Developing Wool Course-Based Undergraduate Research Experiences in Apparel and Civil Engineering at a Hispanic-Serving Institution

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Introduction

Undergraduate research experiences provide a unique opportunity for students to apply critical thinking, problem solving, and collaboration skills for sustainability research. Course-Based Undergraduate Research Experiences (CUREs) are traditionally lab-based courses where students engage in research connected to a real-world problem. This involves using scientific practices, discovery, focusing on a relevant issue, collaboration, and iteration (Auchincloss et al., 2014). Many CUREs are in STEM; however, approaches are expanding across different majors (Monteblanco & Leyser-Whalen, 2022; Shuster et al., 2019).

Purpose

Based on changing U.S. demographics, many universities with a student population of at least 25% Hispanic are designated as Hispanic-Serving Institutions (HSIs) with the aim to create equity and success. A challenge is the lack of "servingness" to meet students' distinct needs based on multidimensional factors (Garcia et al., 2019). The purpose of this study is to develop undergraduate research experiences based on USDA priorities for Hispanic-Serving Institutions (HSIs) including curricula design, materials development, library resources, and experiential learning in an Apparel and Civil Engineering course. Students' research aimed to support USDA Strategic Goal 4 to facilitate rural prosperity and economic development in senior research courses. This study seeks to extend CUREs in sustainability research with a natural fiber—wool—to engage students in research with real-world applications. In the Apparel course, students conducted surveys with US sheep farmers, created map visuals of sheep farm locations, sourced wool, and conducted wool observations. In the Civil Engineering course, student research focused on wool scouring improvements with wastewater reclamation, including an evaluation of ground water contamination and cost efficiency of wastewater treatment (Li et al., 2023; 2020). The following are primary questions to evaluate students' research experiences: (1) After taking the Apparel or Civil Engineering research courses, are there differences among students' perceptions of their (a) research self-efficacy, (b) research identity, (c) research community values, (d) intention to pursue a related research career, and (e) library skills? (2) What aspects of the research courses are most helpful to students? (3) What external factors are impacting student learning? These questions were formed based on previous experiences teaching one of the courses online (Trejo et al., 2022) and existing challenges experienced by minoritized students (Garcia et al., 2019).

Methods

Senior Apparel and Civil Engineering courses were developed as a CURE to meet USDA and HSI priorities at a southwestern university in the United States. The Apparel and Civil Engineering courses were held in-person during the 15-week semester in Fall 2022 with two weekly class meetings. Students led the research with facilitation of faculty based on the designated course. Students worked in teams to develop a literature review, collect and analyze data, and present their findings. With IRB approval, a Qualtrics online pre- and post-survey was distributed to both courses during Fall 2022 for a between-subjects study design. The survey evaluated students' research self-efficacy, research identity, value for research community objectives, intention to persist (Shuster et al., 2019), and library skills (Freeman, 2004) with a Likert scale of 1 to 5 (strongly disagree to strongly agree). Students also indicated main resources that supported their learning and challenges. Statistical Package for the Social Sciences (SPSS) was used for data analysis.

Results

Apparel and Civil Engineering Students enrolled in the courses responded to the pre- (n=39) and post-surveys (n=41); however, only 34 surveys were used for data analysis based on matching participants to pre- and post-survey responses with a unique ID number. This included 7 Apparel students, and 27 Civil Engineering students. Regarding class standing, nearly all students (n=33) were seniors, and 1 was a junior. For race and ethnicity, many identified as Hispanic (n=15), Asian (n=9), White non-Hispanic (n=8), Black non-Hispanic (n= 1), and of two or more races (n=1). Exactly half of the respondents were male and half female (n=17). Their ages were primarily 20 to 23 or older. Less than half of the group identified as first in their family to attend college (n=12).

Survey Analysis. Descriptive analysis conveyed agreement among both groups regarding research self-efficacy and library skills gained; neutrality regarding research identity and value for a research community. Regarding intention to pursue a research career related to sustainability or agriculture, Apparel students expressed disagreement, compared to Civil Engineering students who were neutral. Cronbach's Alpha was consistently above 0.70.

A paired samples t-test of the pre- and post-survey data for the Apparel and Civil Engineering student responses was conducted, which aligns with a previous CURE assessment (Shuster et al., 2019). Results conveyed no significance before and after the research course, $t(33) = 1.059$, $p=0.297$ based on a $p<.05$. To test the null hypothesis that assumes that the error variance of the dependent variable is equal across both groups, the Levene's test was conducted and results conveyed no significant differences between the means $p=0.125$. Analysis of Variance (ANOVA) between subjects testing indicated no statistical significance between the pre and post tests for Apparel and Civil Engineering groups $p=0.911$. Independent samples t-tests were analyzed for each variable, and were not statistically significant.

Regarding resources that helped students learn about research, Apparel and Civil Engineering students shared strong similarities. They both used the online university library (n=31) and Google Scholar (n=21) resources before and after the course. Resources from previous courses that they anticipated would help them stay on track included meeting with peers

and assignments (n=25), as well as meeting with a professor (n=22) and readings (n=21). After completing the courses, students identified assignments to be the most helpful (n=30), meeting with peers (n=17), and readings (n=16). Below are representative quotes regarding what part of the courses were most helpful for students to meet their professional goals:

Apparel student	"Revisions and feedback given by the professor because it allowed me to push myself further with my work which will allow me in my career to do the same.
Civil Engineering student	"Researching was very helpful throughout the course because my past classes required little to no research so it was nice to learn."

These convey positive experiences; nonetheless, many students expressed challenges with distractions in their environment (n=22) and challenges remaining focused on academics (n=18).

Conclusions

Students successfully completed research projects in Apparel and Civil Engineering focused on wool and sustainability in the Course-Based Undergraduate Research Experiences. Results from pre- and post-surveys conveyed no statistically significant results. A limitation is that the survey instruments were adopted from perceptions of "scientific" skills to "research" skills, which are distinct. A longitudinal study can help verify results. Additional assessment tools, such as consistent rubrics, can be used to further assess student learning before and after the CURE (Merrell et al., 2022).

References

Auchincloss, L. C., Laursen, S. L., Branchaw, J. L., Eagan, K., Graham, M., Hanauer, D. I., Lawrie, G., McLinn, C. M., Pelaez, N., Rowland, S., Towns, M., Trautmann, N. M., Varma-Nelson, P., Weston, T. J., & Dolan, E. L. (2014). Assessment of Course-Based Undergraduate Research Experiences: A meeting report. *CBE—Life Sciences Education, 13*(1), 29–40. https://doi.org/10.1187/cbe.14-01-0004

Freeman, C. (2004). The Relationship of Undergraduate students' self-assessment of library skills to their opinion of library instruction: A self-reporting survey. *The Southeastern Librarian, 52*(3). https://digitalcommons.kennesaw.edu/seln/vol52/iss3/8

Garcia, G. A., Núñez, A.-M., & Sansone, V. A. (2019). Toward a multidimensional conceptual framework for understanding "servingness" in Hispanic-Serving Institutions: A synthesis of the research. *Review of Educational Research, 89*(5), 745–784. https://doi.org/10.3102/0034654319864591

Li, S., Galoustian, T., & Trejo, H.X. (2023). Biochar pyrolyzed with concentrated solar radiation for enhanced nitrate adsorption. *Journal of Analytical and Applied Pyrolysis*, 174. https://doi.org/10.1016/j.jaap.2023.106131

Li, S., Chan, C., Sharbatmaleki, M., Trejo, H., Delagah, S. (2020). Engineered biochar production and its potential benefits in a closed-loop water-reuse agriculture system. *Water, 12*(10), 2847. https://doi.org/10.3390/w12102847

Merrell, L. K., Henry, D. S., Baller, S. L., Burnett, A. J., Peachy, A. A., & Bao, Y. (2022). Developing an assessment of a Course-Based Undergraduate Research Experience (CURE). *Research and Practice in Assessment*, *17*(1), 16–28.

Monteblanco, A. D., & Leyser-Whalen, O. (2022). Course-based Undergraduate Research Experiences (CUREs) in general education courses. *Understanding Interventions*, *13*(1). https://www.understandinginterventionsjournal.org/article/36519-course-based-undergraduate-research-experiences-cures-in-general-education-courses

Shuster, M. I., Curtiss, J., Wright, T. F., Champion, C., Sharifi, M., & Bosland, J. (2019). Implementing and evaluating a Course-Based Undergraduate Research Experience (CURE) at a Hispanic-Serving Institution. *Interdisciplinary Journal of Problem-Based Learning*, *13*(2). https://doi.org/10.7771/1541-5015.1806

Trejo, H.X., Lopez, A., Vargas, J., & Li, S. (2022). Engaging students with a US sheep and wool Course-Based Undergraduate Research Experience at a Hispanic-Serving Institution. *International Textile and Apparel Association Annual Conference Proceedings*, *78*, 1. https://doi.org/10.31274/itaa.13790