The Chronicle of Mentoring & Coaching,
2024, Vol. 8, No. 1
doi: 10.62935/oz5265

The Chronicle of Mentoring & Coaching

Retention and Graduation of STEM Students at a Majority Hispanic Serving Institution: Effect of Participation in a Freshman Course-based Undergraduate Research Experiences Sequence

Lourdes E. Echegoyen, Rafael Aguilera, Tolulope Adeyina, Clarissa Reyes, Guadalupe Corral, & Amy E. Wagler

The University of Texas at El Paso

Research training is an important intervention for preparing undergraduate students to pursue further studies and develop research skills. Furthermore, there is mounting evidence indicating that mentored research impacts student success metrics. At the University of Texas at El Paso, a Freshman Year Research Intensive Sequence (FYRIS) was developed to prepare first-year students for research experiences. The FYRIS courses combine research foundations and research-intensive courses. In this manuscript, we present findings demonstrating the impact of FYRIS and subsequent mentored research experiences on 4-year retention and graduation. Results suggest that participation in FYRIS and independent mentored research has a large positive impact on 4-year retention and graduation, while other historical socioeconomic variables have minimal to no impact.

Keywords: research training, intervention, research skills, freshman year, higher education, retention, STEM students

Acknowledgement: The FYRIS program has been supported by awards from the National Institute of General Medical Sciences of the National Institutes of Health under Award Number UL1GM118970 and by the Howard Hughes Medical Institute Award Number 52008125. The authors wish to thank Dr. Stephen B. Aley for his leadership in co-directing the FYRIS program. We also wish to thank the Center for Institutional Evaluation Research and Planning for providing the students' demographic and academic data.

Introduction

This section briefly introduces undergraduate research training at HSIs. Inclusion of minoritized populations in rigorous and impactful research experiences as undergraduate students is a common and worthy goal for higher education institutions. In a Hispanic-serving institution (HSI), the inclusion of students in mentored research is even more important and impactful. While many attempt to include undergraduates in research experiences and promote the practice at an institutional level, many faculty perceive that undergraduates are not trained well enough in research skills and do not possess adequate backgrounds to engage in a research program (Monarrez, Wagler, et al., 2020). At the University of Texas at El Paso (UTEP) and in coordination with the Campus Office of Undergraduate Research Initiatives (COURI), we developed a Freshman Year Research Intensive Sequence (FYRIS) to prepare first-year students with no prior research experiences to engage in rigorous and transformative research experiences during their undergraduate years. This manuscript describes the program and its major impacts on Hispanic majority student cohorts at UTEP. Analysis and results focus on how the FYRIS program increased common academic outcomes, 4-year retention and graduation rate, and how inclusion in FYRIS cultivated more engagement in undergraduate research after the program. The FYRIS program is focused on training students to engage in research in STEM, with most course sequences focused on the biomedical sciences. Moreover, this program, which was modeled after The University of Texas at Austin's Freshman Year Initiatives program, can be easily adopted by other institutions, as it is highly adaptable, and can be employed to prepare students for research in most fields and institutional settings.

Rationale and Similar Approaches

The benefits of traditional mentored undergraduate research experiences have long been documented by a wealth of literature (Barron et al., 2020; Collins et al., 2017; Hernandez et al., 2018; Linn et al., 2015; Lopatto, 2010; Russell et al., 2007). There is evidence that undergraduate research experiences improve student participants' increased interest and subsequent retention in STEM-related careers, lead to higher retention and graduation rates, increased sense of belonging in STEM, as well as skills augmented by conducting research such as critical thinking, writing, and communication. Here, we regard engaging in traditional mentored research, compared to other forms of undergraduate research experiences (UREs), as working closely with a faculty member or researcher on an independent project. This type of mentored research is highly personalized and intensive, thus allowing students to delve deeply into a specific area of investigation. In traditional

mentored research contexts, mentors provide guidance, support, and expertise, helping students develop critical research skills and fostering a sense of ownership over the research process (Pfund et al., 2016).

Traditional mentored research experiences in bench sciences are often intensive, time consuming, require mentors to provide bench space for the undergraduate students and, consequently, limited to few students throughout the year. Course-based Undergraduate Research Experiences (CUREs), on the other hand, were developed by researchers to broaden participation and provide the benefits of UREs to more students (Smith et al., 2023). Recent reviews highlight these approaches in a variety of institutional settings and disciplines (Buchanan & Fisher, 2022; Krim et al., 2019; Watts & Rodriguez, 2023). Although the advent of CUREs in filling the void for limited mentored UREs is promising, studies also indicate that barriers, such as access and representation, still exist, particularly for students from ethnic/racial minorities (Krim et al., 2019; Pierszalowski et al., 2021).

In addition to a lack of racial and ethnic minority participation in CUREs, researchers have also noted the tendency for CUREs to be offered in upper-division courses (Buchanan & Fisher, 2022; Watts & Rodriguez, 2023). These researchers tracked the development of CUREs through the years 2000 and 2020 and noted that, up until the 2010s, CUREs offered were almost exclusively intended for advanced students. Although the number of CUREs being offered to lower-division, introductory courses have been steadily increasing as of late, advanced, upper-division courses have also increased at a similar rate and continue to occupy most of the CUREs offered by institutions.

The FYRIS program was developed at the University of Texas at El Paso (UTEP) to address these gaps while capturing students' interest early on to improve retention. FYRIS consists of a three-course sequence designed to provide incoming freshmen with immersive CUREs and more generally, develop research skill sets such as critical thinking, problem-solving, and communication (Bauer & Bennett, 2003; Monarrez, Morales, et al., 2020; Thiry et al., 2011; Zydney et al., 2002). FYRIS at UTEP is also uniquely positioned to be more inclusive of ethnic minorities, Hispanics in particular, and specifically target students upon entry into their undergraduate careers. The present study will add to a growing body of literature that indicates that students from minoritized populations experience greater benefits from undergraduate research experiences (Collins et al., 2017; Eagan et al., 2013; Espinosa, 2011; Hernandez et al., 2018, 2018; Loeser et al., 2021; Simmons, 2018; Whittinghill et al., 2019), and similarly, that engaging students at earlier stages of their undergraduate careers, compared to later, is more beneficial (Stanford et al., 2017; Wozniak, 2011). In the following, we provide a summary of these approaches and how we conceptualized how they could be combined to address the gap in inclusion for minoritized populations.

Impacts of Mentored Research

Undergraduate research experiences (UREs) generally exist in two modalities: the traditional type, known as independent or mentored UREs, and CUREs. The former has been the most widely adopted model for the past 40 years. Students participate as part of formal programs, usually receiving a stipend, or may work independently with faculty mentors either for credit, a stipend, or both, but not as part of a formal program. This traditional modality has been extensively investigated in part due to the myriad of benefits that both students and mentors experience from engaging in the practice (Battaglia et al., 2022). Mentored research entails matching an undergraduate student with a mentor, typically a faculty member or a post-doctoral researcher, based on several factors, including common research interests and, at times, simply the availability of the mentor and space. Though students sometimes can develop their own research questions during their mentored research experience, they most typically engage in projects that advance their mentor's research. In addition, mentored research experiences vary in length and time, with the majority of students engaging for one semester or the entire academic year. Another type of URE that has also received a great deal of attention is the summer research experience (Pariyothorn & Autenrieth, 2012). Though not a central focus of this paper, it is important to note the various modalities of mentored research a student can engage in. A critical and distinct characteristic of mentored research is that they are intensive in time and effort and involves specialized independent projects unbound by course curricula. Students work directly with a mentor or mentor's research team, initially developing the skills necessary to conduct research and gradually becoming more independent.

These highly specialized and intensive undergraduate research experiences result in a multitude of benefits. For example, students engaged in mentored research report gains in both general and disciplinary research methods and skills, including a deeper understanding of the topic and corresponding research literature, the ability to develop new research questions, use relevant research equipment, collect and analyze data, and effectively communicate science (Graham et al., 2012; Russel et al., 2007). In addition, studies show that participation in research results in the development of skills that go beyond research skills (Gillies & Marsh, 2013; Graham et al., 2012; Healey & Jenkins, 2009; Hensel, 2012; Linn et al., 2015; Lopatto, 2010; Russell et al., 2007), including increases in socio-psychological constructs such as the development of a science identity, increased research self-efficacy, and an increased sense of belonging to the community of science (Olivares-Donoso & González, 2019). Academically,

students benefit from greater retention in their major and greater rates of graduating with a bachelor's degree. In a particular HSI, the impact of research experiences outsized any other factor included in the models and was deemed the most important factor for increasing graduation rates (Caraballo-Cueto et al., 2023). Furthermore, mentored undergraduate research experiences help clarify students' interest in STEM research, increase students' interest in pursuing a PhD, and, ultimately, increase students' interest in obtaining careers in STEM-related research.

Given the multiple benefits of mentored UREs, faculty mentors developed CUREs in an attempt to provide the same benefits to a broadened group of students (Smith et al., 2023). Below, we provide a brief review of CUREs, their benefits and pitfalls, and how we have adopted the CURE model at UTEP to develop our intensive first-year undergraduate research course sequence.

CUREs: Benefits and Shortcomings

CUREs are courses specifically structured to integrate research experiences into the curriculum. Unlike traditional lecture or lab-based courses, CUREs emphasize active participation in the scientific process (Auchincloss et al., 2014; Bangera & Brownell, 2014). In a CURE course, students work on real research problems, conduct experiments, analyze data, and often contribute to ongoing research projects. CUREs are designed to make research more accessible, especially for students who may not have any prior research experience. Here, we distinguish between two particular types of CUREs: Research Foundations Courses (RFCs) and Research Driven Courses (RDCs).

RFCs are academic courses designed to provide students with the fundamental skills and knowledge necessary for research (Branchaw et al., 2010; Chen, 2018). Typically, these courses cover general essential aspects of the research process followed by multiple disciplines, including methodologies, literature review, developing research questions and hypotheses, data analysis, etc. They serve as a theoretical and conceptual groundwork, preparing students for more hands-on research experiences.

While RFCs provide the theoretical basis necessary for understanding the research process, enabling students to approach CUREs and mentored research with a solid background, RDCs bridge the gap between classroom learning and actual research by immersing students in practical, hands-on (though limited) research experiences. Taken together, when implemented for lower-division students, these courses provide an entry point into more independent research endeavors. Engaging in mentored research is a natural progression from lower-division CUREs. Students in these courses develop skills and gain the confidence to venture into more independent projects under the guidance of an experienced mentor. Collectively, these components create a scaffolded approach to undergraduate research engagement, gradually building students' research competencies and fostering a deeper understanding and appreciation for the scientific process.

Similar to mentored research experiences, student participation in CUREs is associated with a multitude of benefits as outlined here (Harris et al., 2015; Smith et al., 2023; Taraban & Blanton, 2008). Though it is important to note that researchers distinguish between mentored research and CUREs (Auchincloss et al., 2014), more recent work by Olivares-Donoso and González (Olivares-Donoso & González, 2019) synthesizing research on students' experiences with both mentored research and CUREs, found, as can be expected, that there is much overlap. Namely, students who participate in CUREs are retained and graduate at higher rates compared to students who do not. Students also express gains in the development of science identity, research skills, self-efficacy in applying those research skills, and a general sense of belonging to the broader scientific community. Despite ample evidence for the benefits of CUREs, researchers acknowledge that CUREs are necessarily ever changing and evolving to ensure students receive the best possible research experience. Among the existing issues with CUREs, studies have shown two specific ones: a lack of participation of students from minoritized groups and a lack of early-stage (lower-division) CUREs.

Although a wealth of literature has documented the need to increase minority participation in research (Hurtado et al., 2009; Hurtado et al., 2008; Hurtado et al., 2011; Lopatto, 2010), more recent research indicates that barriers to minority participation in research still exist (Pierszalowski et al., 2021). Given the ever-growing need for a diverse workforce in science and technology (Byrd, 2018, 2024; Hudson Jr, 2014), more programs that promote minority participation in science and research must be developed to increase minority representation in the workforce. Indeed, work by Hernandez and colleagues (Hernandez et al., 2018) demonstrated that increasing minority participation in research at the undergraduate level is associated with a more diverse scientific workforce. Nevertheless, researchers argue that there still exists a lack of research investigating the impacts of undergraduate research experiences on students from underrepresented racial and ethnic backgrounds (Krim et al., 2019; Lopatto, 2010).

In addition to issues of inclusion of racial and ethnic minorities in CUREs, there is also an issue of inclusion of incoming and early-stage undergraduate students. Buchanan and Fisher, as well as Watts & Rodriguez (Buchanan & Fisher, 2022; Watts & Rodriguez, 2023), conducted a systematic review of CUREs from 2000 to 2020 and found that, up until 2013, CUREs were almost exclusively targeted toward advanced students. However, since 2013, offerings of introductory CUREs have increased, which has resulted in increased research on the impact of introductory CUREs. A wealth of growing evidence from various

Table 1
Research Topics in FYRIS Research Driven Courses

Biology I & II Laboratories	Evolutionary Genetics*
	Brain Mapping and Connectomics*
	Drug Development and Bioassay
	Exercise and Metabolism
	Antagonizing G-protein Coupled Receptors
	Developing Immunotherapies Against Bacterial Infections
	Environmental Sequencing & DNA*
Chemistry I & II Laboratories	Supramolecular Materials*
	Circadian Rhythm Genes and Proteins
	Impact of Carbon Quantum Dots on Nonamyloid Targets
Geology I & II Laboratories	Shallow Subsurface Geophysics Applied to Environmental and Engineering Problems

*HHMI funded. All others are funded by NIGMS. See acknowledgments for award numbers.

STEM-related disciplines, including biology, chemistry, and physics, suggests that targeting undergraduate students earlier is beneficial in promoting the development of basic short-term, intermediate skills and, more importantly, the pursuit of future mentored research experiences (Bowman & Holmes, 2018; Canaria et al., 2012; Chen, 2018; Lo & Le, 2021; Olimpo et al., 2016; Oliver et al., 2023). Below, we introduce a program that aims to curtail the lack of minority participation in CUREs, as well as the lack of more early-stage, introductory CUREs.

Institutional Context

El Paso, Texas, and Ciudad Juarez, Mexico are sister cities situated along the western Texas, U.S.-Mexico border. With nearly ¾'s of households being Spanish and English bilinguals, this region forms one of the largest bicultural and bilingual metropolitan areas in North America. The city of El Paso itself boasts an 83% Hispanic population (U.S. Census Bureau, 2022). However, this rich landscape is also impacted by poverty, with 21% of local families living below the poverty line, compared to 14% in Texas and 11.5% nationally. In this vein, the median household income in El Paso County is at $55,417, which is significantly lower than both the Texas, $73,035, and U.S., $75,149, median household incomes. Furthermore, only 25% of El Paso County citizens hold a bachelor's degree or higher, compared to 32.3% in Texas and 34.3% nationally.

Like El Paso County, UTEP's population is roughly 84% Hispanic, making it the first national research-intensive university serving a 21st-century underrepresented demographic. Moreover, nearly half of the more than 23,000 students enrolled at UTEP are first-generation college students (Texas Monthly, 2023; UTEP, n.d.). Together, these characteristics highlight the needs of this community for effective educational interventions. It is also important to note that successful interventions in this community bode well for the broader academic community, as these interventions necessarily serve students from both minoritized (e.g., racial/ethnic minorities) and marginalized (e.g., low socioeconomic status) populations. In other words, we can be confident that interventions that work in this environment can work in other settings.

Freshman Year Research Intensive Sequence (FYRIS)

This sequence encompasses a research foundations course (RFC) and two semesters of research-driven courses (RDCs), with the latter tailored to specific research tracks. These courses empower freshmen to engage in genuine research endeavors aligned with their majors and interests, generating valuable data that contributes to their professors' ongoing research projects.

Structured to align with the learning objectives of conventional lab courses, FYRIS RDCs allow students to fulfill requirements within their degree plans. Simultaneously, RDCs immerse them in scientific discovery, potentially leading to publications. The traditional lab courses have been adapted to incorporate research experiences, offering a unique blend of academic and investigative pursuits.

Through a carefully designed curriculum, FYRIS provides students with the chance to cultivate their research self-efficacy and acquire the skills necessary for future faculty-mentored research engagements. With diverse research themes available in biological sciences, chemistry/biochemistry, and geology (Table 1), FYRIS caters to various interests and is accessible to any student on

campus. Participation has no prerequisites except qualifying for the corresponding mathematics course required by traditional laboratory courses. During first-year student orientation, students are introduced to FYRIS and can elect to enroll in these courses.

FYRIS is not restricted to majors or scholarship students; its inclusive design aims to democratize research opportunities for all biomedical majors. The program actively involves students at the earliest stages of their academic journey, fostering sustained engagement and success. Consequently, all UTEP first-year students keen on research-based courses in biology, chemistry, or geology are welcome to participate in FYRIS.

Finally, it is important to note that the FYRIS program has been supported by awards from the National Institute of General Medical Sciences of the National Institutes of Health and by the Howard Hughes Medical Institute. Each award (see acknowledgments section for award numbers) funded specific RDC tracks, as shown in Table 1.

In summary, RFCs, RDCs (CUREs), and mentored research are interconnected stages that contribute to the development of undergraduate students as researchers, providing them with a well-rounded and progressively challenging research experience. We note, too, that the use of RFCs and RDCs (CUREs) to prepare students for rigorous undergraduate research mentoring is an intervention important for minority-majority institutions, such as UTEP. In particular, many minoritized student populations may have less access to and inclusion in research preparation prior to college enrollment. Thus, approaches such as the FYRIS program are important for reaching, including, and training student populations historically underrepresented in academic research environments. For our present research, we aim to investigate two specific research questions:

Q1: How does participation in FYRIS courses and independent mentored research contribute to students' 4-year retention rates?

Q2: How does participation in FYRIS courses and independent mentored research contribute to students' 4-year graduation rates?

Methodology

Participants

Institutional data, collected from 2015 to 2018 was utilized for this study. To evaluate the impact of FYRIS on student retention and graduation, we included students enrolled in the courses listed in Table 1, who were majoring in STEM disciplines, started at UTEP as first-time freshmen (FTF), were under 21 years of age, and enrolled in the FYRIS program courses within three semesters of entering college. We restricted our analyses of FYRIS participants to the first three semesters upon entry to account for students who may take an RFC first semester and subsequently enroll in the two-semester RDC sequence the following year. As a comparison group, we selected students with the same characteristics as those in the FYRIS courses (FTF under 21 years of age and majoring in areas offered by the College of Science) who were enrolled in the corresponding (traditional) sections of Biology I and II, Chemistry I and II and Geology I and II laboratories with no research focus.

Measures

The data on FYRIS inclusion was merged with institutional student data that provided information about FYRIS course enrollment (Yes/No) based on course reference numbers, gender, transfer credit hours, inclusion in mentored research hours (as documented by registrar), retention over the four years, and four-year graduation rates. Ethnicity was not included as a predictor variable since over 90% of students in the cohorts were Hispanic, and, consequently, ethnicity would not have been a useful explanatory variable.

First, we categorized the levels of participation in FYRIS by no FYRIS, partial FYRIS, and full FYRIS. Full FYRIS is classified as having taken the RFC course within a students' first year, as well as a sequence of RDC courses (e.g., BIOL 1107, BIOL 1108) within 3 semesters upon entering UTEP. Partial FYRIS participation was defined as completing only one or two sections of the 3-course FYRIS sequence. For example, students could take an RDC but no RFCs or take only an RFC but no RDCs. This also includes students who took only one of the two RDCs in the track, that is, the first or second semester of a two-term laboratory course in introductory biology, chemistry, geology, etc.

Because we included solely students who started as first-time-freshman, we analyzed the data for transfer hours from community colleges and high school rank (percentile). High school rank, or percentile, is taken from institutional data and defines a student's percentile among all other high school students from the same high school. These rankings are unique, as each high school will provide rankings for its own student body. Given that approximately 99% of UTEP students are from the El Paso region, together, these provide some sociodemographic information about the student, so that we can assess to some degree the leveling impact of research training on undergraduate students from a broad range of backgrounds and levels of preparation for university-level instruction. Both high school percentile and transfer hours were standardized using the median and IQR for centering and rescaling the variables.

Finally, for our dependent variables, graduation was coded Yes/No for whether they had graduated by a given semester or not. For retention, we tracked the four cohorts for four years to assess college retention and graduation trends. Upon

first-time entry, we tracked students' college enrollment every year during the fall semester. Successful retention required students to enroll in at least 1-credit- hour each fall semester. That is, a student was considered retained for a year if they enrolled in at least 1-credit-hour during a fall semester and enrolled in at least another 1-credit hour the following fall semester. Retention was coded as 1 = retained, and 0 = not retained.

Preliminary Analyses

After data cleaning and validation, a missing values analysis was conducted and found instances of missingness among gender and high school percentile. The data was missing at random and easily imputed with a multiple-chained equation (van Buuren & Groothuis-Oudshoorn, 2011). Exploratory analysis of the data was performed to assess and report basic student characteristics and program engagement. The exploratory analysis confirmed that a total of 2121 students were eligible for the analysis and summaries are reported in the results section.

Following exploratory data analysis, the data was modeled using a two-step approach. First, propensity score models were estimated using all demographic explanatory variables in the model (high school rank, transfer student credits, gender, year) to predict inclusion in full FYRIS courses. This models the student characteristics that predict self-selection to the FYRIS intervention and, in effect, reduces bias due to self-selection. In particular, the logistic regression model is reweighted using the inverse of the propensity score probabilities estimated for each research participant to reduce the impact of the self-selection on model results. Combining this methodology with the selection of the control group with very similar characteristics provides estimates for FYRIS intervention effects that are reflective of the context but also bias-reduced, thus providing an alternative logistic regression model that considers that students self-selected for the FYRIS courses. This approach also adjusts the estimates for any variation in FYRIS impact by year.

Second, logistic regression models were estimated to predict 4-year graduation and retention as outcome variables. Additionally, to provide estimates that reduce student-based self-selection bias, the models were re-estimated using inverse probability weights (IPW) retained from propensity scores models of full FYRIS inclusion. These models provide evidence about the efficacy of the FYRIS intervention and mentored research courses on retention and graduation with and without self-selection bias reduction. Using this IPW weighted logistic regression model will provide a less biased estimate of the average treatment effect for the FYRIS program effect while still accounting for the other factors associated with retention and graduation. Following the propensity score weighting of the logistic regression models, forest plots summarize the final model results. The advantage of this two-step approach to analysis is that we can compare, side-by-side, the impact of FYRIS on graduate rates and 4-year retention rates using methods of analysis that do not control (unweighted logistic regression using maximum likelihood estimation) and do control (inverse probability weighted logistic regression) for self-selection bias of participants. All analysis was conducted in the R statistical package (R Core Team, 2023) using *the ipw* package (van der Wal & Geskus, 2011).

Results

In the following, we present results summarizing the impact FYRIS had on graduation rates and 4-year retention rates. First, descriptive statistics are presented, and then model-based results are shown in full. Following the presentation of results, a detailed interpretation in context is provided. Table 2 presents data on student demographic characteristics across levels of FYRIS participation for the years 2015 to 2018 for all 2121 students included in the data. Table 2, below, provides information about the level of participation in the FYRIS courses over the years spanning 2015-

Table 2
Number of FYRIS Participants and Demographics

Cohorts		2015 Cohort				2016 Cohort				2017 Cohort				2018 Cohort			
Demographics		All	FYRIS			All	FYRIS			All	FYRIS			All	FYRIS		
			No	Partial*	Full*		No	Partial*	Full*		No	Partial*	Full*		No	Partial*	Full*
N		**486**	406	36	44	**518**	391	38	89	**641**	482	102	57	**569**	322	171	76
Male		**33%**	32%	42%	30%	**38%**	38%	37%	42%	**36%**	35%	30%	53%	**35%**	37%	37%	24%
Female		**67%**	68%	58%	70%	**62%**	62%	63%	58%	**64%**	65%	70%	47%	**65%**	63%	63%	76%
Hispanic		**89%**	88%	88%	93%	**89%**	89%	92%	89%	**92%**	92%	93%	95%	**89%**	91%	87%	86%
Age	M	**18.0**	18.0	18.1	18.0	**18.0**	18.0	18.1	17.9	**18.0**	18.0	18.0	18.0	**18.0**	18.0	18.0	18.0
	SD	**0.38**	0.37	0.39	0.37	**0.40**	0.42	0.27	0.33	**0.36**	0.36	0.33	0.40	**0.41**	0.41	0.37	0.56
High school Rank	M	**70.1**	69.3	66.4	81.3	**68.7**	65.3	68.3	83.6	**67.6**	65.3	73.8	77.0	**67.4**	61.2	72.7	82.4
	SD	**24.94**	24.88	28.23	19.84	**25.98**	26.57	24.03	17.85	**25.88**	26.77	23.16	17.63	**25.99**	26.97	23.38	17.24
Transfer hours	M	**14.3**	14.3	10.9	16.9	**5.9**	5.4	6.1	8.0	**10.8**	11.7	7.7	8.5	**18.1**	18.6	16.2	20.4
	SD	**18.51**	18.92	15.88	16.47	**11.56**	11.15	13.03	12.55	**17.49**	18.78	12.45	12.48	**21.75**	23.94	17.82	19.88

*HHMI funded

Table 3

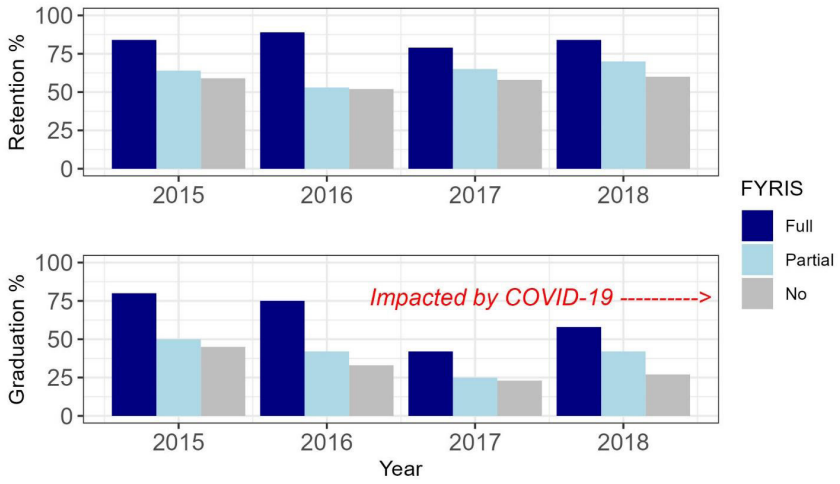
Retention and Four-Year Gradutation Rates for FYRIS Participants

Cohort	2015 Cohort				2016 Cohort				2017 Cohort				2018 Cohort			
Rates	All	FYRIS			All	FYRIS			All	FYRIS			All	FYRIS		
		No	Partial	Full		No	Partial	Full		No	Partial	Full		No	Partial	Full
1-Year retention	**75%**	73%	69%	93%	**74%**	69%	79%	97%	**76%**	73%	78%	93%	**77%**	70%	81%	97%
2-Year retention	**66%**	64%	64%	86%	**65%**	60%	58%	90%	**66%**	63%	71%	84%	**71%**	63%	76%	92%
3-Year retention	**63%**	60%	64%	89%	**62%**	56%	61%	89%	**62%**	59%	62%	84%	**67%**	61%	71%	87%
4-Year retention	**62%**	59%	64%	84%	**59%**	52%	53%	89%	**61%**	58%	65%	79%	**66%**	60%	70%	84%
4-Year graduation	**49%**	45%	50%	80%	**41%**	33%	42%	75%	**25%**	23%	25%	42%	**36%**	27%	42%	58%

*HHMI Funded

Figure 1

Longitudinal Four-year Retention and Graduation Rates



2018. For all 2121 participants and insight into the consistency of the cohorts over time. Note that participation in the FYRIS courses was stable over the years, and there was no major shift in student demographics or characteristics.

Table 3 provides a summary of the retention rates across all four years and graduation rates for each cohort, and Figure 1 presents simplified data from Table 3 using side-by-side bar plots on just the 4-year retention and graduation rates. Note that the pattern of retention and graduation do not vary, but are remarkably consistent across all years of FYRIS. This is a testimony to the consistency of impact, even during the COVID-19 pandemic. However, note that there was a decrease in graduation rates for the 2017 cohort who experienced the pandemic impact most immediately.

4-year Retention Model Results

Table 4 provides summaries of the modeling results for the ordinary (unweighted) and propensity score weighted logistic regression models used for assessing the impact of the FYRIS program on 4-year retention. These are labeled in Table 4 as UW and IPW for the ordinary and weighted versions of the models, respectively. Model fit is moderate (C-statistic = 0.74) and statistically significant (Hosmer & Lemeshow test= 10.25, p-value=0.248) indicating a good fit. The model indicates that the full FYRIS sequence positively impacts 4-year retention (OR(IPW)=2.51, (1.99, 3.33)). This is a significant impact statistically as well as practically since it implies that there is a 151% increase in the odds of 4-year retention for students who take the full FYRIS sequence versus no FYRIS or a partial FYRIS. This percentage derives from the estimated OR for FYRIS (2.51) and its increase over 1. Similarly, there is a

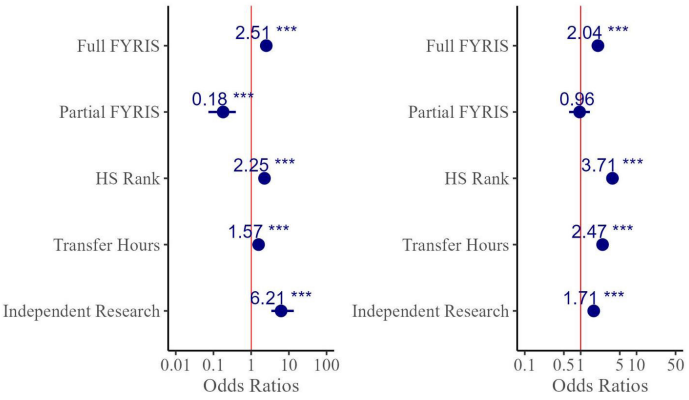
Table 4

Ordinary and Propensity Score Weighted Logistic Regression Model Results for 4-year Retention

	UW			IPW		
Characteristic	**OR[1]**	**95% CI[1]**	**p-value**	**OR[1]**	**95% CI[1]**	**p-value**
Full FYRIS	2.56	1.77, 3.77	<0.001***	2.51	1.90, 3.33	<0.001***
Partial FYRIS	0.24	0.14, 0.38	<0.001***	0.18	0.07, 0.39	<0.001***
Gender (Male)	1.06	0.87, 1.30	0.5	1.13	0.86, 1.49	0.4
High School Rank	1.96	1.69, 2.27	<0.001***	2.25	1.84, 2.76	<0.001***
Transfer Hours	1.50	1.34, 1.68	<0.001***	1.57	1.31, 1.90	<0.001***
Independent Research	4.80	3.24, 7.69	<0.001***	6.21	3.42, 13.5	<0.001***

[1]OR = Odds Ratio, CI = Confidence Interval
*p < .05. **p < .01. ***p < .001

Figure 2
Forest Plot of Propensity Score Weighted Logistic Regression Model Results for 4-year Retention (left) and Graduation (right)



positive impact of participation in independent research among students on their 4-year retention (OR(IPW)=6.21, (3.42, 13.50)). In this case, the odds of retention increase by a very large degree for each 0-credit independent research mentoring course a student enrolls in (enrollment is required for all undergraduates conducting non-CURE, mentored research). Note that the variables for community college transfer (OR(IPW)=1.57, (1.31, 1.90)) and high school rank (OR(IPW)=2.25, (1.84, 2.76)) also impact 4-year retention. Gender is neither practically nor statistically significant. This indicates that any marginal association between these variables and retention is confounded by participation in FYRIS and independent research. Figure 2 provides a visualization of the modeling results for 4-year retention (left side) alongside graduation rates (right side).

FYRIS 4-Year Graduation Rate Results

Table 5 provides ordinary (unweighted) and propensity-scored weighted model results for predicting 4-year graduation, labeled UW and IPW, respectively. Model fit is moderate (C-statistic = 0.81) and statistically significant (H&L = 7.16, p-value = 0.519). These models demonstrate that FYRIS (OR(IPW)=2.04, (1.59, 2.62)) and independent research positively impact graduation (OR(IPW)=1.59, (1.51, 1.94)), indicating more than a 100% increase in odds of graduation for full FYRIS participants and 71% increase in odds for each mentored research experience. These results are similar to those observed for retention but somewhat diminished in magnitude. Being male has a negative impact on the odds of graduation in this model (OR(IPW)=0.55, (0.43, 0.71)), and high school percentile and transfer hours increase the odds of graduation. Figure 2 presents the forest plot depicting the logistic regression model results for graduation rates on the right side.

Discussion

In this manuscript, we demonstrate the positive

Table 5
Ordinary and Propensity Score Weighted Logistic Regression Model Results for 4-year Graduation

	UW			IPW		
Characteristic	**OR[1]**	**95% CI[1]**	**p-value**	**OR[1]**	**95% CI[1]**	**p-value**
Full FYRIS	1.66	1.19, 2.31	0.003**	2.04	1.59, 2.62	<0.001***
Partial FYRIS	0.94	0.67, 1.31	0.7	0.96	0.62, 1.46	0.8
Gender (Male)	0.75	0.58, 0.96	0.024**	0.55	0.43, 0.71	<0.001***
High School Rank	3.31	2.66, 4.16	<0.001***	3.71	2.96, 4.69	<0.001***
Transfer Hours	2.19	1.95, 2.46	<0.001***	2.47	2.16, 2.83	<0.001***
Independent Research	1.69	1.47, 1.95	<0.001***	1.71	1.51, 1.94	<0.001***

OR = Odds Ratio, CI = Confidence Interval
*p < .05. **p < .01. ***p < .001

impact that the FYRIS program has had on both 4-year retention and 4-year graduation rates. The analyses presented are robust to sampling bias, reflect the student demographics of an HSI setting, and indicate that students who engage in undergraduate research have increased retention and graduation rates (Gillies & Marsh, 2013; Graham et al., 2012; Healey & Jenkins, 2009; Hensel, 2012; Linn et al., 2015; Lopatto, 2010). Even more recently, it was found that students participating in research at a 100% Hispanic student institution were more likely to graduate (Caraballo-Cueto et al., 2023). The quantity of research experiences, both CUREs and mentored research, was the primary factor impacting graduation. This manuscript builds on this body of evidence, showing the outweighed impact of research mentoring and training on increasing important student success metrics, 4-year retention, and graduation at HSIs. Our study is consistent with the literature in this area, with a focus on Hispanic servingness and populations.

The models presented in this manuscript suggest that there is an outsized and salient impact of FYRIS and independent research experiences over other highly relevant explanatory variables, such as gender, high school rank, and transfer hours from community college. Though the benefits of CUREs and mentored research are well documented about increasing important student attributes, such as science identity and research self-efficacy (Olivares-Donoso & González, 2019), this study demonstrates that the impact of these research training interventions go beyond those constructs and directly impact important student academic success metrics. Furthermore, the present research provides ample evidence that at an HSI, the development and support of research training interventions similar to FYRIS and ongoing support for independent mentored research are crucial for increasing these metrics of success, that is, 4-year retention and 4-year graduation rates. This manuscript also adds evidence to the idea that FYRIS and independent research are leveling interventions regarding the socioeconomic backgrounds of students. When we control for FYRIS inclusion in the models, variables that typically negatively impact retention and graduation tend to have little to no impact. High school rank and community college transfer hours are significant predictors for both outcomes, and gender has no statistical impact on 4-year retention.

Limitations and Future Directions

Results from the first four FYRIS cohorts are very promising regarding both 4-year retention and graduation rates. However, these results can be framed as preliminary, as there are still several research questions left to investigate. First and foremost, our analyses were purposefully restricted to just the first four cohorts and only up to 4 years out. This was done to present retention and graduation within four years across four cohorts uniformly. Though uniform in length, a recent report indicates that less than half (44.1%) of college students graduate within four years nationally (Henderson et al., 2022). At UTEP, the four-year graduation rate is even lower, standing at just 13% (College Data Analytics Team, 2023). In addition to less frequent 4-year graduation rates, there exist some majors that include practicum, internships, or other training/service that necessarily extend the typical college degree beyond four years. Given these issues, it is important that future research investigate the effects of participation in FYRIS on both four- and five-year retention and graduation rates. Importantly, these analyses would extend our understanding of the effects of participating in FYRIS by examining the longer-term effects. Specifically, we will gain an understanding of whether, at 5 or 6 years, the effects of FYRIS level off, with both non-FYRIS and partial-FYRIS student participants being retained or graduated at similar rates, or whether the effects of participating in FYRIS are more pronounced.

Similarly, the present research limited analyses to only those students who entered as first-time first-year students and were traditional college students at the time of entry, under 21 years of

age, as FYRIS specifically targets early-stage undergraduates. Though FYRIS targets these students, FYRIS is not limited to these students alone. Instead, FYRIS is open to all students regardless of age and classification. Considering that only 45.07% of students at UTEP fall within the "traditional college" student age of 21 or under, it is highly likely that non-traditional students also enroll in FYRIS. Moreover, the percentage of non-traditional students in college is projected to increase significantly (Hussar & Bailey, 2014); thus, future analyses must expand the stringent age criteria to include non-traditional students as well to better understand whether the effects of participating in FYRIS extend to non-traditional students as well.

Finally, there is evidence from prior research suggesting that students' participation in early-stage CUREs leads to increased motivation to seek out future, mentored undergraduate research experiences (Ott et al., 2020). Although the present analyses controlled for participation in a 0-credit, independent research course on both 4-year retention and graduation, future research can further investigate the link between participation in FYRIS and participation in independent, mentored research. Specifically, future research should investigate the interactive effects that participating in FYRIS and/or independent mentored research has on both retention and graduation rates.

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

Bangera, G., & Brownell, S. E. (2014). Course-Based Undergraduate Research Experiences Can Make Scientific Research More Inclusive. *CBE—Life Sciences Education, 13*(4), 602–606. https://doi.org/10.1187/cbe.14-06-0099

Barron, S. I., Brown, P., Cumming, T., & Mengeling, M. (2020). Impact of Undergraduate Research and Student Characteristics on Student Success Metrics at an Urban, Minority Serving, Commuter, Public Institution. *Journal of the Scholarship of Teaching and Learning, 20*(1). https://doi.org/10.14434/josotl.v20i1.25423

Battaglia, S. J., Echegoyen, L. E., The University of Texas at El Paso, Diaz-Martinez, L. A., & The University of Texas at El Paso, Gonzaga University. (2022). Institution-Wide Analysis of Academic Outcomes Associated with Participation in UGR: Comparison of Different Research Modalities at a Hispanic-Serving Institution. Scholarship and Practice of Undergraduate Research, 8–24. https://doi.org/10.18833/spur/5/3/9

Bauer, K. W., & Bennett, J. S. (2003). Alumni Perceptions Used to Assess Undergraduate Research Experience. *The Journal of Higher Education, 74*(2), 210–230. JSTOR.

Bowman, N. A., & Holmes, J. M. (2018). Getting off to a good start? First-year undergraduate research experiences and student outcomes. *Higher Education, 76*, 17–33.

Branchaw, J., Pfund, C., & Rediske, R. (2010). *Entering Research: A Facilitator's Manual: Workshops for Students Beginning Research in Science.* WH Freeman.

Buchanan, A. J., & Fisher, G. R. (2022). Current Status and Implementation of Science Practices in Course-Based Undergraduate Research Experiences (CUREs): A Systematic Literature Review. *CBE—Life Sciences Education, 21*(4), ar83.

Byrd, M. Y. (2018). *Race and diversity in the workforce. In Diversity in the Workforce* (pp. 65–80). Routledge.

Byrd, M. Y. (2024). *64 Race and Diversity in the Workforce. Diversity in the Workforce: Current Issues and Emerging Trends.*

Canaria, J. A., Schoffstall, A. M., Weiss, D. J., Henry, R. M., & Braun-Sand, S. B. (2012). A model for an introductory undergraduate research experience. *Journal of Chemical Education, 89*(11), 1371–1377.

Caraballo-Cueto, J., Godreau, Í., & Tremblay, R. (2023). From Undergraduate Research to Graduation: Measuring the Robustness of the Pathway at a Hispanic-Serving Institution. *Journal of Hispanic Higher Education, 22*(2), 219–232. https://doi.org/10.1177/15381927221074026

Chen, W. (2018). Introduction to Research: A New Course for First-Year Undergraduate Students. *Journal of Chemical Education, 95*(9), 1526–1532. https://doi.org/10.1021/acs.jchemed.8b00102

Collins, T. W., Grineski, S. E., Shenberger, J., Morales, X., Morera, O. F., & Echegoyen, L. E. (2017). Undergraduate Research Participation Is Associated With Improved Student Outcomes at a Hispanic-Serving Institution. Journal of College Student *Development, 58*(4), 583–600. https://doi.org/10.1353/csd.2017.0044

Eagan, M. K., Hurtado, S., Chang, M. J., Garcia, G. A., Herrera, F. A., & Garibay, J. C. (2013). Making a Difference in Science Education: The Impact of Undergraduate Research Programs. *American Educational Research Journal, 50*(4), 683–713. https://doi.org/10.3102/0002831213482038

Espinosa, L. (2011). Pipelines and Pathways: Women of Color in Undergraduate STEM Majors and the College Experiences

That Contribute to Persistence. *Harvard Educational Review, 81(*2), 209–241. https://doi.org/10.17763/haer.81.2.92315ww157656k3u

Gillies, S. L., & Marsh, S. (2013). Doing science research at an undergraduate university. International *Journal of Arts & Sciences, 6*(4), 379.

Graham, D., Couchman, R., & Hempstead, J. (2012). *Forging a template for undergraduate collaborative research: A case study.*

Harris, A., Babkoor, M., Gu, T., & Kremer, G. E. (2015). *Course-based undergraduate research: A review of models and practices. 57106, V003T04A024.*

Healey, M., & Jenkins, A. (2009). *Developing undergraduate research and inquiry.* Higher Education Academy York.

Hensel, N. (Ed.). (2012). *Characteristics of excellence in undergraduate research.* Council on Undergraduate Research.

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

Hudson Jr, S. W. (2014). Diversity in the Workforce. *Journal of Education and Human Development, 3*(4), 73–82.

Krim, J. S., Coté, L. E., Schwartz, R. S., Stone, E. M., Cleeves, J. J., Barry, K. J., Burgess, W., Buxner, S. R., Gerton, J. M., & Horvath, L. (2019). Models and impacts of science research experiences: A review of the literature of CUREs, UREs, and TREs. *CBE—Life Sciences Education, 18*(4), ar65.

Linn, M. C., Palmer, E., Baranger, A., Gerard, E., & Stone, E. (2015). Undergraduate research experiences: Impacts and opportunities. *Science, 347*(6222), 1261757. https://doi.org/10.1126/science.1261757

Lo, S. M., & Le, B. D. (2021). Student Outcomes From a Large-Enrollment Introductory Course-Based Undergraduate Research Experience on Soil Microbiomes. *Frontiers in Microbiology, 12*, 589487. https://doi.org/10.3389/fmicb.2021.589487

Loeser, M. R., Newkirk, M., Gabriel, K. I., & Huerta, A. D. (2021). Development and Assessment of an Undergraduate Research Program at a Two-Year, Rural, Hispanic-Serving Institution: The Essential Role of Partnerships. *Scholarship and Practice of Undergraduate Research, 4*(3), 22–29.

Lopatto, D. (2010). Undergraduate research as a high-impact student experience. *Peer Review, 12*(2), 27–31.

Monarrez, A., Morales, D., Echegoyen, L. E., Seira, D., & Wagler, A. E. (2020). The Moderating Effect of Faculty Mentorship on Undergraduate Students' Summer Research Outcomes. *CBE—Life Sciences Education, 19*(4), ar56. https://doi.org/10.1187/cbe.20-04-0081

Monarrez, A., Wagler, A. E., Morales, D. X., Seira, D., Echegoyen, L. E., & Ramirez, Aleida. (2020). *Mentoring Undergraduate Students in Research: Faculty Barriers and Benefits. 1*(13), 418–424.

Olimpo, J. T., Fisher, G. R., & DeChenne-Peters, S. E. (2016). Development and evaluation of the Tigriopus course-based undergraduate research experience: Impacts on students' content knowledge, attitudes, and motivation in a majors introductory biology course. *CBE—Life Sciences Education, 15*(4), ar72.

Olivares-Donoso, R., & González, C. (2019). Undergraduate research or research-based courses: Which is most beneficial for science students? *Research in Science Education, 49*, 91–107.

Oliver, K. A., Werth, A., & Lewandowski, H. J. (2023). Student experiences with authentic research in a remote, introductory course-based undergraduate research experience in physics. *Physical Review Physics Education Research, 19*(1), 010124. https://doi.org/10.1103/PhysRevPhysEducRes.19.010124

Ott, L. E., Godsay, S., Stolle-McAllister, K., Kowalewski, C., Maton, K. I., & LaCourse, W. R. (2020). Introduction to Research: A Scalable, Online Badge Implemented in Conjunction with a Classroom-Based Undergraduate Research Experience (CURE) that Promotes Students Matriculation into Mentored Undergraduate Research. *UI Journal, 11(1), https://www.understandinginterventionsjournal.org/article/12483.*

Pariyothorn, M., & Autenrieth, R. (2012). Strategic Use of Summer Undergraduate Research Experiences. 2012 *ASEE Annual Conference & Exposition Proceedings, 25*.1177.1-25.1177.13. https://doi.org/10.18260/1-2--21934

Pfund, C., Byars-Winston, A., Branchaw, J., Hurtado, S., & Eagan, K. (2016). Defining attributes and metrics of effective research mentoring relationships. *AIDS and Behavior, 20*, 238–248.

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

Russell, S. H., Hancock, M. P., & McCullough, J. (2007). Benefits of Undergraduate Research Experiences. *Science, 316*(5824), 548–549. https://doi.org/10.1126/science.1140384

Simmons, K. N. (2018). Effect of Undergraduate Research Programs on Retention of Hispanic Students. *ProQuest LLC*. 789 East Eisenhower Parkway, P.O. Box 1346, Ann Arbor, MI 48106. Tel: 800-521-0600; Web site: http://www.proquest.com/en-US/products/dissertations/individuals.shtml.

Smith, K. P. W., Waddell, E. A., Dean, A. N., Anandan, S., Gurney, S., Kabnick, K., Little,

J., McDonald, M., Mohan, J., Marenda, D. R., & Stanford, J. S. (2023). Course-based undergraduate research experiences are a viable approach to increase access to research experiences in biology. *Journal of Biological Education, 57*(3), 618–632. https://doi.org/10.1080/00219266.2021.1933135

Stanford, J. S., Rocheleau, S. E., Smith, K. P. W., & Mohan, J. (2017). Early undergraduate research experiences lead to similar learning gains for STEM and Non-STEM undergraduates. *Studies in Higher Education, 42*(1), 115–129. https://doi.org/10.1080/03075079.2015.1035248

Taraban, R., & Blanton, R. L. (Eds.). (2008). *Creating effective undergraduate research programs in science: The transformation from student to scientist.* Teachers College Press.

Thiry, H., Laursen, S. L., & Hunter, A.-B. (2011). What Experiences Help Students Become Scientists? A Comparative Study of Research and Other Sources of Personal and Professional Gains for STEM Undergraduates. *The Journal of Higher Education, 82*(4), 357–388.

van Buuren, S., & Groothuis-Oudshoorn, K. (2011). mice: Multivariate Imputation by Chained Equations in R. *Journal of Statistical Software, 45*(3), 1–67. https://doi.org/10.18637/jss.v045.i03

Watts, F. M., & Rodriguez, J.-M. G. (2023). A Review of Course-Based Undergraduate Research Experiences in Chemistry. *Journal of Chemical Education, 100*(9), 3261–3275.

Whittinghill, J. C., Slovacek, S. P., Flenoury, L. P., & Miu, V. (2019). A 10-Year Study on the Efficacy of Biomedical Research Support Programs at a Public University. *Council on Undergraduate Research Quarterly, 3*(1), 30–38. https://doi.org/10.18833/spur/3/1/3

Wozniak, C. (2011). Freshman fellows: Recruiting and retaining great students through research opportunities. *Council on Undergraduate Research Quarterly, 32*(2), 8–16.

Zydney, A. L., Bennett, J. S., Shahid, A., & Bauer, K. W. (2002). Impact of Undergraduate Research Experience in Engineering. *Journal of Engineering Education, 91*(2), 151–157. https://doi.org/10.1002/j.2168-9830.2002.tb00687.x

Author Biographies

Dr. Lourdes E. Echegoyen, PhD is the founding director of the Campus Office of Undergraduate Research Initiatives and a Research Associate Professor of Chemistry at the University of Texas at El Paso. She received B.S. and PhD degrees in Chemistry from the University of Miami and started her career as a high school teacher before returning to the University of Miami as a post-doctoral fellow and lecturer. In 2002 she joined the Chemistry faculty at Clemson University and directed their NSF-funded REU program. In 2008, she moved to the American Chemical Society and directed their International REU Exchange Program. Since her arrival at UTEP in 2010, Dr. Echegoyen has received several awards from NSF, NIH, HHMI, and DoE to support undergraduate research. Her earlier publications were in supramolecular and fullerene chemistry, while her most recent ones show the impact of undergraduate research participation on students, particularly those from minoritized groups.

Dr. Rafael Aguilera, PhD is a program evaluator at Research, Evaluation, and Assessment Services (REAS) at the University of Texas at El Paso (UTEP), where he assists in evaluating the impact of several nationally funded training grants aimed at increasing representation of racial-ethnic minoritized students in STEM and the biomedical field. He earned his BS in psychology at UTEP in 2014 and then moved on to the University of Minnesota, where he was a National Science Foundation (NSF) – Graduate Research Fellow and earned his PhD. in social psychology. In addition to program evaluation, Rafael continues to conduct research investigating the factors that influence the development of racial-ethnic minoritized students' science identity, and the interplay of how their own ethnic-racial identity and experiences in and out of the academia influence its development.

Tolulope Adeyina received a Master's in Statistics and is working on a Ph. D. in Data Science at the University of Texas at El Paso. He is a third-year doctoral student and works as a research assistant with the BUILDing Scholars program.

Dr. Clarissa Reyes, PhD received a Master's in Statistics and a PhD in Data Science with a concentration in graphical networks. She is a first-year postdoctoral researcher at the University of Texas at El Paso, working with the BUILDing Scholars program.

Dr. Guadalupe Corral, PhD received a Master's in Sociology and PhD in Psychology with a concentration in social cognitive neuroscience. She has over 10 years of experience evaluating externally funded training programs geared towards positively impacting target populations, such as students, faculty, and community members. She is the founding Director of the Research Assessment and Evaluation Services (REAS) center at the University of Texas at El Paso, where she oversees all center projects. Under Dr. Corral's supervision the REAS center has conducted formative and summative evaluations for over 40 programs, with a combined award amount of $90+ million, by federal, state, and local agencies (i.e., NIH, NSF, ED, DOE, NEH, Texas Governor's Office, Texas Tech, City of El Paso, etc.). Dr. Corral

also has experience teaching research methods and statistics courses to undergraduate and graduate students in psychology, sociology, public administration, and leadership studies programs at UTEP and other institutions.

Dr. Amy Wagler, PhD is a Professor of Public Health Sciences at the University of Texas at El Paso (UTEP). She has a B.S. in mathematics from the University of Texas of the Permian Basin and a M.S. and PhD in statistics from Oklahoma State University. She has been a faculty member at UTEP since 2008 where she was an Assistant Professor from 2008-2014, an Associate Professor from 2014-2020, and a Professor from 2020-2024, in Mathematical Sciences. In 2024, she joined the faculty in the Department of Public Health Sciences as a full professor. She is active in research in health data science, biostatistics, and interdisciplinary projects involving public health issues such as diabetes and food security, biomedical research and workforce training, and equitable measures of student success. She has external funding from NIH, NSF, and ONC to conduct research on student and workforce training in a Hispanic-serving institutional setting. She is also a recipient of the 2014 Regents Outstanding Teaching award from the University of Texas System.