REU Site: Sustainability of Horizontal Civil Networks in Rural Areas

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Introduction

The University of Nebraska-Lincoln (UNL) Sustainability of Horizontal Civil Networks in Rural Areas Summer Research Program (SRP) is funded through a National Science Foundation (NSF) Research Experience for Undergraduates (REU) grant. Rural areas, which contain approximately 20% of the US population and 80% of the land area in the United States, are fundamental to human well-being. Rural areas provide unique resources such as the infrastructure for food and bioenergy production as well as the transportation infrastructure form inland urban centers to ports. Despite this, little attention is paid to the unique challenges and opportunities for sustainable rural civil infrastructure. Substantial challenges facing sustainable rural development include low population densities; communities experiencing flat or negative population growth; and the close connections between rural communities and their surrounding natural environment, and necessitate new technologies and approaches for civil infrastructure in these areas. The primary focus of our REU site will be on sustainable rural infrastructure with emphasis in three areas: (1) environmental and water resources in rural and/or agricultural areas; (2) structural engineering and materials research for sustainable rural civil infrastructure; and (3) sustainable transportation research. These projects are based in fundamental research, but in many cases, include field sites or testbeds located in rural communities. The objectives of this REU site are to (1) provide research experiences to undergraduate students from institutions with limited research opportunities and from minority groups underrepresented in STEM; (2) provide participants with first-hand exposure to the engineering and infrastructure challenges facing the rural United States through research and professional development opportunities in both academia and civil engineering industry; and (3) promote and sustain the interest of undergraduate students in pursuing graduate education in STEM.

Evaluation Methods

Evaluation of the REU Site was conducted by the Social and Behavioral Sciences Research Consortium (SBSRC) at UNL. The evaluation plan included surveys conducted with the students before and after their time in the program and focus group sessions conducted with the students and interviews with their faculty mentors. The evaluation plan also includes follow-up surveys with the participating undergraduate students one year after their completion of the program. Since this is the first year of this program, this data has not yet been collected. The quantitative data collection (pretest, posttest) was conducted by the UNL Office of Graduate Studies and the results were sent to the SBSRC for analysis and reporting. The qualitative data collection (i.e., interviews and focus group sessions) was conducted by the SBSRC staff. Finally, a brief review of demographic information of the applications was conducted.

Applicant and Cohort Demographics

A total of 109 undergraduate students applied for the REU summer program; among them, 57 (52%) were female, and 39 (36%) were underrepresented minority students (URM). Meanwhile, among the nine students who accepted the offer from the program, 6 (67%) were female and 3 (33%) were URM, as shown in Table 1. Our 2017 cohort met our stated program goal of

recruiting at least 50% of the cohort from groups underrepresented in engineering (female and URM students). In addition, 5 of the 9 accepted students (55%) were from institutions with limited research opportunities.

Table 1. Demographics of the Applicants and Accepted Cohort

Demographics	Applied		Accepted Cohort	
Total	109	100%	9	100%
Female	57	52%	6	67%
Male	52	48%	3	33%
Unspecified Gender	0	0%	0	0%
Underrepresented Minority (URM)*	39	36%	3	33%
African-American	13	12%	1	11%
American-Indian	0	0%	0	0%
Hispanic/Latino	22	20%	2	22%
Multiracial	4	4%	0	0%
Hawaiian/Pacific Islander	0	0%	0	0%
Asian	9	8%	1	11%
White	61	56%	5	56%

*URM includes African-American, American-Indian, Hawaiian/Pacific Islander, Hispanic/Latino, & Multiracial Students

Impact of Program on Familiarity with Research and Graduate Education

The majority of students in the REU program reported feeling like their familiarity with issues in research and graduate education either increased a little or a lot in six of eight items (see Figure 2). All (100%) of them reported feeling like their familiarity or knowledge increased the most regarding opportunities in graduate education at UNL (100% increased a lot), the steps to admission for graduate school (100% increased a lot), and current research trends in their discipline (100% increased a lot). The two points at which at least one student felt their knowledge remained the same were careers in their discipline (20% remained the same) and graduate programs in their field (20%).

All (100%) of the students in the REU program either agreed or strongly agreed with 15 out of the 20 items asked about what they gained (see Figure 2). The points of greatest agreement among the students were feeling like they gained a research product worthy of publication or presentation at a conference (60% strongly agree, 40% agree), skill in presenting research to others (60% strongly agree, 40% agree), skill in comprehension of primary literature in their field (60% strongly agree, 40% agree), and skill in interpreting experiment results (60% strongly agree, 40% agree). The only points of disagreement were in whether they felt they gained an ability to research independently (20% disagree), readiness for more demanding research (20% disagree), ability to conduct research/experiments with little direction (20% disagree), confidence as a researcher (20% disagree), and clarification of their career path (20% disagree).

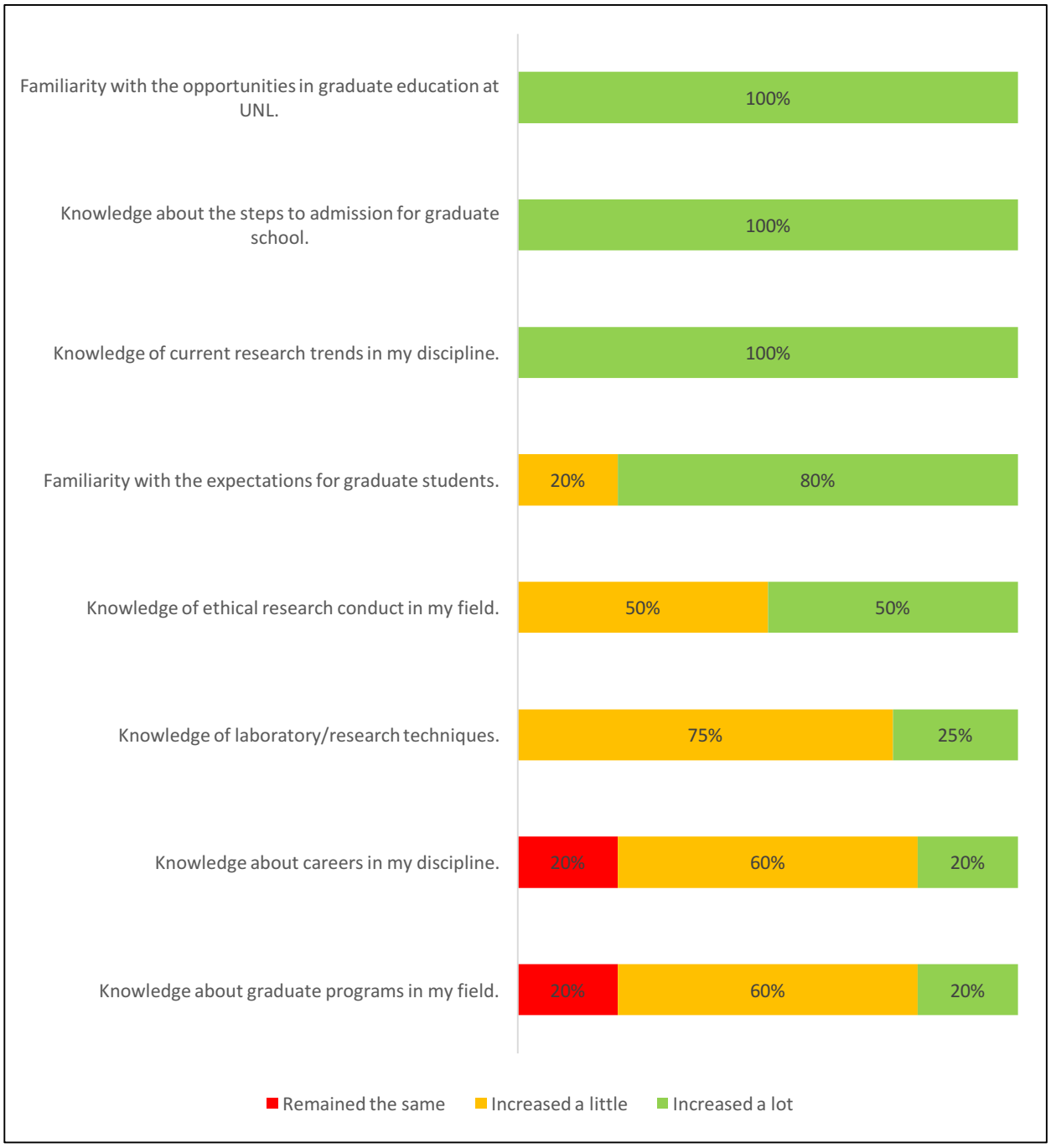

Figure 1. Changes in Familiarity with Issues in Research and Graduate Education (n=4~5)

Figure 2 - What did you gain from attending the 2017 Nebraska Summer Research Program? (n=2~5)

Student's Focus Group Reponses

Students also provided responses to open-response questions regarding suggestions to improve the program and the best aspects of the program. Students were asked what contributed to their success, or would have made their research experience better. Of the five respondents, three (60%) provided feedback, of which two suggested receiving more information about their specific project prior to the summer would contribute to make their experience better. Contributions to success were attributed to graduate students and mentors, "*my mentor's communication helped me succeed"* and *"grad students around me made my experience better."* When asked about the best part of the 2017 Summer Research Program, four of the five respondents (80%) identified the people they met through the program, such as "m*eeting people passionate about their research interests"* and *"becoming friends with other researchers."* Two respondents (40%) also noted the research experience itself was the best part. Two students suggested "*more background information prior to arrival regarding specific projects"* to help improve next year's program. Other suggestions included better coordination and more social activities.