Hello Research! Developing an Intensive Research Experience for Undergraduate Women

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ABSTRACT

This paper describes the design and implementation of a three-day intensive research experience (IRE) workshop for undergraduate women in Computer Science. Expanding on a model pioneered at Carnegie Mellon University, we developed and piloted a regional variant called HelloResearch at Indiana University. Participants were actively recruited from our own and neighboring states. Industry partners provided travel scholarships for low-income and first-generation college students, people with disabilities, and students at Historically Black Colleges and Universities (HBCUs) across the country. The primary goal of HelloResearch was to encourage the pursuit of research careers, enabling participants to reach the highest levels of leadership in their fields. In this paper, we report on the demographics of our 92 participants, outline best practices to ensure an authentic short-term research experience for the students, describe our assessment plans, and share our survey instruments to assist others in jump-starting their own regional workshops.

KEYWORDS

Accessibility, Gender and Diversity, Teamwork and Collaboration, Undergraduate Research

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1 INTRODUCTION

Just 21% of new doctoral degrees in Computer Science are awarded to women — a percentage that has remained unchanged over the last decade [9]. Providing hands-on, meaningful research experiences to undergraduates is known to increase their interest in pursuing an advanced degree [23]. Among the various types of programs that have been proposed and conducted, *Intensive Research Experiences* (IREs) are ones that are measured in days, not weeks or years, and involve students diving into open-ended, yet narrowly-focused problems under the direct guidance of practicing researchers. The experiences culminate in the students giving brief oral presentations of their work and discussing next steps. An IRE allows students to learn about and try doing research without the uncertainty and risks associated with committing a full semester or summer to a completely unknown endeavor. It also can create ongoing mentoring relationships and be a stepping stone to longer and more sustained involvement in research.

The idea for an IRE specifically tailored for women originated at Carnegie Mellon University in 2006 with "OurCS: Opportunities for Undergraduate Research in Computer Science." They repeated the workshop four times, each time larger than the last, with the most recent in 2017 [1]. The popularity of this workshop suggests that demand for such an IRE can no longer be met by one institution in one geographical location. CMU's model has matured to the point that it is ready for export to other regions of the country to reach more diverse populations [20].

We conducted the first regional IRE, called HelloResearch [6], in October 2018 at Indiana University. Undergraduate students (91 women and 1 trans-male) worked in small teams of 6-13 scholars on carefully scaffolded research projects. Teams convened for eight research working sessions (totaling 12+ hours) over the course of three days, with some teams opting to meet for an additional evening research session. Students selected from a menu of twelve different research projects spanning areas such as Algorithms, Health Informatics, and Machine Learning. The projects were led by researchers from five different schools and one company. HelloResearch culminated with the teams presenting to an audience of research professionals, industry leaders, and peers.

In this paper, we describe the design and implementation of HelloResearch. We provide concrete advice for those considering developing an IRE at their own institution, based on our experience. The growing interest in IREs, evidenced by Google's recently-launched exploreCSR program [4] (which funded 15 research-oriented workshops for female undergraduates in 2018-19), portends an impending need to share experiences and establish best practices for IREs.

2 MOTIVATION

IREs offer an alternative for advanced undergraduates who may be exploring different career paths. Conferences, such as the Grace Hopper Celebration of Women in Computing (GHC) or Small Regional Celebrations [28] (e.g., MicWIC and InWIC), focus on networking, exploring industry careers, providing role models, and supporting students in computing. In this vein, HelloResearch included a keynote speech by a highly successful technical woman (Dr. Timnit Gebru, Google AI), a student panel about graduate school, and an undergraduate research poster session. But an IRE is more than *learning about* research; it involves *doing* real research.

We were motivated by our experiences creating the first Small Regional Celebration of Women in Computing conference based on

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GHC [28], which has now morphed and spread across the world [30]. Our previous experiences adapting and disseminating CMU's roadshow idea [25, 26] to HBCUs [24] prompted us to actively target this population. Our prior work designing intensive CS1 experiences for women undergraduates provided a foundation for creating compressed, authentic research experiences [29]. These three past successes combined to inspire us to try expanding CMU's OurCS into a regional IRE model that could be adapted by us and others.

In a pre-survey, we asked accepted participants what motivated them to apply to our IRE workshop. One student captured the essence of HelloResearch by responding, "I want to use computer science to change the world, and for that, research is key!"

3 GOALS

Undergraduate research opportunities can improve undergraduate retention in STEM – especially for underrepresented and first generation college students [17, 19] – by increasing their research skills and self efficacy [22]. However, to increase underrepresented groups' interests in continuing on to graduate school, researchers suggest integrating "culturally relevant pedagogy" [22] that integrates undergraduates' cultural, contextual, and political identities, and desire to serve [18] through their research activities. In addition, faculty must be trained to address their own biases that could adversely impact diverse students' academic and research success [10, 19]. By creating inclusive research experiences based on societally relevant problems, we aim to increase students' interest in joining the next generation of scholars, to develop a pipeline of role models and foster continued diversity in computing research [11]. To this end, we expect HelloResearch participants to:

- Gain an understanding/appreciation of the research process;
- Develop specific research skills;
- Increase self-efficacy and sense of belonging in computing;
- Network with peers/faculty from diverse groups and allies;
- Develop a burgeoning mentoring relationship; and
- Learn about graduate student life.

4 JUMP-STARTING AN IRE

We suggest several steps for those considering a regional IRE:

- *Learn about the model*, potentially by attending an IRE workshop and gaining first-hand experience. CMU graciously invited us to their 2017 OurCS workshop [1], which gave us the courage to embark on HelloResearch.
- *Build enthusiasm from colleagues and obtain commitment from school administrators.* We first decided on our target population, and then identified a small number of specific research areas that would appeal as culturally relevant [22].
- *Apply for funding.* HelloResearch is a partnership between academia and industry. Our major industry partners are Google and Oracle Academy. We recommend applying for exploreCRS [4] funding, for example, and then supplementing with smaller grants from local companies.
- *Identify researchers to design and lead projects.* We met face-to-face with individuals whom we thought were especially well-suited to the program. Once we had secured a few projects as examples, it was easier to solicit involvement from the larger faculty community at our own and nearby institutions. Including industry-led research projects broadened appeal and strengthened connections with the industry partner.
- *Reserve date and space.* Reserving a large block of hotel rooms on our campus had to be done a year in advance, avoiding major athletic and parent events. Due to the small-team nature of the working sessions, many small conference rooms or classrooms were needed, and some projects required a computer lab or a maker space. CMU schedules their OurCS workshop over a long weekend (e.g., fall break) when rooms are more readily available.
- *Assemble an organizing committee.* We involved researchers, staff, and students from the very beginning. We tried to avoid organizer fatigue by assigning specific tasks to individuals and giving them plenty of lead time. Although the organization of HelloResearch spanned a full year, we only met face-to-face as a large group two times.

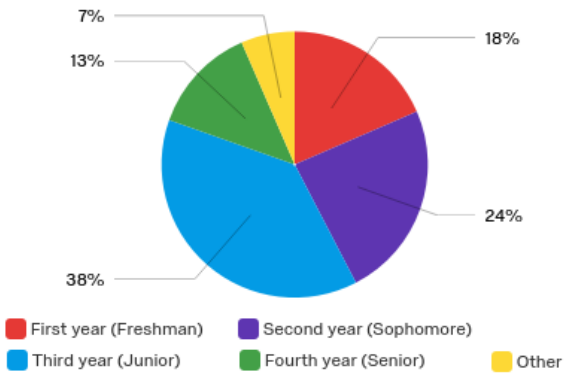

Figure 1: Participants' Current Year in School

5 ABOUT THE PARTICIPANTS

A total of 92 students from 47 different schools in 21 different states participated in HelloResearch; 44.6% came from Indiana schools and another 16.3% came from neighboring states. Figure 1 shows students' year in school, as reported in our application survey [5], where the Other category includes older students returning for a second degree, and two students in their first semester of a Masters program. We asked participants to estimate the availability of research opportunities at their institution: 18% reported "lots of opportunities" and 66% perceived having "some."

5.1 Recruitment Emphasis

Efforts to recruit diverse talent to leadership positions in industry and academia have resulted in small gains [10, 11]. HelloResearch focused on inviting a cohort of diverse women with potential for admission into graduate programs in computing-related fields. We asked faculty to encourage one to three students they knew and believed in to apply to the workshop. We anticipated that faculty could see qualifications in students that went beyond grades, and that students would respond to positive reinforcement from their professors. We urged faculty to also consider students early in their studies who would benefit from a broader vision of computing.

This snowball recruiting identified qualified, diverse participants: 23.9% (22/92) were Black and 7.6% Hispanic or Latino; 36% came from lower socioeconomic status families; 32% were first generation college students. Various institutions were represented: 54% came from public schools (including 3 from community colleges) and 46% from private, of which 7 were HBCUs and 2 were all women. Despite these positive efforts, we encountered some *resistance against diversity efforts* from faculty who voiced concerns about investing in these populations, as past research has found [19].

5.2 Access Matters

Five participants were people with disabilities, whom we contacted immediately after accepting to understand how to accommodate their needs. We applied for AccessComputing funding [2] to secure resources and travel funds, ensuring that all qualified participants could attend and share their rich and unique experiences. We accommodated deaf participants by arranging for two American Sign Language (ASL) interpreters to be present at all sessions. Although we did not anticipate this significant and worthwhile cost in our original budget, AccessComputing funding covered the costs. Assistive listening systems (ALS) were used to broadcast audio directly to special receivers and hearing aids, reducing background noise for people with hearing impairments. In addition, we provided vocabulary lists of technical terms to ASL interpreters and requested presenters to add presentation notes to their slides and share them with participants.

Our institution's Disability Services Office performed a mobility orientation for a participant who was blind. The specialist walked with the blind person between locations, explaining the terrain and street crossings, so she could later navigate independently. Since a person with visual impairments may use a cane or service animal and thus move more slowly than others, we arranged a van service for longer travel distances. People with autism may become overwhelmed and require breaks in a quiet place, so we arranged for a wellness space in the workshop venue.

We learned how to create more inclusive digital experiences through the Accessible By Design conference [3]. We provided pictures of the hotel entrance, meeting spaces, location of elevators, restrooms, and water fountains in advance, as well as approximate step counts to help participants plan their experience. We found that integrating inclusive practices improved everyone's experience.

6 BENEFITS

6.1 For the Institution

In addition to our own faculty, we invited researchers from nearby institutions to lead projects, which we found helped strengthen connections between schools. Much of this was done by involving current and past students. The Programming Languages project was led by a former undergraduate who is now finishing his Ph.D. at CMU. The Wireless Privacy project was led by a former Ph.D. student who is now faculty at Rose-Hulman Institute of Technology. The student panel included a current senior undergraduate with vast research experience (including CMU's 2017 OurCS workshop and a subsequent summer REU at CMU), a former undergraduate (now a second-year Ph.D. student at CMU), and a former M.S. student (now a Ph.D. student at the University of Notre Dame).

Access to a large number of talented undergraduates from diverse institutions is an obvious recruitment windfall for our university: these students are from underrepresented populations, have been vetted by faculty members at their schools, are already considering graduate school, are visiting the campus for several days, and have begun to establish mentoring relationships with faculty.

6.2 For Faculty Researchers

Our IRE encouraged collaboration among our own faculty that went beyond the workshop itself. One pair of faculty who co-led a HelloResearch project, for example, commented that they had always wanted to work together and HelloResearch provided an intense, but low-risk opportunity to "audition" a collaboration. The program also allowed graduate students to take an active role in designing and running research projects, giving valuable experience in teaching and mentoring.

We believe mentoring undergraduates is an educational activity that should be rewarded in merit, tenure, and promotion evaluations. For faculty who are writing grant applications, leading an IRE can be significant evidence of broader impact. On a more personal level, many faculty enjoy working with highly-motivated students and an IRE provides an excellent opportunity to recruit directly into the researcher's lab. One of our leaders was just starting to acclimate a new undergraduate into her research group, and found that the IRE project accelerated that process. Different perspectives, such as a deaf student working on an audio project, presented opportunities for the student to influence the faculty's long-term research directions.

6.3 For Industry Partners

Diverse teams can solve problems better than more homogeneous teams of greater objective ability [16]. Women of color are especially underrepresented in industry. In 2017, black women held only 3% of computing jobs, and Latinas just 1% [8]. Addressing accessibility issues in products during the design phase means *including* skilled deaf and blind people on design teams.

We found that many companies were interested in supporting our IRE, including giving money, resources, and sending speakers and project leaders. Much of this interest was driven by recruitment: industry partners with the vision and patience to allow research talent to develop will have access to a larger, better educated, and more diverse pool of researchers entering the workforce. The opportunity to lead a research project at an IRE also allows the industry partner to showcase how research is conducted in industry.

6.4 For Students

The potential benefits to students are, of course, many. Participants broadened their perspective by working together with students from other schools who share their academic interests and aspirations, including comparing and contrasting their educational trajectory and progress with others. Participants worked with researchers outside their home institution, with the possibility of developing a long-term mentoring relationship, potentially even into graduate school. They learned about the graduate school application process, and potentially increased their competitiveness for research awards, fellowships, and scholarships, and graduate

school admissions (e.g., by obtaining a letter of recommendation from a team leader).

7 LOGISTICS

7.1 When and Where

Among our first actions was to choose a date and reserve a block of hotel and meeting rooms. We chose October, when seniors are thinking seriously about their next steps such as applying to graduate school. Because we intentionally targeted students from low socioeconomic status families, we arranged to waive the graduate application fees at Indiana University, IUPUI, and Notre Dame, effectively removing the financial barrier while encouraging applications to these specific schools. Identifying and reserving suitable meeting space for twelve separate research teams was a challenge.

7.2 Who

Research experience is the ultimate objective of an IRE and obtaining early commitments from researchers to design and lead research projects is critical. We took care to *represent the undertaking accurately* so that researchers understood the scope of the commitment: a multi-day workshop with many hours of research sessions constitutes a significant obligation.

We created a Facebook page and a website about ten months before the workshop, beginning with a skeleton site that described the application process and included a "Notify me" button to sign up for updates. We began accepting applications [5] in early April and filled 100 spots in six weeks. We advertised to faculty contacts from regional GHC conferences and outreach workshops, and on larger mailing lists (SIGCSE, Professhers, Systers), and by word of mouth. We kept our own faculty informed with regular updates at department meetings, seminar presentations, and local conferences. After registration closed, we continued to accept applications on a waitlist; 18 students canceled and we replaced them with waitlisted students on a rolling basis. We had 6 additional cancellations in the 4 days leading up to the workshop and 2 no-shows — those slots went unfilled. About 17% of participants were from our institution.

Once we closed registration in mid-May, we created a distribution list to communicate with participants. Three months before the workshop, we sent another survey [7] to collect roommate preferences, dietary restrictions, and travel plans. We asked their permission to be included in a public directory of attendees, to be photographed and recorded during the workshop, and to participate in an on-site interview to study the workshop's effectiveness. Some participants were unable to bring a laptop, so we arranged to provide loaners. We assisted students with travel difficulties, gathered accommodation requirements, and initiated the reimbursement process for scholarship recipients.

7.3 What

We assigned participants to projects systematically: each participant listed her top three choices, which we put into a Simplex Linear Programming problem in Excel with #participants × #projects binary variables. We used the OpenSolver Excel Add-in from opensolver.org since the number of variables was over 200. Every student received either her first or second choice. We notified students of their project assignment about a month in advance by creating a Slack workspace and inviting each participant to join the private channel for their specific project. We created individual computer accounts for each participant so that they could access our wireless network and lab machines. For some projects, we installed specialized software and hardware in our labs.

7.4 Behind-the-Scenes Roles

7.4.1 Administrative Assistant. Organizing our workshop required significant help from a staff member knowledgeable about school policies and procedures for travel, purchasing, catering, and reimbursement. We involved the administrative assistant from the beginning of the planning process, and also arranged for overtime pay so they could attend the entire workshop.

7.4.2 Project Manager. We hired an undergraduate part-time (5 hrs/wk) to maintain the website, distribute survey instruments, organize volunteers, coordinate with leaders to determine space/material needs, schedule meetings, and communicate with participants.

7.4.3 Instructional Design Coach. An experienced teaching professor on our faculty volunteered to coach the team leaders during the design phase and share ideas for promising practices. During the workshop, the coach circulated around all sessions, and was the point of contact in case anything went awry. The coach was particularly valuable for researchers from industry who are unaccustomed to working with undergraduates, as well as for faculty from other institutions who were unfamiliar with our school's facilities. But even faculty from our institution benefited from the advice of a dispassionate observer with a global view of all projects.

8 PREPARING THE MENTORS

The choice and design of research projects are key to the success of the workshop: projects need well-defined goals that can be understood by undergraduates. Projects had to be challenging and interesting, but not frustrating or overwhelming – especially given the short three-day time frame. We tried to select faculty who would enjoy the challenge of scaffolding their research for undergraduates while still ensuring a research contribution at the end. One month before the workshop, we held a mentor meeting where we provided demographic data about our participants, introduced our Instructional Design Coach, outlined two project designs, and had a Q&A with an experienced project leader from CMU's OurCS.

It was important for mentors to understand that many of our participants had little prior experience with or understanding of the research process. In our application survey, we asked students to explain what they thought research entailed. Many responses exhibited a lyrical, but marginal understanding of the process; one wrote, "Research is about discovery. Research is about learning. Research is about applying what I learn to better understand why something happens. I expect to have to write alot [sic] — something that I need to improve upon. I also expect to use my problem solving and analytical skills." Responses tended to abstract the research process, as in "Research entails tackling the problems that people do not yet have answers to. It involves thinking critically and creatively and persevering when faced with difficulty. I am not sure what day-to-day research is like, but that is what I hope to find out through this experience." Also, "The process of doing

ARG Element	IRE Activities
team building	community meals; networking breaks; interactive workshops; lab tours
skill development	4-5 hours of research workshops; panels and talks
skill practice	6-8 hours of research workshops; poster session; team presentations
goals & objectives with deliverables	project leader preparation; research workshops

Table 1: Adapting the Affinity Research Group (ARG) Model to an Intensive Research Experience (IRE)

research is to formalize curiosity into a tangible problem that can be further broken down into small pieces of steps and to eventually find insights from completing these steps."

We recommended that project leaders describe research as an iterative process that builds on prior research: review the literature, formulate a problem, try a solution, make mistakes, iterate. To save time, leaders summarized related work in the project area and showcase at least one relevant academic paper, highlighting the important sections for later close reading [13].

8.1 Affinity Research Group Model

Our IRE was informed by the Affinity Research Group (ARG) model, a structured team approach to involving students with diverse backgrounds in scholarly research [14] by having project leaders share their *affinity* for their research. Project leaders guide undergraduate researchers in developing skills so that each team member — including the undergraduate researcher with a diverse background — becomes a subject-matter expert. With their new expertise, undergraduates become equal contributors to the research group [14]. The ARG model is composed of four main elements: team building, deliberate skill development, skill practice, and goals and objectives with accompanying defined deliverables [31]. We adapted the ARG model to an IRE as shown in Table 1.

8.2 The Author Audit

We encouraged leaders to conduct an *author audit* of papers selected for study so that authors were (at least) representative of computing, and include pictures, names, and schools to show diversity (especially women and people of color). Author audits are important because although women increasingly publish in computing conferences [12], women are less likely to be cited [15]. If leaders were unable to identify related work by underrepresented groups, we suggested showcasing efforts to increase diversity (e.g., the Computing Research Association's Discipline Specific Workshops).

8.3 Research Questions

Team leaders either prepared research questions in advance to give to the students, or they planned to guide students in generating their own questions. If the latter, we recommended that leaders provide sufficient information about the problem space and instruction on formulating research questions (e.g., avoid "yes/no" questions).

9 PROJECT EXEMPLARS

HelloResearch included twelve projects representing a wide range of computer science research, from autonomous vehicle navigation, to programming language design, to augmented and virtual reality. As examples, we briefly describe two of the projects, how they fit into the IRE-adapted ARG model, and the accommodations we made for students with disabilities.

9.1 Creating Custom Technology to Improve One's Quality of Life

The undergraduate researchers reflected on personas of underserved communities in technology — from rural older adults to pregnant teens to low socioeconomic status children — to develop custom, interactive technology to assist these underserved groups improve their quality of life. The lead faculty member started her workshop with an overview of the nascent sociotechnical research to improve the health of underserved populations [27]. She also provided a brief synopsis of her own research and how her research group developed personas and scenarios based on qualitative research to seed the undergraduate researchers' ideas. The faculty leader interleaved research skill teaching with brainstorming and prototyping sessions so that undergraduate researchers could experience iteration cycles as they explored barriers that target populations faced and designed sociotechnical solutions. Research skill sessions included developing design guidelines from qualitative data, physical prototyping via 3D printing and laser cutting, and programming embedded systems.

Students identified a target population, developed a research question to address a barrier that their selected persona and scenario experienced (e.g., how can a community know what types of clothing low-income children need?), iterated on 2-3 sociotechnical solutions, built an interactive system to explore the research question (e.g., a clothing box that can sense how full it is and send notifications to donors about needs), and documented their solution for presentation and future publication.

The faculty leader was able to adapt most of the tasks for a blind undergraduate researcher by providing digital materials that the student read on her laptop with assistive software. One challenge for her was connecting alligator clips to small electrical pins during embedded system programming. To address this, we utilized pair programming so that groups of two worked together and switched off between hardware and software. The project leaders modified the way they taught electronic circuitry based on the Blind Arduino Project [21] by instructing students how to orient components based on feel — which benefited all students. In addition, all students discussed how to make their projects more accessible — from adding lights, sounds, and vibration to laser cutting braille signs.

9.2 Activity Recognition Through Deep Learning with Sound and Video

This project sought to give students experience with cutting-edge artificial intelligence and machine learning technologies and research methodologies. The project was framed in terms of next-generation home devices that could respond based on an awareness of what is going on around them — e.g., a smart home assistant might call for help if an older person falls, or might turn off the television if

everyone falls asleep. To do this, devices would have to capture and analyze the sights and sounds of the household to recognize and understand what is going on around them.

The two project leaders were an expert in computer vision and an expert in audio understanding. They began by each giving brief overviews of their respective fields, concentrating on research directions, techniques, and open questions. Participants brainstormed perception abilities that they thought both could be useful for home devices. To help properly scope project goals, the team was asked to narrow the list to three: an "easy" task that they thought was easily within the capabilities of current technology, a moderate task that they thought could probably be solved, and a difficult task that would be challenging. After discussion, the team voted and decided to focus on recognizing the identity of speaking people based on both their physical appearance and their voice.

After a discussion of IRB, the team designed and carried out a methodology for collecting a (small-scale) dataset for training and testing. The team of 9 students was split into two groups to investigate visual recognition and audio recognition in parallel. Each team had access to a machine learning cloud service donated by Google. Mentors helped each team follow an iterative process typical of AI research: start with a simple algorithm, train it on part of the data, test on the rest, identify failure modes, make improvements to the algorithm based on the failures, and repeat. This iterative process meant that even if some of the recognition tasks were very difficult, participants would still have results to show during their presentation. The mentors emphasized that the goal was not to create a working system, but to better understand what work would need to be done in order to create such a system. In the end, the team developed a prototype algorithm written in Python to identify among 10 different speakers. The prototype achieved an accuracy of about 60%, compared to a random baseline of 10%, and the team analyzed the failure cases to recommend future research directions.

Decisions had to be made at various points in the project — e.g., which problem to pursue, which technical approach to try, etc. The team leaders gave their input but left the decisions themselves to the team through discussion and voting. Notes on the discussion were kept by one of the team leaders on a shared Google Doc, and participants were encouraged to also contribute to the document in real-time. Besides helping to keep the team on track, we found that this shared real-time note-taking helped allow our participant who was deaf to more actively engage in the discussion without relying on the sign language interpreters (who often struggled to interpret technical terms). To create the team presentation, the group defined nine key topics that needed to be covered (e.g., problem statement, dataset collection, approach, etc.), and assigned each topic to a participant, who created a slide for the topic and added it to a shared Google Slides presentation.

10 ASSESSMENT PLAN

Our primary objective is to measure the impact of HelloResearch on participants' intention to attend graduate school and to see if changes are sustained over time. We asked applicants to indicate where they saw themselves in 2-4 years. We repeated the question in the post-survey to assess if and how their future intentions changed

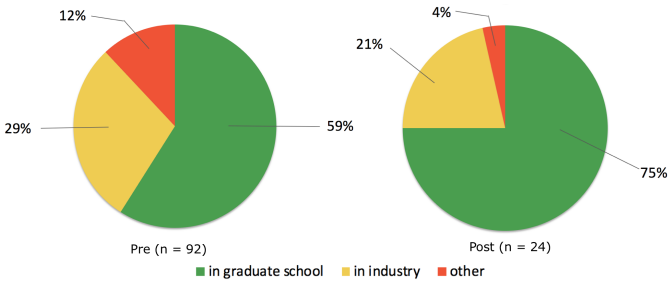

Figure 2: Where Participants See Themselves in 2-4 Years

(Figure 2). We will follow up with attendees at 6-month intervals to determine how many apply and enroll in graduate school.

During the workshop, we encouraged participants to build their LinkedIn professional identities. We invited them to a HelloResearch group so we could keep in touch. Photographers took free professional headshots for their profiles. LinkedIn provides a stable way for us to connect with the participants, over the long term, to disseminate opportunities and invitations to future studies.

We hired an external evaluator to develop ethics board approval materials, facilitate two focus group interviews during the workshop, and analyze the data to measure the utility and impact of the workshop. The evaluator is experienced in pairing quantitative with qualitative data so we can better understand not only where changes are happening, but also why the changes occurred.

Further quantitative and qualitative assessment services were provided through exploreCSR: pre-post surveys of participants, an on-site ethnographic study, and follow-up interviews with students and team leaders. One week post, we surveyed our mentors. One team leader listed the mentor benefits as "Having fun! Identifying promising students to potentially recruit as graduate students. Helping form collaborations with other faculty. Getting to know other faculty better." Conclusions drawn from analyzing the data collected from all sources will be reported in a future paper.

11 FORWARD MOMENTUM

At the end of the workshop, we provided information and resources to aid participants in taking the next step, e.g., a summer or year-long REU program. We offered to provide feedback on students' statements for graduate school applications. At least two teams have continued work on their research projects with an eye towards publication. Six students from our institution reprised their presentations in our Teaching & Learning seminar series.

We expect to repeat HelloResearch in 2020 and conduct further studies of those participants to see how they compare with the 2018 cohort. We plan to organize IRE Infrastructure workshops to aid others in designing a regional IRE based on HelloResearch.

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