

Undergraduate Research As a Catalyst for Career Competency Development

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Abstract

The National Association of Colleges and Employers identifies eight career readiness competencies undergraduates should practice before graduation. To emphasize the importance of undergraduate research to developing student awareness and confidence in these competencies, the Office of Undergraduate Research at UNC Charlotte created discrete student learning outcomes to frame student learning through undergraduate research in the career competency areas. Students' self-assessed confidence and mentors' descriptions of student behaviors were assessed for growth in these career competencies. This one-year pilot study demonstrates strong association of career readiness with undergraduate research and significant development of career readiness among participants. This study sets the stage to more deeply investigate the structures and mentoring practices that promote career readiness through undergraduate research.

Keywords: *career/workplace readiness, extracurricular research programs, programmatic assessment, public institutions, research universities*

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High-impact practices encompass a range of cocurricular opportunities that are particularly effective in enhancing student learning, development, and persistence, including activities such as service learning, internships, study abroad, and undergraduate research (Kuh, Schneider, and AACU 2008; Miller, Rocconi, and Durnford 2018). These experiences require substantial commitments from

students coupled with structures that provide plentiful feedback from faculty and engagement with peers, and ultimately enhance many transferable skills highly desired by employers (Kuh et al. 2013; Zilvinskis 2019). Experiential learning, including undergraduate research, allows students to learn by actively engaging in real-world experiences and reflection. The National Association of Colleges and Employers (NACE) found that many students in undergraduate programs recognized the value of experiential learning opportunities, and that 79 percent of the graduating class of 2023 had participated in some experiential learning (NACE 2023). Employers also expressly acknowledge the value that experiential learning adds for applicants and new hires, particularly experience with undergraduate research (UR). According to Finley (2021), 85 percent of employers reported that they would be more likely to hire a recent graduate with UR experience.

The studies discussed above demonstrate that engagement with experiential learning can make graduates more hireable, in part due to the transferable skills that students develop throughout these opportunities (Miller et al. 2018). However, focusing on UR specifically, McClure-Brenchley, Picardo, and Overton-Healy (2020) point out that (a) not enough students recognize the benefit of UR to their career path, and (b) students who did UR do not effectively articulate career readiness components of their experiences. A more recent study demonstrates that, upon reflection, students do attribute undergraduate research experiences (UREs) to the development of career readiness (Burt, Wirgau, and Brummette 2025). Unfortunately, not all students are able to express these connections equally, therefore the authors conclude that

there is a need for intentional professional development and mentorship to support students. To address these obstacles, one option is to leverage NACE's career readiness framework to design programmatic structures that support the needs of students, educators, and employers as new graduates prepare to enter the workforce (MacDonald et al. 2024).

Part of this framework is made up of the career readiness competencies, a defined set of skills that are highly valued by employers. These competencies include career and self-development; critical thinking; equity and inclusion; leadership; professionalism; teamwork; and technology. Interestingly, although both new graduates and employers place high levels of importance on skills, with nearly 65 percent of employers stating they use skills-based hiring, there is a significant discrepancy in the proficiency levels for some skill-based competencies. For example, 96 percent of employers say communication skills are important to employment, whereas only 53.5 percent of employers rate students as proficient in communication (NACE 2025). Such discrepancies call for higher education to find more effective ways to embed this skill development into experiential learning—or at the very least, to help students learn to better articulate the skills that they are already developing.

McClure-Brenchley, Picardo, and Overton-Healy (2020) implemented an integrated model of UR, highlighting shared learning outcomes from URE and employer expectations, designed to help students leverage and articulate their experiences as career readiness. Subsequent studies report perspectives of alumni on career readiness (Newell and Ulrich 2022), focus on narrow disciplinary outcomes (Kistner et al. 2021), examine capstone projects only (Gunnels et al. 2024), or pilot intervention strategies (Miller et al. 2025) with small cohorts. Although these studies lay important groundwork for demonstrating the transferability of skills from these experiences, they often contain learning outcomes aligned with only a subset of NACE's eight career readiness competencies. Although the Council on Undergraduate Research recognizes that UR may serve as a career-readiness tool (Mekolichick 2023) and many students inherently develop some of these competencies through their undergraduate coursework and cocurricular experiences, there is a gap in research that explicitly explores how experiential learning opportunities, such as UR, can build these skills among all students.

Methods

Student Learning Outcomes

The National Association of Colleges and Employers career readiness competencies and associated language were reviewed and used to develop 16 student learning outcomes specific to the practice of research. These outcomes were developed by the University of North Carolina (UNC)

Office of Undergraduate Research in consultation with the Career Center and aligned with language the university was already using to communicate and assess student career readiness. There were two learning outcomes for each of the eight career readiness competencies (see Table 1). These student learning outcomes were the framework for the assessment of student learning through undergraduate research.

Survey Procedures

The survey questions were developed after reviewing multiple preexisting undergraduate research assessment tools, and the bookend structure was inspired by the EvaluateUR (Singer et al. 2022) approach. The survey instrument and instructions were refined in fall 2023 during a prepilot stage with a small group of student and mentor volunteers. All surveys were administered electronically to participants. Informed consent to participate was collected using digital signatures. The study included two steps: mentoring agreements and end of research assessments. Mentoring agreements were completed collaboratively during the first week of the experience and included selecting four learning outcomes for the student that were consistent with both the project and the student's skills. Mentors were asked to describe how the project or experience could help the student develop this competency or skill.

During the final week of the research experience, both mentors and student researchers were independently provided a link to an end of research assessment survey. Mentors were asked about their confidence in the student's ability for each of the previously selected student learning outcomes and to assess whether the mentorship and project structures supported growth in learning for the student as originally described in the mentoring agreement. Mentors were asked to rate the student's skill levels at both the beginning and end of the research experience. Mentors were asked to write a qualitative description of at least two indicators of growth or skill proficiency that the student displayed during the project. Student researchers were asked to review their self-confidence in each of the previously selected student learning outcomes, quantitatively and qualitatively, and indicate whether there were opportunities that supported growth in learning in this area. Students were asked to self-evaluate their skills at the beginning and end of the research experience and provide an additional score for perceived growth in each skill area. Finally, students were asked to identify specific experiences that helped them develop competency in the skill area. Student competency Likert scale questions had a range of 1 (not confident at all) to 6 (very confident). Opportunity Likert scales ranged from 1 (not at all) to 6 (very much so). Students-only Likert scales on learning through the experience ranged from 1 (no growth) to 4 (tremendous growth). The full survey is available from the authors upon request.

TABLE 1. NACE Career Readiness Competencies and Student Learning Outcomes

NACE career readiness competency	Student learning outcome 1	Student learning outcome 2
Critical thinking	Gather and analyze information from a diverse set of sources to fully understand a problem.	Accurately summarize and interpret data with an awareness of personal biases that may impact outcomes.
Communication	Communicate in a clear and organized manner, with respect to the needs of diverse audiences (i.e., ability, culture), so that others can effectively understand your research.	Ask questions, seek feedback, provide feedback appropriately to seek guidance and inform others of your needs and progress during the research process.
Teamwork	Effectively manage conflict, interact with and respect diverse personalities, and meet ambiguity with resilience.	Employ personal strengths, knowledge, and talents to collaborate with others to achieve common goals.
Technology	Navigate change and be open to adapting to and learning new and unfamiliar technologies in research settings.	Identify appropriate technology for completing specific tasks and use technology to improve efficiency and productivity in the research.
Leadership	Inspire, persuade, and motivate self and others through encouragement and building trust under a shared vision.	Plan, initiate, manage, complete, and evaluate projects.
Professionalism	Act equitably with integrity, approaching your work in the interest of the larger community and workplace.	Prioritize and complete tasks to accomplish goals within the broader research environment.
Career and self-development	Display curiosity; seek out opportunities to learn with an awareness of one's own strengths and areas for development.	Establish, maintain, and/or leverage relationships with people who can help one professionally.
Equity and inclusion	Demonstrate flexibility by adapting to diverse environments, diverse ideas, and new ways of thinking.	Actively contribute to inclusive and equitable practices that influence individual and systemic change.

To understand the growth demonstrated by students during their experience, the following research questions guided the approach:

1. Are all aspects of career readiness associated with undergraduate research?
2. Is career readiness improved through undergraduate research experience?
3. Do other factors, such as program length or previous experience, affect career readiness outcomes?
4. How would students describe their development of career readiness through undergraduate research?

Data Analysis

Student learning outcome (SLO) selections were analyzed using the chi-square test with H_0 of equal distribution of selections. Self- and mentor evaluations were analyzed quantitatively with a pairwise one-tailed T test. Distributions were analyzed by analysis of variance (ANOVA) in conjunction with a Tukey honestly significant difference (HSD) post hoc test with H_0 of equal distribution in all cases. Qualitative data analysis was performed with NVivo and included the following steps: (a) preliminary exploration of the data by reading through assessment responses and making annotations; (b) applying open coding and segmenting and labeling the text; and (c) using inductive

coding to develop themes by aggregating similar codes together. The quantitative portion of the analysis was completed first, followed by the qualitative; this allowed for intentionality in uncovering how the qualitative responses could enhance what the quantitative data demonstrated.

Study Population

This study occurred in 2024, across two 16-week academic semesters and one 10-week summer program, involving approximately two hundred student-mentor pairs (150 unique students and 90 unique mentors). The population of students in the study reflected the broader campus population by race, ethnicity, gender, and major discipline, with some exceptions.

Results

The students in this study represented all nine colleges within the university and 82 different majors. The students represented all class years but were not evenly distributed, with most (40 percent) being third-year, 33 percent fourth-year, 21 percent second-year, and 6 percent first-year undergraduates. Mentors in the study were over-represented by tenure-track faculty, with over 40 percent at the assistant professor rank. Mentors represented eight of nine colleges with 40 different departmental affiliations but were more likely to be in STEM-related disciplines

when compared to the university faculty. There were more female scholars and male mentors than expected from the university population. Nonetheless, this pilot study included a diverse population of students, faculty, and disciplines, emphasizing the broader relevance of these findings (see Table 2).

Quantitative Data

The first question addressed whether all aspects of career readiness were associated with undergraduate research by analyzing how the SLOs were selected by research teams. All potential student learning outcomes were selected by multiple research teams, emphasizing the connection between different aspects of career readiness and UREs. There were no significant differences in the selection of the SLOs between the academic semester and summer programs (chi-square, $p = .65$). Certain SLOs, or career readiness competencies, were more likely to be selected, including critical thinking, communication, and technology, whereas leadership, professionalism, and equity and inclusion were less frequently selected (see Figure 1; ANOVA, $p = .004$) at the beginning of the experience. The uneven distribution of selections suggests that some connections between UREs and career readiness were more obvious than others.

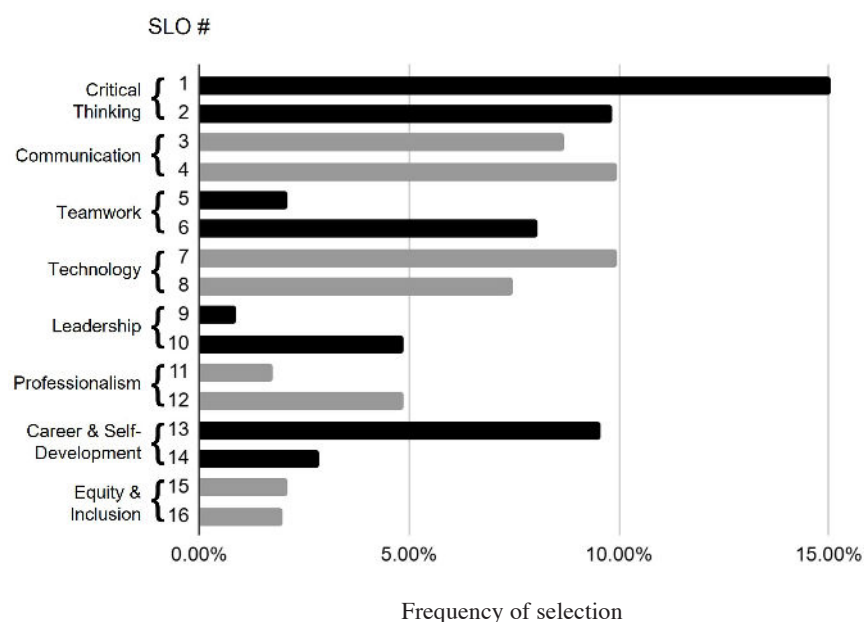
Each career readiness competency area had two distinct SLOs (see Table 1) and the percentage of selections is indicated. Although all SLOs (and all career readiness competencies) were selected by more than one research team, not all SLOs were selected with equal frequency (ANOVA, $p = .004$, $n = 804$).

The second question considered whether career readiness improved through UREs. Both mentors and students felt strongly that there were opportunities to develop different career readiness skills through the URE. These were identified at the beginning of the program while preparing mentoring agreements and positively affirmed after the conclusion of the URE. The combination of self-evaluations by students and assessments by the mentors demonstrated comparable confidence in career readiness development by the students. A strong majority of assessments (83 percent of mentors and 86 percent of students) showed growth and learning for individual SLOs, and a majority (71 percent of students and 67 percent of mentors) demonstrated student growth in all four SLOs selected. There was a tremendous increase in confidence (rated at the top half of the scale) among student skills across assessments (52 to 95 percent for students and 54 to 96 percent for mentors) after completion of the program (see Figure 2). Moreover, ratings of lowest confidence (1 or 2 on a scale up to 6) decreased from 18 to 1 percent of responses, and ratings of the highest confidence (ratings of 5 or 6) increased from 20 to 25 percent to over 80 percent of responses for both students and mentors. Rater perceptions of student career readiness were significantly improved for all 16 SLOs following the URE (see Figure 3). The average student confidence rating across all SLOs for 638 observations improved from 3.56 ± 1.18 standard deviation (SD) to 5.17 ± 0.90 SD (T test, $p < .05$). The average mentor competence rating across all SLOs for 684 observations improved from 3.65 ± 1.29 SD to 5.23 ± 0.91 SD (T test, $p < .05$). Students were least confident entering the URE in aspects of technology and professionalism,

TABLE 2. Comparison of Student and Mentor Populations to University Population

Student populations			Mentor populations		
Classification	Scholars	University	Rank/title	Study	University
White	43.55%	46.84%	Assistant	41.6%	21.8%
Asian	20.16%	10.62%	Associate	25.2%	27.4%
Hispanic	13.98%	15.40%	Full	22.0%	29.9%
Black	14.78%	17.76%	Teaching	2.4%	10.6%
PI/NA/AN	0.81%	0.36%	Clinical	1.2%	4.9%
Other	5.11%	7.31%	Research	3.2%	9.3%
Unknown	1.61%	1.66%	Other	4.4%	NA
Gender	Scholars	University	Gender	Study	University
Female	57.1%	48.4%	Female	40.7%	49.1%
Male	42.9%	51.6%	Male	59.3%	50.9%

Note: NA, not available; PI/NA/AN, Pacific Islander/Native American/Alaskan Native

FIGURE 1. Student Learning Outcomes (NACE Career Readiness Competencies) Selected by Student-Mentor Teams

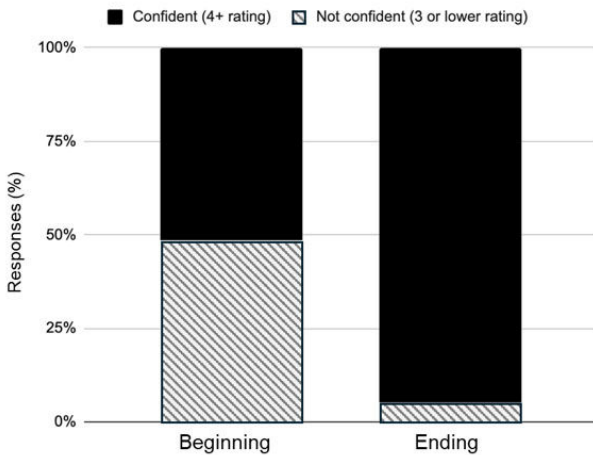
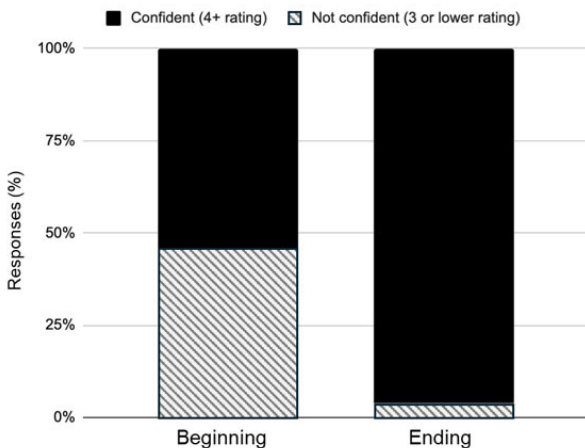
starting at a 3.00 and 3.01 average score respectively, and most confident in an aspect of equity and inclusion, with a starting average of 5.00. Meanwhile mentors had the least confidence in student competence in critical thinking (3.21) and the most confidence in teamwork (4.81) components at the start of the URE. At the end of the URE, mentors were most confident in student competence in aspects of professionalism (5.47) and least confident in leadership behaviors (4.94). Regardless of the starting point, both student confidence and mentor confidence in career readiness significantly improved for all outcomes (see Figure 3; *T* test, $p < .05$).

Because this cohort included a diverse set of student experiences as well as programmatic structures, the next questions considered whether other factors might affect career readiness outcomes. Unsurprisingly, the data demonstrated that students without prior experience (128 students; 512 ratings) were initially rated lower in their skill level by both self (3.44 vs 3.92; $n = 512$ vs 140) and their mentors (3.49 vs 4.21; $n = 532$ vs 152). After the conclusion of the program, however, student confidence was comparable to that of experienced research students (5.15 and 5.16). Mentors, however, continued to have less confidence (statistically) at the end of the program in first-time participants (5.20 vs 5.36), although the gap had reduced by 80 percent (*T* test, $p = .03$). Similarly, first-year students (32 ratings from eight students) in the program rated their confidence in career readiness significantly lower at the start and end of the program compared

to all other class years (ANOVA, $p = .01$). Interestingly, mentors did not initially rate first-year students ($n = 36$ ratings of 9 students) with lower confidence, but mentors did have less confidence in their career readiness compared to higher class peers after the URE (ANOVA, $p = .001$). Additionally, no effect of the program structure on the outcomes was identified in this study comparing 76 academic year students to 84 summer students. The populations were similar, with the summer program having more novice students (84 percent vs 72 percent), but fewer first-year students (4 percent vs 7 percent). Therefore, in this pilot study, a 16-week semester program for up to 160 research hours with five required workshops was just as effective at building career readiness in students as the 10-week summer program for up to 400 research hours including four workshops.

Qualitative Data

Finally, the goal was to identify key trends in structures that students engaged with that contributed to their growth connected to the selected SLOs. The selected qualitative data set included responses from the students' end of term assessments to the prompt "Please provide at least two specific experiences that occurred through your research project participation that helped you practice and improve this skill." Through open coding, the following seven themes were identified: establishment of respect and equal partnership; development of independence and self-resilience; application of tools and resources; reinforcement of respect and equal partnership; metacognition; approach

FIGURE 2. Improvement of Student Self-Confidence and Mentor Confidence in Career Readiness Skills**A. Students****B. Mentors**

Note: Student confidence ratings across all student learning outcomes exceeded 94 percent, after starting at 52 percent, following an undergraduate research experience. Mentor confidence in student skills increased comparably and exceeded 95 percent.

to workplace with an open mind; and communication of research.

The first theme, establishment of respect and equal partnership, had the highest number of references among the set of applicable codes. This theme emphasized clear opportunities that students identified in which they could comfortably speak up within their research team (particularly with their mentor) to express concerns, ask questions, seek feedback on strengths and opportunities for growth, and discuss future plans. It is evident that students' ability to engage in these moments was often a prelude to or connected to other growth experiences identified in the additional themes (see Table 3).

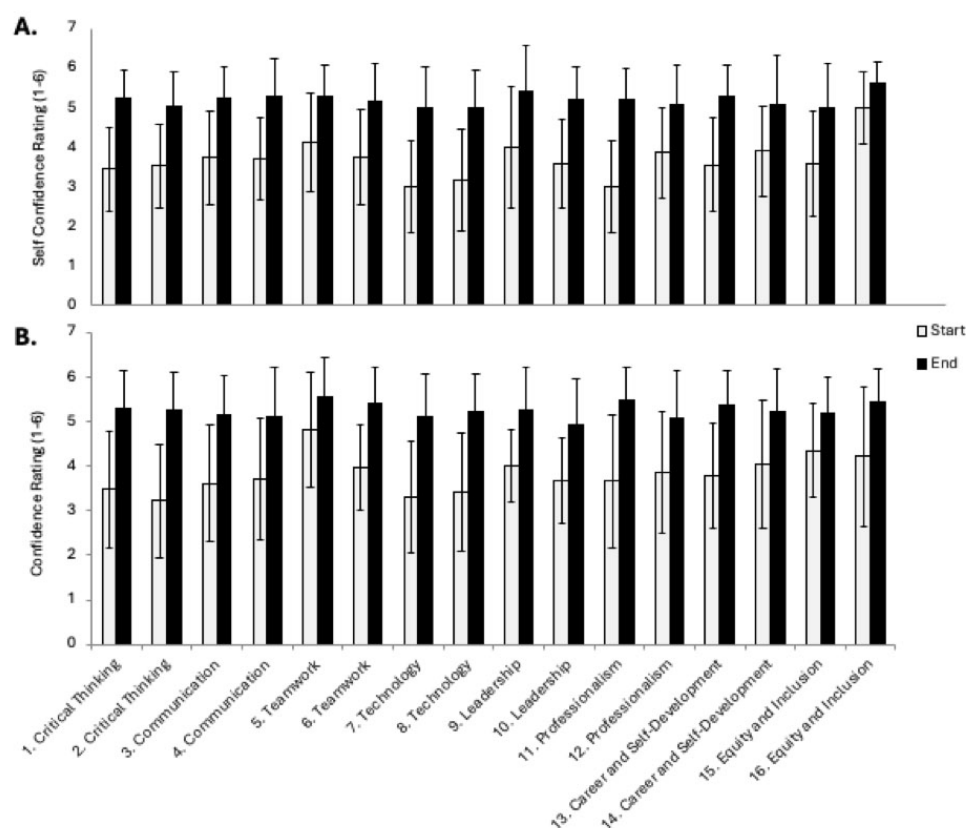
The second theme, development of independence and self-resilience, highlighted instances in which students recognized their responsibility to take ownership of their work. This included references to problem-solving, how they handled mistakes, and being able to identify how to avoid similar obstacles in the future. This theme also encompassed moments of students setting benchmarks and timelines for themselves and navigating how to successfully meet or appropriately adjust those goals.

Application of tools and resources, the third theme, demonstrated the opportunities that students had to use various forms of technology (both general, such as Google sheets, and more technical, such as MAXQDA or Python). In these references, students discussed how being part of a research team gave them unique access to these tools as well as their learning curve in developing competency to apply them.

Whereas the first theme discussed (establishment of respect and equal partnership) focused on the evidence of early infrastructure built into the research environment to empower students to feel included as a valued team member, the fourth theme, reinforcement of respect and equal partnership, identified evidence of ways that empowerment was maintained throughout the course of the experience. This was demonstrated by students continuously being able to negotiate how to divide tasks effectively, delegate, and recognize how tasks delegated to them reflected their strengths. They also identified the value of being given a platform to share ideas in meetings.

The fifth theme, metacognition, emphasized the students' reflections on how they were engaging with the experience and noticeably learning. These instances included students discovering the unpredictable nature of research and the need to adapt to change quickly and thoughtfully. Additionally, references in this theme showed that students were open to feedback and participatory in self-assessment of their strengths and opportunities for growth. Students were also aware of those moments, while engaging in their research environment, that reinforced their strengths and the limits of their abilities.

The final two themes were less frequently mentioned than their predecessors, but there was still significant evidence of them throughout the student responses. Approach to workplace with an open mind was the sixth theme, and these references highlighted the students' ability to recognize value in a variety of perspectives. Not only did students discuss benefits of having a range of experience levels on their teams, but there were also plentiful references to interdisciplinary content that enriched their own discipline's knowledge base. Students pointed to the value of the research experience providing them a space to understand their own biases and perspectives more

FIGURE 3. Student and Mentor Assessments of Student Career Readiness Following Undergraduate Research

Note: (A) Student self-assessments of skill competencies were significantly higher for all 16 student learning outcomes. (B) Mentor assessment of student skills was significantly higher for all 16 SLOs. Paired *T* test, $p < .05$.

intentionally and to be aware of how those perspectives might influence their approaches to and interpretation of research.

Last, communication of research underlined the many ways in which talking about their research enhanced the students' skill development. Students referenced a range of professional spaces, such as team meetings and discipline-based conferences, where they had the freedom to "get into the weeds" of what they were discovering through their work. At the opposite end of the spectrum, students also reflected on the merit of being able to get general audiences understanding, excited, and engaged in conversation about the research content being shared.

Discussion

The Office of Undergraduate Research (OUR) Scholars program at the University of North Carolina at Charlotte builds connections between UR and the development of career readiness. The OUR Scholars program served the

entire university community, allowing study of career readiness across a diverse range of academic disciplines, class years, and demographics. Although the populations opting into this study did not perfectly match the university community, this pilot study included a diverse population of students, faculty, and disciplines, emphasizing the broader relevance of these findings. This feature makes this study unique, as few previous studies looking at career readiness development through UREs have incorporated both broad disciplinary representation and examined students at a variety of career stages from different backgrounds (MacDonald et al. 2024). The professional development workshops and career readiness interventions were required parts of this program, ensuring consistent career readiness interventions for all students in this study. Finally, this study included both the summer program as well as academic year programs, demonstrating that students can build career readiness effectively when engaged in research full-time as well as when balancing research engagement and classes.

TABLE 3. Themes, Codes, and Examples of Qualitative Responses

Themes	Codes	Example student quotes
Establishment of respect and equal partnership	Safe space to communicate Goal setting (tasks) Goal setting (professional) Reflective practices (professionalism)	“Every week the lab had team meetings where we all talked to the other members about what we had been working on in the past week and any new developments. This helped me a lot because I felt comfortable talking to the lab and even if I didn’t have a lot of interesting progress in my project all the other members of the lab were super receiving and gave really good feedback”
Development of independence and self-resilience	Independent problem-solving Self-accountability	“I kept a list of everything I needed to do for the week to ensure that I was on task and on track to complete the project. I periodically evaluated my research progress and communicated with my advising professor to ensure that I wasn’t falling behind on my work.”
Using new tools	Use of new tools Engagement with professional resources	“I collaborated with my mentor to review the data analysis tools we were using and explored alternatives that could better handle our data sets. We decided to transition to more advanced statistical software, such as NVivo as well as Excel, which improved the efficiency and accuracy of our analysis. This experience helped me practice evaluating different technologies and selecting the most appropriate ones to meet our research needs.”
Reinforcement of respect and equal partnership	Sharing or dividing responsibility Team discussion of ideas	“I worked with my mentor to identify my strengths in data analysis and writing, which allowed us to allocate tasks effectively. By taking on responsibilities that aligned with my skills, such as synthesizing survey data and drafting initial summaries, I was able to contribute more confidently and effectively. This process helped me understand the value of recognizing individual strengths within a team to achieve our shared objectives.”
Metacognition	Applying feedback Adapting to change Reflective practices (learning)	“[My mentor] constantly asked me “well what do YOU think?” which forced me to consider what was important to my own style of learning in order to come to my independent conclusions. This really forced me to come to terms with the fact that much of my academic career had forced me to study in a way that was pleasant to the teachers I was learning from, when in fact I wasn’t really developing confidence of my own.”
Approach to workplace with an open mind	Engagement across perspectives Deconstructing knowledge or bias Interdisciplinary content/ideas	“This challenged me to think critically about social biases and inclusivity. I had to adapt my approach to ensure the research outputs were fair, unbiased, and reflective of diverse groups. This experience helped me develop a deeper understanding of equity and broaden my perspective when addressing complex issues.”
Tailoring communication of research	Communicating research to general audiences Intrateam communication Communicating research to academic peers	“[One] experience was during every conference I attended this semester. These individuals I presented to were not in the same science community as me. I felt that my communication was effective because following my elevator speech, people often reiterated back to me what they grasped from my project. On many occasions, my audience was able to understand and repeat what the goals of my project [were].”

Students and mentors associated UR with all aspects of career readiness. Interestingly, they selected student learning outcomes for critical thinking, communication, and technology at higher rates. Because critical thinking, communication, and teamwork, which ranked fifth among selection frequency in this study, are often identified as very important for career readiness, it was encouraging

that students and mentors believed that UR can support development in these areas. A previous study (Burt et al. 2025) found that students’ reflective responses most associated UR with career and self-development, which was the fourth most selected set of SLOs in this study. Their study classified post-experience reflections on learning, whereas this study asked participants to identify areas of

learning at the start of the experience, a distinction that likely explains the variability in selection frequency. It also strengthens the concept that building durable skills through experiential learning can have multiple effects and impact student career readiness in ways that may be unanticipated at the beginning of the experience. Because this study's population of students included many students engaging in their first URE, it is not surprising that leadership was one of the least selected SLOs. It would be interesting to compare learning outcome selections with a different program that served students with previous research experience to determine whether different aspects of career readiness were associated with the amount of time engaged in undergraduate research, as in a scaffolded curriculum. Nonetheless, the OUR professional development workshops encouraged leadership development using methods already demonstrated to be impactful for undergraduate learners (Reed et al. 2016). This further emphasizes that this study focused on enhancing student skills in all aspects of career readiness, even if research teams did not initially identify that specific area as a focus at the start of the program. Finally, although a variety of disciplines were represented, the initial study design did not allow the effective examination of whether specific career readiness competencies were preferentially associated with undergraduate research by disciplinary focus. In the future, this connection between specific competencies and the field of research is worth considering.

The students in this study show statistically significantly increased confidence in all SLOs associated with career readiness. Mentors identified improvement in career readiness in all four outcome areas for 67 percent of students and 84 percent of students for at least three SLOs, which was also comparable to the 71 percent (all 4 SLOs) and 84 percent (3+) of self-reported growth in SLOs by students. Because the survey asked students to rate themselves at the beginning and during the final assessment, this finding was not surprising. This singular rating system was chosen by design, as the negative post-URE ratings associated with increased student awareness of the breadth of knowledge (similar to the Dunning-Kruger effect; Dunning 2011) are well documented. This purposeful design was aimed at limiting the impacts of lack of awareness on these results. Despite asking students and mentors to assess skill levels with the benefit of hindsight, only 86 percent of responses showed higher ratings at the end of the URE, with 2 percent of ratings showing regression. This finding was encouraging because it does suggest that students are providing honest assessments based on variable experiences in UREs. Interestingly, even when students rated themselves comparably, or lower, at the end of the URE, the overwhelming majority still reported growth in skill development and could provide specific examples of how they strengthened career readiness through the URE. These data help reinforce the potential limitations of

student self-evaluations, which is why independent mentor evaluations were used to corroborate the self-ratings. A strong correlation between mentor and self-ratings was identified, which strengthened the argument for the reliability of the ratings. Mentors identified skill improvement in 83 percent of all SLOs assessed, comparable to 86 percent of students. Mentors identified a small percentage of student regressions as well, suggesting that lower ratings post experience may be due to more than simply lack of awareness in these cases. This will require further research and a larger sample size for full investigation. Likewise, a deeper study of connecting specific mentoring practices or professional development opportunities with career readiness development may inform program structures in the future.

Further qualitative analysis of open responses helped elucidate what experiences and practices, as part of the URE, were helpful to students in developing career readiness skills and confidence. Although some studies (Kistner et al. 2021; Marsh et al. 2016) have focused on more technical connections between URE and career readiness specific to individual disciplines, this study empowered students to reflect upon and name the specific ways in which their URE led to improved career readiness across disciplines and levels of academic experience. This process exemplifies a unique methodological approach in this body of work. Whereas previous studies (Burt et al. 2025; Gunnels et al. 2024) have utilized and extrapolated data to retroactively demonstrate the impact that UREs had on career readiness, the current assessment tool begins with provision of clear definitions of career competencies and their connections to research. Because students select the SLOs (or, the specific competencies) upon which they want to focus, they can intentionally reflect on their progress and desired outcomes throughout the course of the URE. Ultimately, the final assessment empowers them to engage in direct articulation of their individual skill development and enhance their ownership of the experience. This allows students to become authorities of their own learning and able to provide the narrative of their career readiness learning beyond the simple awareness that traditional Likert scale scoring of learning emphasizes.

Study results did show some differences related to student preparation and career readiness. Although students who were new to research, or participating in their first experience, rated their own skill levels significantly lower at the beginning of the experience, they felt as confident in their skills after the URE as students who had previous research experience. Interestingly, the mentors also had lower confidence in the new research student skills at the beginning, but they retained their lower confidence even after the URE. Mentors had significantly more confidence in the skills of returning research students before and after the URE. This is not surprising but does inform how support

is provided to students with different experience levels during UREs. First-year students also had lower confidence in their abilities at the beginning of the experience and even after the URE when compared to all other class years. Interestingly, second- through fourth-year students were statistically similar. Most likely this is because all first-year students were also first-time research students, which also is associated with lower confidence regardless of class year. More “tiering” of confidence was expected across the class years, but that was not apparent in this pilot study, with no differences noted among second-through fourth-year students. Incorporating this assessment approach with other program structures that serve different populations may elucidate connections between career readiness and prior experiences. Mentors’ perceptions differed from student self-perceptions in that they did not believe the first-year students lagged their peers in the beginning, but after the URE, the mentors felt that those students still had not achieved the same level as their higher class peers. Although responses were agnostic of discipline, there are potential explanations. For example, URE qualification narratives for some technical disciplines (e.g., computer science) are more likely to list specific course or skill requirements for students, which may lead mentors to assume experience, knowledge, and skills in the beginning; differences in skill level then become more apparent during the URE. As the study population increases, the ability to examine SLO selection and outcomes to evaluate whether any differences correlate with discipline will become possible.

This study included similar numbers of responses from summer and academic semester research experiences, which varied significantly in number of hours students spent engaged in research. Program support structures, such as professional development opportunities that included workshops and a public presentation event, however, were similar in the two programs. Despite the different number of hours spent on research, all similarities and differences previously described were maintained when comparing the results between the academic semester programs and the summer program. This was surprising and suggests that the programs assessed here are either meeting a minimum research experience level (that is, hours committed) or that support programming (for example, professional development workshops) is supporting student skill development in a manner that compensates for less mentor-mentee interaction time.

Conclusions

This pilot study demonstrated that students and mentors associated all aspects of career readiness with undergraduate research. Students gained confidence in durable skills associated with career readiness through UREs, and independent mentor evaluations corroborated these skill gains. Interestingly, there were no significant differences

between the summer program and the academic year programs in career readiness learning outcomes. This finding is important to supporting students universally as they discuss career readiness developed through UREs. Finally, this study identified that nearly all students benefited from URE participation by growing career readiness through durable skill development, but results may vary based on the student’s previous coursework or research experiences. The data strongly support the development of career readiness in university students through undergraduate research and some key mentoring components that support confidence and competency development in students.

Further work is needed to deepen the understanding of the impact of UREs on career readiness. Potentially comparing results with programs using different support structures would allow a better understanding of how programmatic components support durable student skill development and career readiness through UREs. Another feature that may have impacted the outcomes of this pilot study was the support of students with mentoring techniques and structures. One question that this study left unanswered was whether there are correlations between specific mentoring techniques and learning outcomes. Modifications to the survey instrument will be necessary to directly address this question.

Data Availability Statement

The data underlying this study are not publicly available because they contain student submissions. They are available from the corresponding author with authorization of the UNC Charlotte IRB.

Institutional Review Board

This study (protocol number IRB-24-0294) was reviewed by the Office of Research Protections and Integrity (ORPI) at UNC Charlotte and was determined to meet the exempt category under 45 CFR 46.104(d).

Conflict of Interest

No conflict of interest to declare.

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