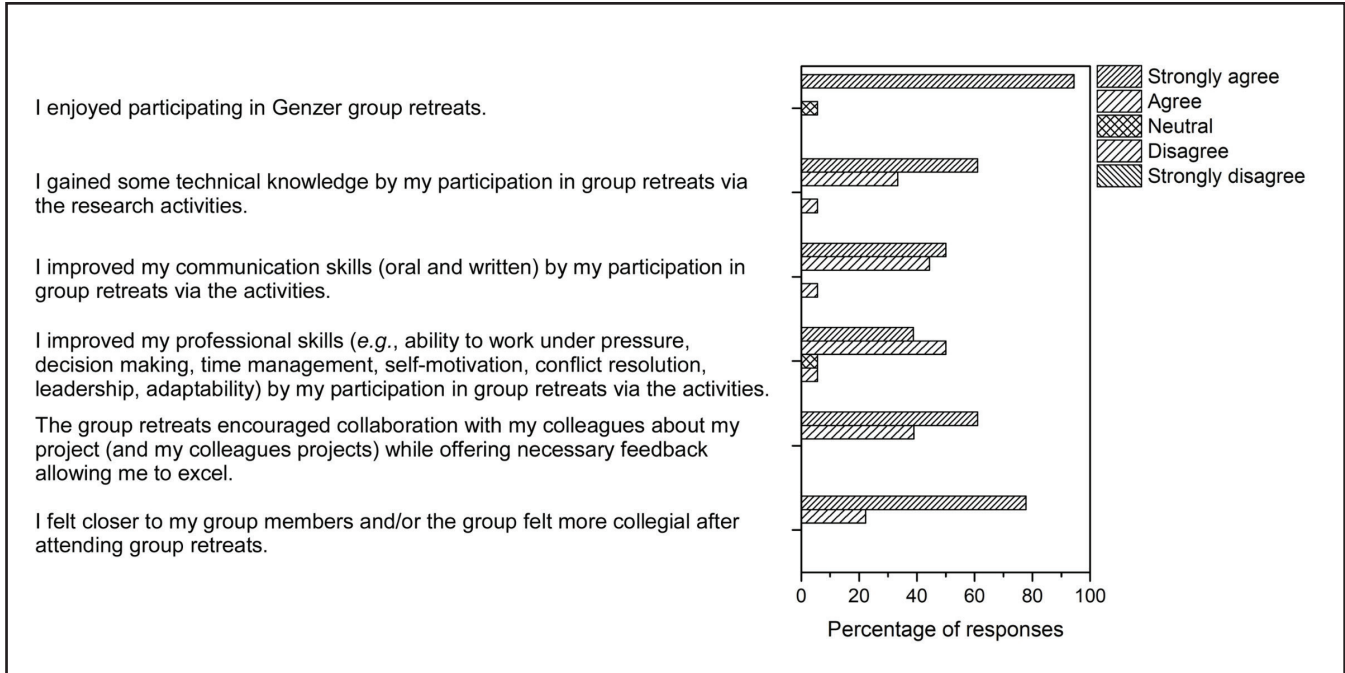


Figure 5. The results from the feedback poll regarding group retreats. This poll was sent anonymously to current and former group members. We display the question in the left portion of the figure and use the histogram on the right to report the percentage of responses. This poll had a total of 18 participants.

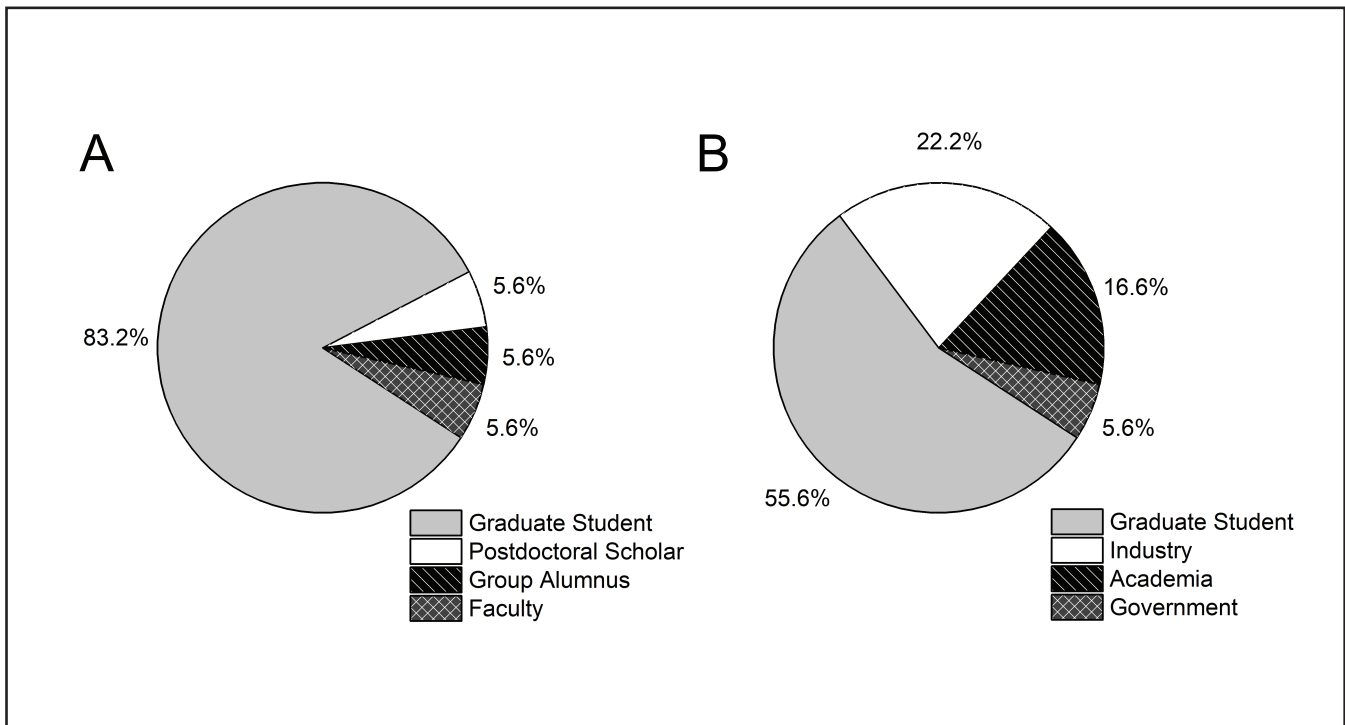


Figure 6. Pie charts depict the role of poll participants (A) during the time they attended the group retreat and (B) in their current position.

FINAL THOUGHTS

As a result of the group retreats, our research group has become more cohesive and collegial. This makes the group more productive as students become eager to help each other and support one another. The students feel that they belong to a coherent unit whose goal is for everyone to thrive. The retreats provide an opportunity for the research advisor to observe how students perform in a neutral environment and encourages stronger communication between the advisor and each group member. Spending time together as a group, while playing games, cooking, and getting to know one another's backgrounds, creates bonds that could never happen within the confines of departmental activities. We note, however, that before leaving campus for group retreats, the research advisor must review expectations with all students regarding their behavior while on the retreat. While the retreat takes place off-campus, the university rules for appropriate behavior still apply.

Ultimately the group retreat provides a mechanism for establishing and sustaining a healthy group culture. Bullard, Keith, Silverstein, and Visco define the culture of a departmental group as its "relationships, interactions, activities, and events."^{6]} The research retreat catalyzes and nurtures relationships among all members of the group (including students and the research advisor). The primary goal has always been to motivate our students to be creative and productive while acting as members of a larger coherent unit. It is the mutual interaction among all group members that endows the unit its coherency, dynamic, life, and prosperity.

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