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Perspectives on Undergraduate Research & Mentoring

Barriers to Participating in Undergraduate Research: Implications for Hispanic-Serving Institutions

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Introduction

Hispanic-Serving Institutions (HSIs) serve a vital role in educating the nation, with enrollment of over five million undergraduates or one-third of all students in nonprofit postsecondary education (Hispanic Association of Colleges and Universities, 2025). With 615 HSIs in the United States – colleges/universities with at least 25% Hispanic enrollment (HACU, 2025) – only 26 HSIs are research-intensive (Alliance of Hispanic Serving Research Universities, 2025), meaning students at HSIs study in environments not structured to (primarily) promote research inquiry. To support these students, the National Science Foundation (NSF) created the HSI Program (e.g., Equitable Transformation in STEM Education [ETSE], Improving Undergraduate STEM Education [IUSE]). However, in 2025, the federal government administratively terminated significant portions of this program, including our NSF HSI IUSE grant.

Through our five-year NSF HSI IUSE grant, we sought to build a culture of research among undergraduates and faculty at one of the nation's largest HSIs: California State University, Northridge (CSUN). As a designated teaching institution, we observed that many students lacked access to undergraduate research experiences, a key high-impact practice for student success (Kuh, 2008). Thus, our goal was to increase awareness of and access to research training for all 12,000 undergraduate STEM students at our institution. After two rounds of data collection, the grant's early termination in May 2025 halted our ability to track long-term progress towards achieving this goal. It also eliminated resources that support undergraduate student researchers, thereby impeding our final objective: to create a sustainable, flexible model of undergraduate research that other HSIs can adopt.

In this article, we review the literature on the importance of faculty-mentored undergraduate research, as well as the barriers to accessing undergraduate research experiences (such as faculty-mentored research). We then discuss how institutionalizing undergraduate research experiences through a centralized office can serve as a solution to such barriers, using our program – *ESTUDIO* – as an example. We then present empirical data on undergraduates' self-reported barriers to participating in undergraduate research at an HSI and discuss the implications of these barriers for student-faculty mentoring dynamics in the context of HSIs.

The Importance of Faculty-Mentored Research

Faculty-mentored research is recognized as a cornerstone of undergraduate STEM education, functioning as a high-impact practice that facilitates both academic success and professional integration (Kuh, 2008). Within the context of HSIs, the quality of the relationship between a student and their faculty mentor is often a primary determinant of the student's trajectory. Research indicates that quality mentorship, particularly when sustained over multiple semesters, significantly predicts a student's scientific self-efficacy, scientific identity development, and the internalization of scientific values for students at HSIs (e.g., Camacho et al., 2021), as well as in a study of students at 50 universities across the U.S. (Estrada et al., 2018). These elements are critical for minoritized students (Fernandez et al., 2026), as they foster a sense of belonging at the university (Fernandez et al., 2022) and social integration, both of which are strongly correlated with persistence in STEM during the undergraduate years and beyond (Estrada et al., 2018). The impact of mentorship on student self-efficacy is often mediated by the mentor's ability to provide constructive feedback, offer a clear overview of the research project's broader significance, and ensure the student feels included within the laboratory environment (Byars-Winston et al., 2015). When mentors actively demonstrate interest in a student's progress and appreciate their unique contributions, students report higher research self-efficacy and are more likely to pursue advanced degrees, such as Ph.D. or M.D. programs (Byars-Winston et al., 2015). Furthermore, the duration and intensity of the mentoring relationship are vital: long-term mentorship (lasting more than one year) is associated with higher rates of collaborative faculty-student publications and presentations (Giuliano et al., 2022; Thiry et al., 2013), providing students with high-level research experience and transferable skills that make them competitive for careers and graduate study in STEM.

Effective mentorship also serves as a protective factor against academic and situational barriers. For instance, competent faculty mentoring has been shown to reduce student motivation challenges, particularly during periods of high stress or institutional disruption (e.g., during the COVID-19 pandemic; Grineski et al., 2022). One example of this is the communication level between mentors and mentees, an important characteristic of successful mentoring relationships (Straus et al., 2013). Frequent communication between mentors and mentees helps students navigate the 'time crunch' often experienced when balancing research with rigorous coursework (Grineski et al., 2022). At HSIs specifically, practices such as regular interactions, clear expectation-setting, and allowing students the autonomy to explore their own interests have been identified as essential for fostering successful research outcomes (Estepp et al., 2017).

Beyond technical skill acquisition, the psychosocial dimension of the mentoring relationship is pivotal to student success, particularly for minoritized students (Kuchynka et al., 2025). Students who perceive themselves as similar to their mentors – whether through shared values, life experiences, or social identities – report higher levels of psychosocial support and greater satisfaction with the mentoring experience (Hernandez et al., 2017; Pederson et al., 2024). For minoritized students and women in STEM, the desire for "identity-matched" mentoring was reported to be a key factor in their sense of belonging (Kricorian et al., 2020). Ultimately, the role of the faculty mentor extends beyond the "lab", providing the navigational capital and professional networks necessary for students to transition from undergraduate learners to professional scientists (Adedokun et al., 2012)

Barriers to Engaging in Faculty-Mentored Research

The personal and professional benefits for students participating in undergraduate research are clear (e.g., Adebisi, 2022; Amelung & Helmke, 2025; Pierszalowski et al., 2021). However, not all undergraduates have access to this significant high-impact practice. At institutions of higher education that do not prioritize (or cannot financially support) research inquiry at scale, such as comprehensive teaching institutions, students may be less likely to participate in research than their

undergraduate peers at research-intensive institutions where faculty appointments are primarily driven by their research programs. However, research directly assessing why students cannot participate in undergraduate research is limited, particularly among minoritized students (Pierszalowski et al., 2021), such as first-generation, low-income, and ethnic-racial minority students. In their synthesis of this developing area of research, Pierszalowski and colleagues (2021) identified ten categories of barriers for minoritized students in STEM including: 1) lacking representative role models, 2) family and cultural barriers, 3) psychosocial barriers including exposure to stereotypes and lack of belonging and identity, 4) academic preparation, 5) financial barriers, 6) institutional barriers, including campus climate and faculty issues, 7) lacking capital, including information, 8) STEM fields historical barriers, including STEM cultural barriers, 9) student interest, and 10) racial barriers, including racism. Of particular note was the lack of support and resources for students in finding and navigating undergraduate research opportunities (Pierszalowski et al., 2021). For example, Mahatmya and colleagues (2017) reported that students across four universities reported lacking knowledge of and access to research opportunities on their campuses. Faculty have also noted that students' lack of awareness of research opportunities poses a challenge to creating a vibrant undergraduate research experience at their respective institutions (Orton et al., 2025). Thus, without intentional effort and sustained institutional support, students are hindered from engaging in undergraduate research on campus.

Institutionalizing Undergraduate Research – *ESTUDIO* as an Example

Given the barriers experienced by faculty at predominantly teaching institutions in conducting research (e.g., time, workload; Morales et al., 2017; Nurtegin et al., 2020) and those experienced by undergraduate students in accessing research opportunities (Mahatmya et al., 2017; Pierszalowski et al., 2021), institutions must intentionally make an effort to create both access to and opportunities for undergraduate research. One way to do so is through centralized efforts that build student capacity while minimizing faculty workload, which were the two overarching objectives of our grant. Funded by NSF HSI IUSE, *the Excellence in Student Training for Undergraduates, Diversity Initiative Office* (ESTUDIO) aimed to transform how CSUN and other HSIs bolster and scale research as a high-impact practice for STEM students and faculty mentors.

Centrally located in the university library, *ESTUDIO* served as a hub for undergraduate STEM researchers, providing knowledge, resources, and skills-building opportunities for students to engage in mentored research at CSUN. From students beginning their journey into research to more advanced researchers, *ESTUDIO* assisted over 900 undergraduate students during its two-year existence. Below, we highlight three main student-centered activities that *ESTUDIO* provided.

Workshops and Research Certificates

ESTUDIO adapted workshops developed under a previous training grant for STEM undergraduate students into research certificates whereby students could take individual workshops to increase their knowledge and skills in a specific area or topic (e.g., writing an abstract, reading research articles) or could complete a series of workshops within a research theme (e.g., research ethics, professional development) to earn a certificate of completion. Research demonstrates that faculty prefer students to have basic skills, including searching databases and reading and understanding research articles (Huddleston et al., 2019; Pitera & Bush, 2025), prior to beginning faculty-mentored research. Other skills faculty expect students to have include soft skills – such as time management, critical thinking, and communication (Pitera & Bush, 2025). These training modules provided students with essential research tools and knowledge to excel in faculty-mentored research, while simultaneously lowering faculty mentors' workload by giving students a head start in their research training.

Summer JumpStart (SJS)
To prepare students for mentored research, *ESTUDIO* held an intensive two-week, paid research-skills-building training for novice undergraduate students to strengthen their research skills in four areas: biological laboratory skills, qualitative methods, quantitative methods, and coding. These half-day summer trainings provided students with foundational skills (e.g., wet lab, computational), a community of like-minded peers, and a greater sense of belonging to the campus. The SJS programming is evidence-based, stemming from a larger externally funded SJS model (Escobedo et al., 2023). However, to be sustainable, the SJS program under *ESTUDIO* is divided into the aforementioned workshops (offered throughout the academic year) and the skills-building half-day trainings over two weeks, which together total the same number of training hours. During the two *ESTUDIO* summers, SJS received 310 applications and ultimately had 68 participants across the four areas. After participating in SJS, 70% of the 2024 SJS participants and 66% of the 2025 SJS participants went on to participate in faculty-mentored research during the academic year. This outcome further underscores the boost to students from receiving research-related training before joining a research group, streamlining their pathway into faculty-mentored research.

Faculty-Mentored Research
ESTUDIO facilitated students' ability to find research mentors through an annual "Getting Into Research" event. This half-day event drew approximately 200 students, where they listened to brief presentations from research-focused programs and participated in the Research Faculty Mixer, where they had the opportunity to interact with faculty seeking research assistants. In addition, during its NSF-funded period, *ESTUDIO* directly supported 10 students as faculty-mentored paid research assistants, expanding the number of paid research opportunities available to undergraduate students.

The Current Study
In addition to its student-centered initiatives, *ESTUDIO* aimed to cultivate a culture of undergraduate research at our institution. To support this goal, we assessed the state of undergraduate research by surveying STEM students at the outset of the project (May 2023). This information was intended to serve as a baseline for understanding the cultural change needed at our HSI and, by extension, at other HSIs. The repeated administration of our student surveys over subsequent years was intended to provide insight into how the developing research culture at our institution (due, in part, to our campus-wide interventions via *ESTUDIO*) may shift students' perceptions and experiences related to research.

In the current study, we review survey data from our finalized student survey (i.e., pilot data were excluded) related to barriers. Specifically, we: (1) provide an overview of undergraduates' self-reported barriers to participating in undergraduate research, and (2) discuss the implications of these barriers for student-faculty mentoring dynamics in the context of HSIs.

Methods
Sample
The sample for the current study comprises 2,190 undergraduate students from two consecutive years of an annual survey at our large, public HSI. Over half of the respondents identified as female (68.7% female, 30.6% male, 0.70% non-binary), and 62.2% reported receiving a federal Pell Grant, which served as an indicator of low-income status. Additionally, 72.6% of students identified as first-generation college students, meaning they were the first in their families to pursue a college degree. Participants' majors were housed within one of four STEM-degree-granting colleges: Engineering and Computer Science (n = 495; 22.6%), Math and Science (n = 323; 14.7%), Health and Human Development (n = 811; 37%), and Social and Behavioral Sciences (n = 561; 25.6%). In terms of racial-ethnic background, the study's demographics largely mirrored those of the STEM student body,

with the three largest groups being Hispanic/Latino (59.3%; *n* = 1,298), White (14.4%; *n* = 315), and Asian (13.8%; *n* = 302).

Procedure

All full-time (i.e., students enrolled in at least 12 units) STEM majors (~12,000) received an email invitation to participate in a Qualtrics survey. This survey instrument was developed by the *ESTUDIO* research team in consultation with the grant's external evaluator, guided by existing research on this topic (e.g., research on barriers by Pierszalowski et al., 2021; research on student perceptions by Rodríguez Amaya et al., 2018), as well as our combined experiences as research-active faculty at a teaching institution across STEM disciplines. Prior to finalizing the survey instrument for official data collection, a pilot survey instrument was developed, distributed, and analyzed with CSUN students, and student focus groups were also conducted. The survey in its final form took about 20 minutes and asked students about their involvement in undergraduate research opportunities both on and off campus, their perceptions of undergraduate research, and the barriers to participating in undergraduate research. Participation was voluntary, and the study was IRB-approved for human subjects research. The first 300 students who finished the survey received a $20 Amazon gift card as compensation.

Measures

Research

Prior to answering close-ended survey questions, participants were provided with the Council on Undergraduate Research's (CUR) definition of undergraduate research, which states that research is "a mentored investigation or creative inquiry, conducted by undergraduates, that seeks to make a scholarly or artistic contribution to knowledge." Thus, when answering survey questions about research, participants responded with this definition in mind.

Barriers

Participants were asked, "To what extent have each of these EVER posed a challenge or barrier to you conducting research during your time at CSUN?" followed by 14 items assessing their perceived barriers to participating in undergraduate research. These items were informed by the findings of Pierszalowski and colleagues (2021), by focus groups conducted with STEM students at our institution, and by our combined, diverse experience as STEM faculty who work directly with students. Example items include, "I had no idea I could conduct research as a student" and "I had other obligations (work, family, etc.)." For respondents, the response options ranged from severe barrier (1) to not a barrier (5). The response options were reverse-coded during data analysis, so that not a barrier reflects (1) and a severe barrier reflects (5). Table 1 contains the written statement of each of the 14 barriers.

Table 1. *Frequencies of each barrier, by degree of barrier, in ranked order from most intense barrier to not a barrier*

	Not a Barrier		Minimal Barrier		Moderate Barrier		Strong Barrier		Severe Barrier		***Moderate to Severe Barrier***	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	***n***	**%**
1. I had other obligations (work, family, etc.).	148	6.8	233	10.6	555	25.3	699	31.9	443	20.2	**1697**	**77.4**
2. I was not sure how to approach professors about conducting research.	244	11.1	284	13	623	28.4	533	24.3	388	17.7	**1544**	**70.4**
3. I did not think that I was qualified to conduct research.	515	23.5	349	15.9	555	25.3	380	17.4	268	12.2	**1203**	**54.9**
4. I did not think I would enjoy research.	430	19.6	483	22.1	676	30.9	331	15.1	154	7	**1161**	**53**
5. I did not feel like I belonged in STEM.	610	27.9	372	17	507	23.2	336	15.3	251	11.5	**1094**	**50**
6. I did not see research opportunities that matched my interests.	599	27.4	409	18.7	599	27.4	310	14.2	150	6.8	**1059**	**48.4**
7. I did not know how research would benefit me.	531	24.2	531	24.2	647	29.5	269	12.3	94	4.3	**1010**	**46.1**
8. I had no idea I could conduct research as a student.	631	28.8	499	22.8	556	25.4	281	12.8	110	5	**947**	**43.2**
9. I did not see any culturally-relevant research role models.	701	32	490	22.4	553	25.3	226	10.3	102	4.7	**881**	**40.2**
10. I did not know what research was.	741	33.8	514	23.5	623	28.4	147	6.7	56	2.6	**826**	**37.7**
11. I became disinterested in STEM.	894	40.8	436	19.9	457	20.9	164	7.5	123	5.6	**744**	**34**
12. I tried but I was not accepted.	1314	60	240	11	325	14.8	116	5.3	76	3.5	**517**	**23.6**
13. I felt that my family would not support me conducting research.	1290	58.9	323	14.7	293	13.4	108	4.9	56	2.6	**457**	**20.9**
14. I faced discrimination when trying to get involved in research.	1376	62.8	295	13.5	282	12.9	72	3.3	47	2.1	**401**	**18.3**

Results

The Most Reported Barriers

Of the 14 assessed barriers to participating in research, at least 50% of respondents reported that five were moderate to severe barriers (i.e., indicated a response of “3”, “4”, or “5”). The top barrier reported by students was having other obligations (e.g., work, family), with 1,679 (77.4%) respondents reporting it was a moderate to severe barrier. The second-highest barrier was students’ uncertainty about how to approach professors about conducting research (*n* = 1,544; 70.4%).

Students thinking they were not qualified to conduct research was the third-highest barrier (*n* =1,203; 54.9%). The fourth-highest barrier reported by students was thinking they would not enjoy research (*n* = 1,161; 53%), followed by feeling they do not belong in STEM (*n* = 1,091; 50%). Table 1 provides the breakdown of each barrier.

The Lowest Reported Barriers

Of the 14 assessed barriers to participating in research, over half of the participants reported that three of them were not barriers at all. Specifically, 62.8% of respondents (*n* = 1,376) stated that facing discrimination when trying to get involved in research was not a barrier at all. Additionally, attempting to do faculty-mentored research but not being accepted was not a barrier for 60% of students (*n* = 1,314), and feeling that their family would not support them in conducting research was not a barrier for 58.9% of students (*n* = 1,290).

Discussion

Faculty-mentored undergraduate research is a well-documented high-impact practice that fosters greater STEM persistence, self-efficacy, and belonging (e.g., Kuh, 2008; Estrada et al., 2018). However, not all undergraduates have access to this high-impact practice, particularly those attending teaching-intensive institutions. This study provides a baseline portrait of why, despite well-established benefits, faculty-mentored undergraduate research remains limited at a large, teaching-intensive HSI. The pattern in our data is less consistent with "low student demand" than with a mismatch between (a) student constraints and uncertainty, and (b) faculty capacity and institutional infrastructure.

Structural Constraints Create a Faculty Capacity Problem

The dominant barrier students reported was external obligations, such as work and family, which directly affect faculty mentoring. Students who must prioritize employment or caregiving often have less schedule flexibility, making research participation more episodic and difficult to sustain across semesters. That variability increases the coordination burden on mentors (e.g., onboarding, scheduling, and continuity planning), especially in labs and project settings where sustained engagement is needed for progress and ongoing training and professional development. Moreover, as an unintended side effect, students with tight schedules may be excluded from research tasks that are required to occur at a specific time of day. They may fall behind or even leave the research project mid-stream, leaving both the student and the mentor disappointed, and requiring the mentor to find a replacement.

At teaching-intensive institutions, this needed additional investment by the mentor collides with the reality that faculty time is already scarce, and mentoring is often under-recognized in formal workload and reward structures. National evidence consistently identifies time, workload, and weak incentives as core constraints on faculty willingness and ability to mentor undergraduate researchers, even among faculty who value mentoring outcomes (Morales et al., 2017). This matters for HSIs because most (~96%) are not research-intensive and therefore have fewer built-in mechanisms (e.g., staffing, lab infrastructure, course releases, graduate student support) to help faculty absorb the "hidden labor" of undergraduate research mentoring. Indeed, research demonstrates that such feelings of perceived institutional support correlate to faculty participation in undergraduate research mentoring (Davis et al., 2020), including at the California State University system (DeAngelo et al., 2015).

In other words, the barrier profile in our student data suggests a reality of faculty workload in which many students have limited discretionary time, necessitating a more structured and supportive mentoring model. Otherwise, faculty will be forced to mentor only students who already have the

time, confidence, and prior exposure to research, sustaining or widening the already known equity gaps in STEM.

Navigational Uncertainty Shifts the Burden onto Individual Mentors

The two highest psychosocial barriers (i.e., "not knowing how to approach professors" and "feeling unqualified") are student-level issues that also present faculty-level throughput constraints. When students lack "navigational capital" (Yosso, 2005), mentors must spend more time on recruitment, expectation-setting, and foundational training before any meaningful research begins. That front-end investment is precisely where mentoring becomes fragile in teaching-intensive environments. This aligns with mentoring research, which emphasizes that quality mentoring requires time-intensive, often uncompensated activities, including regular communication, explicit expectation-setting, and inclusive climate-building (Haeger & Fresquez, 2016). When institutions lack standardized entry pathways and shared training supports, mentors must repeatedly recreate these structures one student at a time. Over time, this creates a norm in which a small subset of faculty mentors a small subset of students, while most students remain on the outside looking in, not because of a lack of interest, but because the system cannot scale. Moreover, this paradigm likely favors students from more resourced backgrounds who may possess navigational capital from external sources, leaving minoritized students without access to the high-impact practice of faculty-mentored research.

The Promise of *ESTUDIO* in Broadening Participation

It is well-established that undergraduate research provides students with opportunities to engage in independent research, develop scientific thinking skills, and build relationships with faculty mentors. Specialized "boutique" undergraduate research programs (e.g., BUILD, REU, U-RISE) designed to provide small cohorts of students with intimate, hands-on, immersive research experiences have been linked to positive outcomes, including STEM persistence, strengthened science identities and belonging, and increased interest in graduate education (Camacho et al., 2021; Escobedo et al., 2023; Hernandez et al., 2018; Srinivasan et al., 2025). However, they are very competitive and costly to sustain.

The proposed *ESTUDIO* intervention model (centralized undergraduate research infrastructure, plus student readiness modules and mentor-development supports) was designed to directly target some of the faculty constraints implied by the reported barrier data. In faculty terms, the program's value proposition is not merely "more student participation," but lower marginal cost per additional student mentored, one of the only ways that undergraduate research participation can scale at a large HSI. Concretely, *ESTUDIO* was being designed to reduce repetitive onboarding by standardizing "lab-readiness" or "research-foundations" training, shifting the basic training (e.g., research norms, ethics, data practices, lab culture, communication expectations) from individualized mentoring to shared infrastructure (cf. Orton et al., 2025). *ESTUDIO* programming would also have improved the quality of mentor-mentee matches and reduced failed starts by offering clear entry routes that reduce friction, allowing faculty to mentor students who are prepared and appropriately placed. On the faculty side, *ESTUDIO* would have ostensibly increased mentoring consistency and quality by providing ongoing, evidence-based professional development and training. It would also have protected faculty from the "invisible overload" of mentoring by providing staff coordination, training infrastructure, and (ideally) student stipends, all conditions that would render faculty mentoring more feasible and less dependent on uncompensated labor.

Taken together, these mechanisms convert undergraduate research from a boutique activity sustained by a small number of high-commitment faculty into an institutionally supported practice. That shift matters for equity, as it expands access beyond the students who already have time, confidence, and insider knowledge. In addition, it matters for the US workforce, enabling a wider

breadth of students to persist in their STEM degrees through graduation – an effect we saw with *ESTUDIO*. During the brief duration of *ESTUDIO,* students who engaged with it had a retention rate of 93%, while those who did not engage with *ESTUDIO* had a retention rate of 85%. Although this statistic is purely descriptive, it suggests that the programming and opportunities provided by *ESTUDIO* – funded through the terminated NSF grant – were a promising mechanism for student success.

Without *ESTUDIO*, Faculty Challenges Persist (and Intensify)

The administrative termination of major NSF grants in 2025, including ours, which funded the establishment of *ESTUDIO*, created a structural sustainability risk for exactly the kind of capacity-building that HSIs require. For faculty, the likely consequences are not abstract, and they map onto predictable workload dynamics. Mentoring remains concentrated among a few faculty and primarily with students who can quickly "plug in," reinforcing inequitable access. Students in STEM with heavy work/family obligations or lower academic confidence (e.g., Ong et al., 2011; Totonchi et al., 2021) are less likely to persist long enough to become research-ready without structured supports. We would expect higher attrition in early-stage research apprenticeships because students enter research without preparatory scaffolding, increasing the likelihood of early disengagement. On the faculty side, this is experienced as churn or a frustrating series of repeated starts that do not translate into durable research progress, which further reduces willingness to take on novice students. Ultimately, this results in mentor burnout and reduced mentoring quality because time and reward misalignment suppresses faculty engagement (Morales et al., 2017). Without centralized training and coordination, the "hidden curriculum" work (orientation, norms, troubleshooting) returns to individual mentors, increasing the risk of burnout and limiting the number of students a faculty member can realistically support. These outcomes together result in a slow erosion of research culture-building, perhaps the most consequential cultural effect, where infrastructure recedes, mentoring becomes episodic and personality-dependent rather than a stable institutional practice. That makes it difficult to sustain consistent expectations for students and faculty, and difficult to evaluate whether interventions are shifting participation over time. Moreover, when combined, these effects continue to prevent many students at teaching-intensive institutions from accessing the high-impact practice of undergraduate research.

Implications for HSIs and Mentoring Systems

The central implication of our findings is that increasing undergraduate research participation at HSIs requires treating mentoring capacity as an institutional resource (and responsibility), rather than an individual virtue. Student barriers in our survey (time scarcity, uncertainty about approaching faculty, self-doubt) will continue to translate into predictable faculty burdens unless a centralized model absorbs the front-end work of readiness, coordination, and entry pathways. *ESTUDIO* is best described as a mentoring efficiency and equity intervention program that reduces the cost of mentoring novice researchers while improving the likelihood that early-stage student engagement becomes sustained participation.

In this sense, the termination of external support does more than pause a project: it threatens the conditions needed for faculty-mentored research to scale in teaching-intensive contexts such as our HSI. The data reported here remain valuable precisely because they identify where institutional investments most directly affect faculty workload realities, which ultimately influence STEM student success through access (or lack thereof) to the high-impact practice of faculty-mentored undergraduate research.

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References

Adebisi, Y. A. (2022). Undergraduate students' involvement in research: Values, benefits, barriers, and recommendations. *Annals of Medicine and Surgery, 81,* 104384. https://doi.org/10.1016/j.amsu.2022.104384

Adedokun, O. A., Zhang, D., Parker, L. C., Bessenbacher, A., Childress, A., & Burgess, W. D. (2012). Understanding how undergraduate research experiences influence student aspirations for research careers and graduate education. *Journal of College Science Teaching, 42*(1), 82–90. http://www.jstor.org/stable/43748410

Alliance of Hispanic Serving Research Universities. (2025, July 17). *Alliance of Hispanic Serving Research Universities welcomes five new members.* https://www.hsru.org/in-the-news/alliance-welcomes-five-new-members

Amelung, C., & Helmke, B. P. (2025). Lowering barriers to entry in undergraduate research through student-led virtual workshops. *Biomedical Engineering Education, 5*, 47-56. https://doi.org/10.1007/s43683-024-00157-3

Byars-Winston, A. M., Branchaw, J., Pfund, C., Leverett, P., & Newton, J. (2015). Culturally diverse undergraduate researchers' academic outcomes and perceptions of their research mentoring relationships. *International Journal of Science Education, 37*(15), 2533–2554. https://doi.org/10.1080/09500693.2015.1085133

Camacho, T. C., Vasquez-Salgado, Y., Chavira, G., Boyns, D., Appelrouth, S., Saetermoe, C., & Khachikian, C. (2021). Science identity among Latinx students in the biomedical sciences: The role of a critical race theory–informed undergraduate research experience. *CBE—Life Sciences Education*, *20*(2). https://doi.org/10.1187/cbe.19-06-0124

Davis, S. N., Jones, R. M., Mahatmya, D., & Garner, P. W. (2020). Encouraging or obstructing? Assessing factors that impact faculty engagement in undergraduate research mentoring. *Frontiers in Education, 5(*114), 1–8. https://doi.org/10.3389/feduc.2020.00114

DeAngelo, L., Mason, J., & Winters, D. (2016). Faculty engagement in mentoring undergraduate students: How institutional environments regulate and promote extra-role behavior. *Innovative Higher Education, 41*(4), 317-332. https://doi.org/10.1007/s10755-015-9350-7

Escobedo, P., Garcia, D., Cascelli, L., Chavira, G., Flores, G., E., Brown, J. L., Boyns, D., & Ainsworth, A. T. (2023, Dec.). Delivery of undergraduate research training program: comparing student outcomes before, during, and after the COVID-19 quarantine. *PLOS One, 18*(12): e0295901. https://doi.org/10.1371/journal.pone.0295901

Estepp, C. M., Velasco, J. G., Culbertson, A. L., & Conner, N. W. (2017). An investigation into mentoring practices of faculty who mentor undergraduate researchers at a Hispanic serving institution. *Journal of Hispanic Higher Education, 16*(4), 338–358. https://doi.org/10.1177/1538192716661906

Estrada, M., Hernandez, P. R., & Schultz, P. W. (2018). A longitudinal study of how quality mentorship and research experience integrate underrepresented minorities into STEM careers. *CBE—Life Sciences Education, 17*(1), ar9. https://doi.org/10.1187/cbe.17-04-0066

Fernandez, F., Mason, S., Chavira, G., Khachikian, C., Kwan, P., & Saetermoe, C. L. (2026). Undergraduate research experience, graduate school choice, and expected and unanticipated transitions to and through graduate school. AREA Open, 12(1), 1-17. https://doi.org/10.1177/23328584251406644

Fernandez, F., Mason, S., Saetermoe, C. L., & Chavira, G. (2022). Evaluating mentorship programs: Survey items for improving student affairs practice. *Journal of College Student Development, 63*(2), 223–228. https://dx.doi.org/10.1353/csd.2022.0017

Grineski, S. E., Morales, D. X., Collins, T. W., Nadybal, S., & Trego, S. (2022). A US national study of barriers to science training experienced by undergraduate students during COVID-19. *International Journal of Environmental Research and Public Health, 19*(11), 6534. https://doi.org/10.3390/ijerph19116534

Giuliano, T. A., Kimbell, I. E., Olson, E. S., & Howell, J. L. (2022). High impact: Examining predictors of faculty-undergraduate coauthored publication and presentation in psychology. *PLOS ONE*, *17*(3), e0265074. https://doi.org/10.1371/journal.pone.0265074

Haeger, H., & Fresquez, C. (2016). Mentoring for inclusion: The impact of mentoring on undergraduate researchers in the sciences. *CBE—Life Sciences Education, 15*(3), ar36. https://doi.org/10.1187/cbe.16-01-0016

Hernandez, P. R., Estrada, M., Woodcock, A., & Schultz, P. W. (2017). Protégé perceptions of high mentorship quality depend on shared values more than on demographic match. *The Journal of Experimental Education, 85*(3), 450–468. https://doi.org/10.1080/00220973.2016.1246405

Hernandez, P. R., Woodcock, A., Estrada, M., & Schultz, P. W. (2018). Undergraduate research experiences broaden diversity in the scientific workforce. *BioScience, 68*(3), 204-211. https://doi.org/10.1093/biosci/bix163

Hispanic Association of Colleges and Universities. (2025, April 25). *Hispanic-Serving Institutions across the nation total 615.* https://hacu.net/hispanic-serving-institutions-across-the-nation-total-615/

Huddleston, B. S., Bond, J. D., Chenoweth, L. L. & Hull, T. L. (2019). Faculty perspectives on undergraduate research skills: Nine core skills for research success. *RUSQ: A Journal of Reference and User Experience, 59*(2), 118-130. https://doi.org/10.5860/rusq.59.2.7277

Kricorian, K., Seu, M., Lopez, D., Ureta, E., & Equils, O. (2020). Factors influencing participation of underrepresented students in STEM fields: matched mentors and mindsets. *International Journal of STEM Education*, *7*(1), 1-9. https://doi.org/10.1186/s40594-020-00219-2

Kuh, G. D. (2008). *High-impact educational practices: What they are, who has access to them, and why they matter.* Association of American Colleges and Universities.

Kuchynka, S. L., Gates, A. E., & Rivera, L. M. (2025). When and why is faculty mentorship effective for underrepresented students in STEM? A multicampus quasi-experiment. *Cultural Diversity & Ethnic Minority Psychology, 31*(1), 69–75. https://doi.org/10.1037/cdp0000596

Mahatmya, D., Morrison, J., Jones, R. M., Garner, P. W., Davis, S. N., Manske, J., Berner, N., Johnson, A., & Ditty. J. (2017). Pathways to undergraduate research experiences: A multi-institutional study. *Innovative Higher Education, 42*(5), 491–504. https://doi.org/10.1007/s10755-017-9401-3

Morales, D.X., Grineski, S.E. & Collins, T.W. (2107) Faculty motivation to mentor students through undergraduate research programs: A study of enabling and constraining factors. *Research in Higher Education, 58,* 520–544. https://doi.org/10.1007/s11162-016-9435-x

Nur-tegin, K., Venugopalan, S., & Young, J. (2020). Teaching load and other determinants of research output among university faculty. *The American Economist*, *65*(2), 300-311. https://doi.org/10.1177/0569434520930702

Orton, G., Barnes, M. A., Syed, S. B., Reid, J. W., & Smith, A. C. (2025). Challenges for activating undergraduate research: a summary from the 2021 American Society for Microbiology Conference for Undergraduate Educators. *Journal of Microbiology & Biology Education*, *26*(1), e00099-24. https://doi.org/10.1128/jmbe.00099-24

Pedersen, R., Woodcock, A., Schultz, P. W., & Hernandez, P. R. (2024). When perceived similarity overrides demographic similarity: examining influences on STEM students' developmental mentor networks. *International Journal of STEM Education*, *11*(1), 1-21. https://doi.org/10.1186/s40594-024-00480-9

Pierszalowski, S., Bouwma-Gearhart, J., & Marlow, L. (2021). A systematic review of barriers to accessing undergraduate research for STEM students: problematizing under-researched factors for students of color. *Social Sciences*, *10*(9), 328. https://doi.org/10.3390/socsci10090328

Pitera, J., & Bush, L. (2025). Faculty expectations and student skills: The research instruction gap. *The Journal of Academic Librarianship, 51*(6). https://doi.org/10.1016/j.acalib.2025.103157.

Rodríguez Amaya, L., Betancourt, T., Collins, K. H., Hinojosa, O., & Corona, C. (2018). Undergraduate research experiences: Mentoring, awareness, and perceptions—A case study at a Hispanic-serving institution. *International Journal of STEM Education*, *5*(1), 9. https://doi.org/10.1186/s40594-018-0105-8

Srinivasan, J., Cobian, K. P., Ramos, H. V., Christie, C. A., Crespi, C. M., & Seeman, T. (2025). Examining undergraduates' intentions to pursue a science career: A longitudinal study of a national biomedical training initiative. *Education Sciences*, *15*(7). https://doi.org/10.3390/educsci15070825

Straus, S. E., Johnson, M. O., Marquez, C., & Feldman, M. D. (2013). Characteristics of successful and failed mentoring relationships: a qualitative study across two academic health centers. *Academic Medicine*, *88*(1), 82-89. https://doi.org/10.1097/ACM.0b013e31827647a0

Thiry, H., Weston, T. J., Laursen, S. L., & Hunter, A. B. (2012). The benefits of multi-year research experiences: Differences in novice and experienced students' reported gains from undergraduate research. *CBE—Life Sciences Education*, *11*(3), 260-272. https://doi.org/10.1187/cbe.11-11-0098

Totonchi, D. A., Perez, T., Lee, Y. K., Robinson, K. A., & Linnenbrink-Garcia, L. (2021). The role of stereotype threat in ethnically minoritized students' science motivation: A four-year longitudinal study of achievement and persistence in STEM. *Contemporary Educational Psychology*, *67*, 102015. https://doi.org/10.1016/j.cedpsych.2021.102015

Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race Ethnicity and Education*, *8*(1), 69-91. https://doi.org/10.1080/1361332052000341006