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A Summer Research Program for Community College Students Led by Graduate Students at the University of Washington

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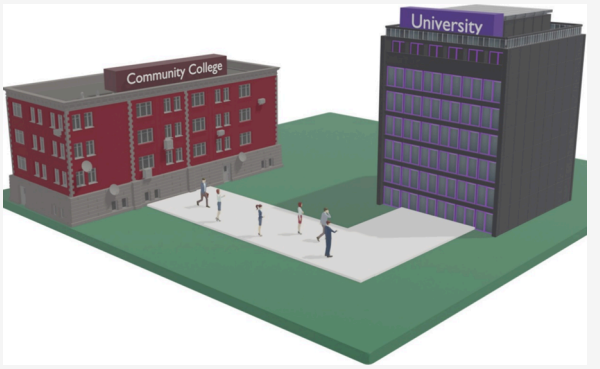
ABSTRACT: Chemistry students at community colleges often experience a lack of hands-on research opportunities, which can be a significant disadvantage when they transition to four-year universities. To address this, the Summer Chemistry Research Opportunities for Community College Students (SCROCCS) was established in 2022 by graduate students at the University of Washington to provide early chemical research exposure to community college students in the Greater Puget Sound area. SCROCCS has two primary goals: (1) to provide participating students with research experience and skills crucial for their success in chemistry and related STEM fields, and (2) to offer leadership opportunities for graduate students at host universities. SCROCCS shows promise in improving the readiness of community college students for research-focused universities, thereby enhancing their academic and career trajectories. This paper presents the design, execution, evaluation, and results of SCROCCS over its first two years. The findings indicate significant benefits for participants as they transferred to four-year universities. With its successful design and implementation, SCROCCS is considered replicable at other institutions, demonstrating a pathway to increase equity and inclusion in the chemical sciences nationally.



KEYWORDS: *Undergraduate Research, Outreach, Minorities in Chemistry*

1. INTRODUCTION

Community colleges play an important role in the United States education system, providing accessible and affordable higher education entry points to a diverse population, particularly for underrepresented and low-income students. According to a Community College Research Center (CCRC) analysis of National Center for Education Statistics (NCES) data, community colleges serve approximately 41% of all undergraduates in the United States, translating to 8.9 million students in the 2020−2021 academic year.[1] Data from the 2016 National Postsecondary Student Aid Study shows that community colleges, compared to their four-year counterparts, cater to a more varied demographic with nearly half of the student population falling in the 25−59 age bracket, and a significant number of first-generation students and those juggling academic commitments with parenthood.[2] Moreover, the National Science Foundation reports that 44% of students receiving a science or engineering bachelor's or master's degree at the beginning of the 21st century attended a community college during their education.[3] These institutions are essential pathways for students looking to transfer to four-year colleges or universities and those who wish to gain additional skills and knowledge for job qualifications.[4,5]

Despite their important roles, most community colleges do not offer their students hands-on undergraduate research opportunities, which are critical for students' learning and career development.[6] Engaging in research projects helps students apply theory to real-world issues, enhancing their understanding, critical thinking, and problem-solving abilities. These experiences also develop communication and teamwork skills through collaboration with peers and mentors. Furthermore, undergraduate research assists in clarifying career goals, preparing students for advanced studies or chemical industry roles. These experiences strengthen students' competitiveness for scholarships, internships, and jobs, showcasing dedication and practical skills in their field.[7−11] Consequently, lack of undergraduate research experience during the first two years of college can be disadvantageous for community college students when they transition to their next educational destinations.[12,13]

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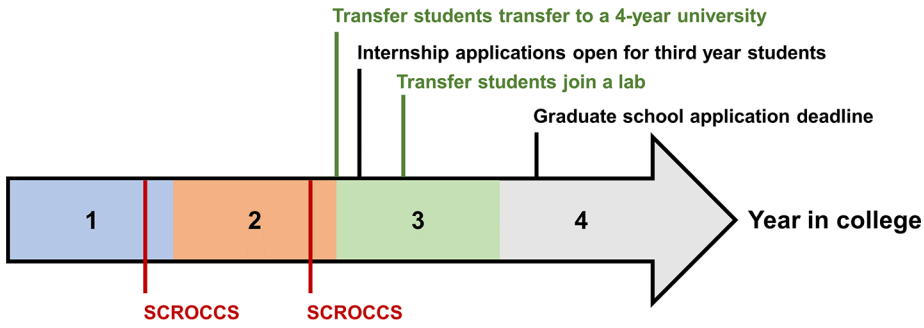

Figure 1. Comparative timeline between traditional students and transfer students, delineating key stages such as entry into research laboratories, opening of internship applications, deadlines for graduate school applications, and potential junctures for community college students to engage in hands-on research experiences via SCROCCS.

Recently, community colleges have started to recognize the importance of undergraduate research and many undergraduate research initiatives at these institutions have been founded.[7,14−19] Schauer classified approaches to implementing undergraduate research at community colleges into two models: traditional research model and curricular research model.[20] The traditional research model closely resembles undergraduate research experience at R-1 universities, where students work under mentors on a research project outside of the students' curriculum. The main downside of this approach is that the faculty are the only mentors at community colleges, which makes this model almost impossible since community college faculty often have heavy teaching loads, grading responsibilities without teaching assistant support, and significant advising commitments. The curricular research model embeds research components directly within the chemical education curriculum, either through individual experiments, or a series of investigative laboratory exercises, or a research-based capstone course. This approach poses some unique challenges including lack of diversity in research topics, high demand in advising, and the research timeline being strictly tied to the academic schedule.

Although external research programs for undergraduate students, such as Research Experiences for Undergraduates (REU), exist and encourage community college students to apply, these students may not be aware of such opportunities and often face heightened competitiveness since they have to juggle multiple responsibilities, such as work, childcare, and financial constraints, making it challenging and impractical for them to allocate time and effort to research endeavors.[6,16] Hence, it is imperative to establish summer research initiatives that specifically welcome community college students and cater to their unique educational trajectories. An example of such initiatives is the Research Experience for Community College Students (RECCS), an REU program in environmental and geosciences in Colorado, funded by the National Science Foundation (NSF). In a recent study assessing the feedback from RECCS alumni, the authors show that program significantly enhances students' scientific and professional skills, fosters a scientific identity, boosts interest in pursuing graduate studies, and increases confidence in their scientific capabilities.[21] In an effort to bring similar research experience to community college students with specific interest in chemistry, we have established an initiative: the Summer Chemistry Research Opportunities for Community College Students (SCROCCS) program at the University of Washington (UW). Chemistry majors transferring from community colleges typically join research laboratories later than their traditional students who start directly at four-year institutions, resulting in less time and experience to prepare for internships or graduate school. Figure 1 shows that a typical chemistry major transferring from a community college to a university faces a constrained timeline, with just one year available to gain research experience for their graduate school applications. Since the best time for undergraduates to undertake internships is the summer after their third year, and internship applications typically open early in that year, transfer students without prior research experience from their community colleges find themselves at a significant disadvantage, often having minimal practical skills when applying for internships. To address this gap, SCROOCS offers community college students early access to research opportunities at an R-1 university, aligning their experience with that of traditional first-year university students[14]

2. PROGRAM DESCRIPTION

SCROCCS is designed to be an annual 9-week summer program similar to existing REU programs. The program at UW Seattle campus targets local community college students in the Greater Puget Sound area. The first two years of SCROCCS, summer 2022 and 2023, admitted two students each year. Each participating student conducted hands-on research in a chemistry laboratory at UW and attended workshops and events organized by graduate student organizers. Participants were offered stipends provided by the lab hosts. Details about program organizing, including a timeline for SCROCCS organizers (Table S1), can be found in Section S1.

2a. Recruitment

The organizing team reached out to community colleges in the Greater Puget Sound area, distributing program advertisements and online application forms. We communicated with chemistry professors at these colleges through emails and online meetings to advertise SCROCCS and requested that they promote the program in their classrooms or at career fairs and science events at their institution. Establishing and maintaining relationships with community college representatives, particularly science professors, were crucial for the success of our program. A strategic approach to make these connections involved having graduate or undergraduate students who previously attended local community colleges in our organizing team. For instance, in our first year, two graduate students from UW, both alumni of nearby community colleges, proactively engaged with their former chemistry professors, effectively introducing the SCROCCS program to

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them and advertising the program to community college students. Furthermore, we provided updates to these community college professors, especially when their students participated in SCROCCS to ensure a continuous and meaningful dialogue between the program and the community colleges. In total, we contacted seven community colleges and received more than 15 applications each year (2022 and 2023). See application questions in Section S2. The applications were reviewed by the organizing team, who created a list of top candidates. The participating faculty then selected their preferred students based on the participant interest and compatibility with the lab host. The application process was designed to be straightforward and efficient. Applicants were assessed based on their motivation to participate, clarity of career goals, and eagerness to engage in scientific pursuits. It is important to note that the number of student admissions was based on the available laboratories in the department. For example, the organizing team approached four chemistry laboratories at UW in 2022 and two laboratories agreed to host a SCROCCS student. The availability of a lab host can be varied year to year based on the financial and graduate student mentor capacities.

2b. Activities

The main focus of SCROCCS was on research activities. At the beginning of the program, usually in the first week, students met with their graduate student mentors and faculty advisors to define research goals, establish expectations, and plan their schedules. They then engaged in research alongside their mentors in a traditional research fashion. Mentors and advisors set a primary goal for the program, along with short-term milestones involving reading and hands-on activities, to guide students through the research process step by step. An example of this planning document is included in the Supporting Information.

Furthermore, a key component of the SCROCCS program is the variety of activities including Campus Tours, Interdisciplinary Research Lab Visits, workshops, and presentation opportunities (Table 1). These activities were often organized in collaboration with other REU programs or organizations on campus to create opportunities for SCROCCS participants to interact and engage with a wider student community. In the first week of the program, we introduced students to UW campus with a Campus Tour that enabled them to explore the campus and learn about the school's offerings. Free campus tours are often offered by most universities to provide a general overview of academic and student life. In our program, the organizers contacted UW office of administration to schedule the tour.

Table 1. List of SCROCCS Activities and Their Objectives

Activities	Objectives
Campus Tour	Familiarize participants with the university environment and resources
Interdisciplinary Research Lab Visits	Expose participants to diverse scientific fields and career paths
Tips for Transferring Workshop	Provide insights and strategies for successful university transfer
Science Communication Workshop	Develop effective research presentation and discussion skills
Reading and Writing a Research Paper Workshop	Enhance critical analysis and scientific writing abilities
Weekly Journal Club	Foster critical thinking, analytical skills, and scientific curiosity
Grad Student Panel/ Grad School Information	Offer insights into graduate school life, application processes, and career opportunities
Final Presentation	Showcase research findings, build confidence in scientific work, receive feedback, and improve presentation skill

Although SCROCCS is a chemistry-focused program, the participants may not have a clear vision about their interests in future majors and research topics due to their lack of exposure. Therefore, the Interdisciplinary Research Lab Visits were designed to let students explore a diverse range of laboratories across departments at UW. The lab tour consisted of five 30 min visits to laboratories in different departments. During each visit, representatives from the lab explained their scientific field, introduced their research projects, and showcased the instruments and products of their research. These tours not only provided students with a broader perspective on their intended majors, but also inspired them to explore new scientific disciplines and appreciate cutting-edge research. To organize the tours, the graduate student team contacted laboratories with different scientific research topics and scheduled all lab tours into a one-day event. Lab selection was done based on two main factors: (1) the overall diversity of science topics, and (2) the possibility for short hands-on activities offered by the lab. For example, in 2023, the Yankowitz lab in the Physics department at UW offered SCROCCS students a hands-on demonstration where the students conducted a short graphene exfoliation experiment and looked at the graphene layers under an optical microscope, while the Stromberg lab in the Biology department let the students observe and examine plant and animal macrofossils. Figure 2 shows the 2023 SCROCCS lab tour schedule and description.

In addition to the tours, participants engaged in career development workshops that covered reading and writing research articles, designing and presenting research posters or presentations, and science communication. These workshops were designed by the graduate student organizers. For the Reading and Writing a Research Paper Workshop, SCROCCS participants learned to classify different types of articles i.e. review articles vs research articles, identify journals and their scopes, apply the "three-pass method for reading research papers" introduced by Keshav[22] and other active reading strategies,[23] use writing strategies established by the White-sides' group,[24] and to effectively utilize available tools such as Google, ChatGPT, and Zotero for active reading and writing.[25,26] For the Science Communication Workshop, we invited a graphic designer with expertise in scientific communication to give a talk titled "Design Eye for the Scientist", where students learned the significance of scientific presentations, rules for effective communication through graphics, how to design chemistry posters and slides, and how to present science to a targeted audience. The outlines for these workshops are available in the Supporting Information.

The above workshops worked synergistically with the Weekly Journal Club as it presents a good introduction for practicing scientific literacy every week and is advised to be held earlier in the program. The Weekly Journal Club, organized in collaboration with other REU programs on campus, served as a platform for students to learn essential skills such as using journal databases like SciFinder to find research papers, comprehending research papers, and crafting

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Summer Chemistry Research Opportunity for Community College Students

Lab Tours

July 11th, 2023

Lab 1: The Pozzo Lab (1:00-1:30 PM)

The Pozzo Research Group focuses on the control and optimization of material structures for applications in alternative energy, synthesis, separations, medicine, and more. They employ machine learning, high throughput analysis, automation of laboratory procedures, and advanced characterization techniques using small angle x-ray and neutron scattering to accelerate the discovery and screening of novel materials.

Lab 2: The Baker Lab (1:40-2:10 PM)

The Baker Lab develops protein design software and utilizes it to create molecules that address challenges in medicine, technology, and sustainability. By constantly iterating between computation and laboratory experiments, they continually improve their protein design methods.

Lab 3: The Stromberg Lab (2:20-2:50 PM)

The Stromberg Lab investigates the evolution of grasses and the assembly of grassland ecosystems. They explore questions such as the origin and diversification of grasses, the emergence and spread of grasslands, and the influence of grasses on faunas and faunal evolution. Their research spans multiple regions and continents to gain a comprehensive understanding of the evolutionary history of grasses and the formation of grassland ecosystems.

Lab 4: The Yankowitz Lab (3:00-3:30 PM)

The Yankowitz Lab is an experimental condensed matter physics laboratory at the University of Washington in Seattle. They specialize in the investigation and control of novel electronic states in quantum materials, particularly atomically-thin van der Waals materials and heterostructures. Their research involves characterizing devices at low temperatures and in high magnetic fields using electrical transport measurements and scanning probe microscopy.

Lab 5: The Majumdar Lab (3:40-4:10 PM)

The Majumdar Lab focuses on the synergy of fundamental physics and intelligent engineering in technological advancements. They study light-matter interaction at the Integrated Quantum Optoelectronics lab, addressing challenges such as changing the amplitude, phase, and frequency of light with lower energy, faster speed, smaller size, and reduced cost. Their research aims to develop scalable nanophotonic systems and explore new applications in optical computing, communication, imaging, sensing, and quantum information science.

Figure 2. SCROCCS lab tour schedule for the 2023 program.

and delivering scientific presentations. Mentors worked alongside students to select a research paper that aligns with their summer project. Together, they learned the paper's content, core findings, and concepts. Students then created a 10 min presentation, summarizing their chosen paper and their understandings. This was followed by a presentation to their peers at the journal club, during which they addressed questions from the audience. This process boosted students' confidence in several key skills, including a more profound understanding of their research project, critical reading, presentation creation, and public speaking.

SCROCCS also offered a Tips for Transferring Workshop designed to assist students in transferring to a 4-year university. Graduate students who previously attended community colleges were invited to share their perspectives, discuss challenges they faced during the transfer process, and provide tips on crafting compelling applications, including personal statements and resumes. Students were also introduced to university resources that help transfer students such as the career center and the university office of admission.

With the goal of introducing participants to graduate school as a postcollege pathway, SCROCCS held a graduate student panel event where they invited a group of graduate students from different departments. During the session, these panelists shared their firsthand experiences working as researchers in the lab and offered insights into their journey through graduate school, detailing their decisions to pursue advanced studies and discussing various career opportunities.

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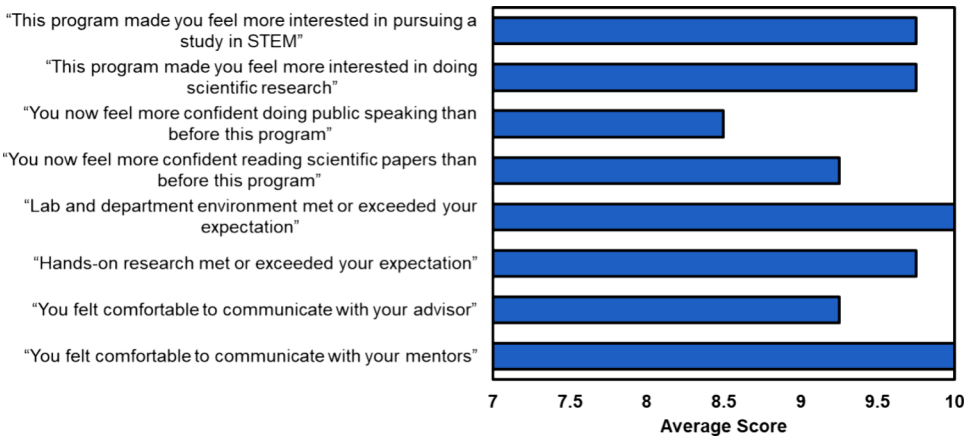

Figure 3. Student Ratings of SCROCCS Program Experience and Impact on STEM Motivation.

In the last week of the program, participants were asked to submit a research summary and give a formal presentation about their research to a group of graduate students and professors. The final presentation provided a crucial avenue for community college students to showcase their summer research. It was also a chance for them to apply communication skills learned from workshops hosted by SCROCCS. This presentation, along with the research summary, encapsulated their scientific journey and served as an invaluable experience for their academic and professional growth in the field of chemistry.

2c. Cost and Resources

The operational expenses of the SCROCCS program included student stipends, transportation assistance, and costs associated with organizing social events. For the 2022 and 2023 SCROCCS programs, we offered approximately $600 per week in stipend, which was comparable to most STEM REU programs at UW. Depending on the participant's situation and the local public transportation rate, we offered transportation assistance from none to $200 per summer. Primary financial support for the program was derived from participating faculty, who allocated funds for summer student positions in their grant proposals or by directly requesting supplemental undergraduate funding from their program managers. To minimize costs, the program utilized the university's available resources such as free campus tours, workshops led by graduate student volunteers, and events sponsored by established research centers and REU programs across the university. By using the available resources, we did not have to raise any external funds for our first two years of SCROCCS.

2d. Roles of Organizers, Mentors and Research Advisors, and Their Experience

The SCROCCS program was led entirely by graduate students, who had a diverse array of responsibilities. These included program development and promotion, engagement with chemistry faculty, application processing, continuous communication with students, mentors, and advisors, logistical arrangements for meetings, orchestrating career workshops and social gatherings, and managing unforeseen schedule adjustments. Overall, the SCROCCS organizers saw the program as a practical opportunity to cultivate leadership skills while actively contributing to the community.

Mentors guided a related side-project throughout the program, collaborating with the SCROCCS student daily to enhance their confidence and knowledge in chemistry research. Before each program began, mentors and mentees met to discuss project overviews, set goals, and establish expectations regarding communication and safety. The initial week was dedicated to safety training and lab procedures, while the following weeks focused on learning fundamental research skills. To ensure a productive mentor-mentee relationship, we recommended establishing a mentorship agreement (the detailed agreement can be found in the Supporting Information), collaboratively completed by both parties during an in-person meeting. This process was particularly beneficial for community college students who were new to one-on-one academic mentorship. This also helped mitigate potential tension arising from mismatched expectations. Ultimately, the mentorship in SCROCCS prepared students to navigate the challenges of a research-intensive environment and offered insights on transitioning to a four-year institution or pursuing a career in STEM fields. Within the lab, mentors helped SCROCCS students familiarize themselves with the social dynamics of working in a research lab. This integration allowed them to feel more welcome and supported by peers while engaging in both science and nonscience related topics. Additionally, students were encouraged to present their research updates at regular meetings with other group members. Receiving suggestions, asking for help trouble-shooting, and navigating questions from peers were essential skills to practice when conducting chemistry research. Graduate student mentors reported significant benefits to their own graduate studies by partaking in the SCROCCS program. Mentors appreciated the opportunity to improve their time management and communication skills while broadening their scientific and academic perspectives.

Research advisors oversaw research projects and ensured participants received a meaningful educational experience. Their main responsibilities included project design and approval, resource allocation, progress monitoring, quality assurance, and networking and collaboration. They ensured that research conducted adheres to high standards and helped community college students expand their professional networks. Moreover, one-on-one meetings between the SCROCCS student and the research advisor were a valuable opportunity for the student to present specific research updates, re-evaluate their research goals, and discuss any outstanding questions or concerns regarding the program or their relationship with their graduate student mentor. The

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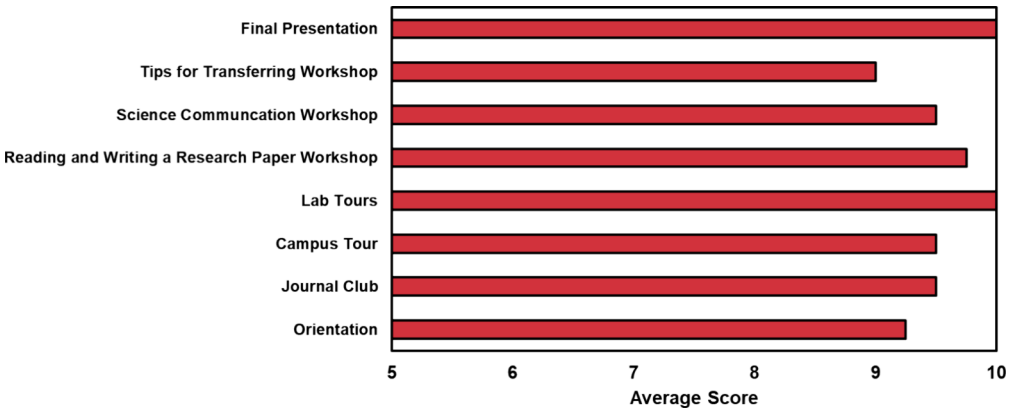

Figure 4. Average scores for SCROCCS activities at summer 2022 and 2023 programs from participants.

purpose of these meetings was open-ended, primarily serving as a private space for the student to communicate directly with the faculty.

Following the initial two years, SCROCCS garnered favorable feedback from engaged mentors and faculty. Notably, the original involvement of two chemistry faculty members in the inaugural SCROCCS program led to their commitment for two additional years.

3. SCROCCS PROGRAM OUTCOMES

After each program concluded, we sent out an exit survey to the student participants to assess their experience with the program. Four students from the first two SCROCCS cohorts, 2022 and 2023, provided positive feedback on the valuable learning opportunities and social connections offered by the program. We divided the results from the survey into two categories: quantitative and qualitative findings.

3a. Quantitative Findings

We asked the participants to give scores to statements reflecting their experience with SCROCCS. The list of statements in our exit survey was created to align with the program's objectives and motivations. We aimed to evaluate the effectiveness of the program's activities and to determine whether the students' experiences aligned with the anticipated outcomes we envisioned during the program's development. The scale for the scoring is from 0 to 10, where 0 is strongly disagree and 10 is strongly agree. In Figure 3, the bar graph presents the average scores from four students, reflecting their responses to a series of statements about their experiences in the SCROCCS program. All the statements received high ratings, with averages ranging from 8.5 to 10. This indicates a general satisfaction with various aspects of the program, such as mentor communication and the lab environment, and a significant improvement in students' confidence in key academic and professional skills, including reading scientific papers and public speaking. The average scores above 9.5 for statements about (1) increased interest in pursuing study in STEM, (2) increased interest in doing scientific research, satisfaction in (3) lab and department environment, (4) hands-on research experience, and (5) feeling comfortable communicating with mentors. These scores highlight the program's impact in enhancing both the skill set and the scientific enthusiasm for its participants.

Figure 4 shows average scores from student evaluations of various activities at SCROCCS. The data reveals a uniformly high level of satisfaction across all activities, with scores ranging from 9 to 10. Notably, the Lab Tours and Final Presentation each achieved a perfect score of 10, reflecting their exceptional impact and popularity among the students. Additionally, the Reading and Writing a Research Paper Workshop closely followed with an impressive average of 9.75, indicating its significant value in enhancing students' academic skills. Other activities, including the Journal Club, Campus Tour, Science Communication Workshop, and Tips for Transferring Workshop, also received scores above 9. These results collectively underscore the effectiveness and appeal of the SCROCCS program's diverse and enriching activities in fostering a comprehensive and engaging learning experience for the students

3b. Qualitative Findings

As of 2023, SCROCCS had a total of four participants, making the quantitative data less impactful for drawing broad statistical conclusions. Therefore, we place a stronger emphasis on the qualitative findings to highlight the individual experiences and outcomes of our participants. The program provided a unique environment for education and discovery, effectively combining detailed academic study with a supportive community atmosphere. Responding to the exit survey, students shared their experience that highlights both personal growth and collective achievements.

One participant, who had only taken two quarters of General Chemistry courses at their community college, described the initial apprehension and subsequent comfort:

> *I wanted to share how at first, I was slightly nervous and intimidated about how it was going to be, but from the moment I arrived, I was welcomed into a very friendly and supportive environment. I learned how to handle different instruments and different experimental techniques and also incredibly enjoyed with the people I was working with.*

This sense of a welcoming environment and excitement for learning, exploring different instruments, and experimental techniques alongside new friends underscored the welcoming and supportive spirit of SCROCCS. This student continued working as an undergraduate researcher at the research lab after the summer and has already presented their research work with SCROCCS at three symposia including the University of Washington Undergraduate Research Symposium, the American Chemical Society (ACS) Younger Chemists Committee's Pa' Adelante y ARRIBA (Onward and Upward) symposium, and the 2024 ACS National Meeting Undergraduate Research in Catalysis Symposium. The student also shared their insights on how SCROCCS influenced their career trajectory:

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Table 2. Suggested Steps to Start a SCROCCS Program at Your Institution Including Resources and Possible Outcomes

Steps	Resources	Outcomes
1. Assemble a team of organizers	Graduate students and faculty in the department, especially those who have experience working with or attending community colleges	This team coordinates all aspects of the program, from planning to execution, ensuring a broad range of skills and perspectives are utilized in developing the program
2. Identify funding sources, lab host availability, and target community colleges in the area	This work (Section 2c), other similar works, faculty, existing university and departmental programs and organizations	Transparent funding sources enable the program to offer high-quality resources and support to participants while clear community college targets help identify needs and demands
3. Develop a recruitment plan, including advertisements such as a Web site or flyers and application materials	For Web site: Free and user-friendly Web site development services such as Wix.com or Google Slides. For recruitment plans and application materials: this work (Section S1 and 2a), other similar works, university and departmental REU program coordinators	Early recruitment and strong advertising plans increase the program's visibility within the target community colleges, leading to a diverse and motivated pool of applicants. The program Web site can also help archive past cohorts, showcase program highlights, and increase program credibility
4. Design and identify organizing timeline, program schedule, and possible activities	This work (Table S1, and Section 2b), other similar works, university and departmental REU program coordinators	Clear organizing timeline and program plan help run the program smoothly
5. Make connections with local community college science professors	Local community colleges	Strong and long-lasting connections with local community college professors ensure successful advertising and recruitment of the program. They also help identify needs from community college students in terms of research opportunities

As someone who is still exploring potential careers in the field of chemistry, my participation in the SCROCCS program allowed me to apply chemistry concepts in a real-world research project, offering insight into the kind of research I might want to pursue in possible graduate studies and beyond. This experience helps me boost my confidence in my academic abilities and also improved my critical and analytical thinking skills in a science setting, which I can apply to any future opportunities and programs, and in the career, I will ultimately decide to pursue.

Another student shared insights into their transformative journey, emphasizing the shift from initial uncertainty to a distinct and forward-looking trajectory:

This has been a phenomenal experience and [I] will pursue doing more research during my undergrad and possibly beyond. [...] I felt very comfortable approaching my mentors and other labmates with questions or help.

They expressed enthusiasm for learning advanced techniques such as air-free synthesis and NMR, especially when engaging in discussions with graduate students on topics that were once beyond their understanding. Their involvement in summer research led to their contribution as a coauthor on a research paper, and they successfully transferred to a R-1 university, where they continues to participate in undergraduate research projects.

Further emphasizing the program's practical benefits, another participant, who had a strong background in chemistry from taking Organic Chemistry courses and working as a Chemistry Stockroom assistant, appreciated the independence in conducting experiments and acquiring new skills during SCROCCS. They expressed their enthusiasm:

I enjoyed being able to set up my own experiments while learning new techniques.

With an eye on graduate school, they used their free time to gather insights, saying,

I spent my free time learning about everyone's experiences and why they chose to pursue grad school, which gave me a lot to consider about my future plans.

Reflecting on their SCROCCS experience, they highlighted its impact on their academic and professional trajectory:

I know the experience I gained through SCROCCS will qualify me for more opportunities that I otherwise would not be able to pursue. I plan to continue being involved with research while finishing my bachelor's, and my involvement in this program will make me a more competitive student.

Their journey has now led them to UW, where they are preparing to apply to the School of Dentistry after their undergraduate studies.

All students valued the connections made with their mentors, graduate students, and peers, which not only enriched their learning experience but also helped their career trajectory. Students commented on the experience:

Lots of highlights: making connections with other grad students and professors, getting lab experience at an R1 school and learning directly from grad students, having fun in lab, understanding the environment and daily life of a grad student.

I also felt like I really connected with my mentor. She even helped me write a CV to apply for more research opportunities.

Some highlights were meeting and working with lots of great people, making friends with other undergrads from different places. Working and learning with a great mentor.

These comments capture the comprehensive and engaging nature of the SCROCCS program, which ultimately leads to student success.

4. HOW TO START A SCROCCS AT YOUR INSTITUTION

To establish a SCROCCS program at your university, we suggest following the steps in Table 2 below with the timeline for organizers included in the Supporting Information.

5. CHALLENGES AND HOW TO OVERCOME THEM

Running the SCROCCS program comes with various challenges that need to be tackled to ensure a successful experience for community college students. One crucial concern is the potential for low applicant turnout from these students, which might be due to limited awareness or perceived barriers to participation. Organizers should be proactive in advertising the program many months in advance. Additional efforts to create flyers or use social media to increase reach to local communities can be very helpful in

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promoting the program. Obtaining sufficient funding to support student stipends and program activities can be demanding. We have experienced situations where university faculty were not willing to host SCROCCS students due to lack of grant funding. Directly discussing the financial availability of prospective lab hosts in the department should be the first thing organizers consider when starting the program.

Moreover, some participants may be not comminicative, or not actively engage in events, or not fully commit to research plans. Hence, it is crucial for organizers, mentors, and advisors to establish robust communication practices with all participants. This involves organizers reaching out to admitted students prior to the program's commencement to ensure their commitment, while advisors and mentors play a pivotal role in crafting comprehensive research plans, schedules, and guiding participants to adhere to the outlined schedule. Organizers must also remain adaptable in the face of unforeseen circumstances, such as changes in university regulations, lab availability, or participant needs. Ultimately, ensuring the long-term success and growth of SCROCCS requires continuous effort, dedication, and support from university stakeholders and graduate students. By addressing and overcoming these challenges, organizers can create a valuable and rewarding research experience for community college students.

6. VISION

SCROCCS is unique among other REU programs in three ways: (1) it directly provides students from local community colleges with a traditional hands-on research experience on cutting-edge science and an opportunity to work with graduate students, postdocs, and faculty at the host university; (2) it does not require resources from community colleges and their faculty; and (3) while NSF-funded programs like RECCS requires a university faculty to initiate, SCROCCS is led entirely by graduate students at the host university, providing graduate students themselves with opportunities to improve their leadership, management, and organizational skills. This structure also ensures the adaptability of the program and allows for flexible adjustments in alignment with the available resources and needs of the host university, thereby enhancing the program's efficacy and reach.

As the program continues to grow and evolve, we envision a future where this initiative expands into a national network of SCROCCS programs at universities across the United States. This network will facilitate collaboration and resource sharing, promoting best practices in supporting community college students seeking research opportunities in chemistry and other STEM fields. In addition to offering summer research experiences, we anticipate extending the program to provide research opportunities during the academic year, further enhancing community college students' access to hands-on research experiences.

To promote seamless integration with existing undergraduate research initiatives, we envision a collaboration with existing programs focusing on research for community college students such as the Louis Stokes Alliances for Minority Participation (LSAMP), the course-based undergraduate research experiences (CUREs),[27,28] and the Community College Undergraduate Research Initiative (CCURI). The LSAMP programs aimed at increasing the quality and quantity of underrepresented minority students successfully transitioning from community colleges to four-year degree programs in STEM fields by providing academic support, mentoring, and research opportunities. CUREs are educational programs that integrate research experiences into the curriculum, allowing students to engage in scientific investigation as part of their coursework.[27,28] CCURI, on the other hand, uses an inquiry-based teaching approach, where students start with real-world science case studies in their introductory courses and then move on to hands-on research related to those cases.[29] By working in conjunction with these programs, SCROCCS aims to provide community college students with comprehensive research experiences that span classroom and laboratory settings. Furthermore, we intend to expand the SCROCCS program's scope beyond chemistry to include other STEM disciplines, offering a more diverse array of research opportunities for participating students.

In comparison to established undergraduate research programs such as CUREs,[28] SCROCCS operates on a smaller scale, which offers distinct advantages and challenges. The intimate size of SCROCCS cohorts can significantly boost student confidence and enhance teamwork skills, akin to the benefits observed in Peer-Led Team Learning programs.[30] This small group setting allows for greater flexibility, enabling organizers to tailor the program to meet participants' needs annually. However, the smaller scale presents challenges in program evaluation and establishing a consistent program structure. Unlike CUREs, which have defined upper and lower-division courses for varying levels of research involvement,[28] SCROCCS occasionally includes students at disparate levels of their academic journey, from those who have not taken general chemistry to those who have completed organic chemistry. Despite these challenges, SCROCCS's focus on individual development provides a unique, personalized research experience for each participant.

Ultimately, our vision for the SCROCCS program is to create an inclusive, supportive, and interconnected ecosystem that empowers community college students to excel in their chosen fields. By cultivating a rich network of research experiences and fostering collaborations among students, mentors, and institutions, we believe that SCROCCS can become a cornerstone for promoting equity and inclusivity in STEM education on a national scale.

■ ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available at https://pubs.acs.org/doi/10.1021/acs.jchemed.3c01277.

Example of SCROCCS application template, suggested rubric for organizers, examples of milestones and goals of a SCROCCS participant, outlines of workshops offered by SCROCCS, and suggested template for a mentor−mentee contract (PDF, DOCX)

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Notes

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