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TLIC PAPER

Redesigning STEM Courses to Advance Hispanic Student Success: A Case Study of OLLU's Title V DHSI Initiative

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ABSTRACT

This case study explores Our Lady of the Lake University's (OLLU) strategic initiative to enhance STEM education for Hispanic students, a project supported by a Title V DHSI grant. Facing challenges in STEM retention and success, OLLU implemented a multifaceted approach, including needs assessments to pinpoint student-specific obstacles. Key programmatic strategies, such as Universal Design for Learning (UDL), Experiential Learning (EXL), and Writing to Learn techniques, were employed to redesign core STEM courses. The article will detail the implementation process, highlighting the establishment of the EXL STEM Studio and the subsequent redesign of the courses. Outcome analysis will focus on demonstrable impacts: student retention, graduation rates, and the increase in STEM degrees awarded to Hispanic students. This case study offers valuable insights for HSIs seeking to improve STEM outcomes, emphasizing the effectiveness of tailored academic support and innovative pedagogical approaches.

KEYWORDS

Hispanic STEM Education, Experiential Learning (EXL) Title V DHSI Grant

1 INTRODUCTION

1.1 Overview of HSI's and their role in STEM education

Hispanic-Serving Institutions (HSIs) play a crucial role in providing access to higher education for Hispanic students, a population that remains significantly underrepresented in STEM fields [1]. While Hispanics comprise nearly 19% of the U.S. population and represent the largest and fastest-growing minority group [2], they remain substantially underrepresented in STEM degree attainment, comprising only 12% of bachelor's degrees and less than 9% of advanced degrees in STEM fields [3]. This disparity not only limits individual opportunity but also constrains the diversity and innovation capacity of the U.S. STEM workforce. HSIs, by virtue of

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their missions and demographics, are uniquely positioned to advance educational equity and contribute to a more diverse and inclusive STEM workforce by supporting Hispanic students who pursue and succeed in STEM careers.

Our Lady of the Lake University (OLLU) exemplifies both the promise and the challenge of this mission. As an HSI with a main campus located in San Antonio, Texas, approximately 150 miles from the Mexico border, OLLU serves a student population in which 77% identify as Hispanic and 56% qualify as low-income. Students are primarily drawn from San Antonio's historically underserved West Side, where many students arrive from high schools lacking adequate academic and support services, entering college underprepared for the demands of rigorous coursework, especially in STEM fields.

These realities underscore OLLU's mission not only to expand access to higher education but also to ensure that Latino students receive the support they need to succeed, graduate, and make a lasting impact on their communities, families, and professions. Recognizing the importance of a supportive and engaging learning environment, OLLU is especially committed to Hispanic students in STEM fields. The university provides resources and opportunities that empower these students to overcome challenges and achieve their academic and professional goals in STEM fields.

In addition to these national trends, recent studies highlight the growing importance of comprehensive STEM interventions at HSIs. Initiatives such as the Louis Stokes Alliance for Minority Participation (LSAMP) and Title V-supported STEM programs at peer institutions have demonstrated the value of culturally responsive teaching, undergraduate research, and experiential learning in improving outcomes for Hispanic students [4], [5]. Yet, while these models provide useful benchmarks, few published case studies exist on the experiences of smaller, private HSIs like OLLU, creating an important opportunity for this study to contribute to the field.

1.2 The need for targeted support at OLLU

Despite its commitment to serving Hispanic students, OLLU has experienced concerning trends in recent years. From 2012 to 2019, STEM enrollment declined by 11.5%, and there was a 20% drop in STEM enrollment among low-income students. In addition, retention rates for STEM students lagged behind institutional averages, and retention rates for Hispanic STEM students were only 63.7%, which is significantly below the national retention rate of 82% for four-year institutions in 2020 [6]. Furthermore, many Hispanic students struggle in core STEM courses, which hinders their academic progress and contributes to low retention and graduation rates [1]. These challenges underscore the urgent need for targeted interventions to support Hispanic students in STEM at OLLU. STEM fields offer the most significant opportunities for high-demand/high-wage careers for OLLU's low-income students, yet fewer and fewer are pursuing this path.

Internal faculty surveys reinforced these findings, highlighting a reliance on traditional lecture-based pedagogy, with only 11% of STEM faculty reporting consistent use of evidence-based teaching practices. Resource constraints and limited funding for professional development further hinder instructional innovation.

The university acknowledged that addressing these issues necessitates a comprehensive approach that encompasses academic support, curriculum redesign, and the development of a more inclusive STEM learning environment. To this end, OLLU applied for and was awarded a Title V Developing Hispanic-Serving Institutions (DHSI) grant. This funding presents a critical opportunity to implement

innovative strategies and initiatives that enhance the STEM education experience for Hispanic students and improve their overall success.

1.3 Student perspectives and lived experiences

Beyond quantitative trends, qualitative data collected through student focus groups and interviews highlight the barriers and opportunities for OLLU's Hispanic STEM students. Students frequently cited feelings of isolation in early STEM courses, lack of hands-on applications, and difficulty balancing academic and financial pressures. One student shared that "before the redesign, it felt like STEM wasn't for me. The EXL studio gave me a place to experiment and see myself as capable." Another student noted "having professors use UDL strategies made it easier to follow the material. I wasn't just memorizing—I was actually learning." These voices provide critical insight into the lived experiences of OLLU students and underscore the need for tailored, evidence-based supports.

2 PROJECT GOALS AND OBJECTIVES

2.1 Project goals

Using funding from the Title V Developing Hispanic-Serving Institutions (DHSI) grant, a comprehensive STEM support initiative was launched to address the critical need for improved STEM education outcomes for Hispanic students at OLLU [1]. The project's overarching goals are threefold. First, it seeks to increase Hispanic student success in STEM courses by providing effective academic support and implementing innovative teaching strategies, ultimately enhancing their understanding of core STEM concepts and improving their performance. Second, the project aims to enhance retention and graduation rates for Hispanic students pursuing STEM studies. Through targeted interventions and support services, it aims to create a more inclusive and supportive STEM learning environment, leading to increased retention and higher graduation rates for Hispanic students pursuing STEM degrees. Finally, the project seeks to improve the overall quality of STEM education at OLLU by redesigning core STEM courses and expanding academic support resources, benefiting all students, particularly those from underrepresented groups [1]. The curriculum redesign will be anchored in the Universal Design for Learning (UDL) framework and will include the development of experiential and active learning environments, featuring a new STEM Makerspace Studio for collaborative, hands-on engagement. By aligning teaching practices with the needs of Latino and underserved students, this program promotes equity, increases retention and graduation rates, and prepares students for successful STEM careers in their communities.

2.2 Project objectives

To achieve these goals, the project has established a set of specific, measurable, achievable, relevant, and time-bound (SMART) objectives, closely aligned with OLLU's institutional goals and the Title V program's purpose of expanding educational opportunities and improving the academic attainment of Hispanic students. These objectives include: redesigning core STEM courses to incorporate

evidence-based pedagogical approaches; expanding academic support resources to provide comprehensive assistance to students; improving student retention and graduation rates, particularly among Hispanic and STEM students; increasing the number of STEM degrees awarded to Hispanic students; and enhancing students' financial literacy to enable better financial planning and decision-making. These objectives provide a clear roadmap for the project's implementation and evaluation, guiding efforts to enhance STEM education and support services for Hispanic students at OLLU, and contributing to the broader goal of promoting equity and diversity in STEM fields.

3 PROGRAMMATIC STRATEGIES

3.1 Redesigning core STEM courses

To enhance the quality of STEM education and better support Hispanic students, OLLU implemented a comprehensive course redesign initiative focusing on core STEM courses. This initiative focused on three key strategies: implementing a Universal Design for Learning (UDL) framework, incorporating Experiential Learning (EXL) and Writing to Learn techniques, and developing and utilizing discipline-specific and interdisciplinary EXL STEM Studio resources.

The UDL framework is an evidence-based approach to curriculum design that emphasizes flexibility and accessibility to accommodate diverse learning needs and preferences. By incorporating UDL principles, OLLU created a more inclusive and supportive learning environment that benefits all students, particularly those who may face challenges in traditional learning settings.

A considerable challenge for universities is securing funding for faculty training. Professional development is often overlooked in favor of more pressing budget priorities, such as instructional equipment and departmental needs. OLLU recognized that improving student outcomes requires both curriculum changes and significant investment in faculty development. With the Title V grant, OLLU was able to provide training for STEM faculty, ensuring they have the tools, resources, and support needed to redesign their courses and create more engaging learning experiences. OLLU STEM faculty participated in an eight-week training course through CAST, the Center for Applied Special Technology, to learn how to incorporate UDL principles into their classes. Then, the faculty, with support from a grant-funded Faculty Development Specialist, worked to redesign courses to be more student-centered and engaging using UDL principles. Traditional lecture-based instruction alone is no longer enough. UDL provides a new approach, one that creates multiple pathways for learning and engagement, fostering an inclusive and engaging learning environment.

While lectures have value, incorporating hands-on, interactive learning can significantly enrich the educational experience. Instead of simply memorizing facts, students engage in hands-on activities that foster a deeper understanding, stronger retention, and sharper critical thinking. Experiential learning offers students the opportunity to engage in practical activities, apply their knowledge to real-world contexts, and refine their problem-solving skills. Moving beyond traditional lectures encourages active engagement, meaningful reflection, and the application of concepts in authentic situations. In addition, Writing to Learn provides students with opportunities to use writing as a tool for reflection, exploration, and deeper

understanding of STEM concepts. Together, these approaches were integrated into core STEM courses to increase engagement, promote active learning, and improve overall outcomes.

OLLU established an EXL STEM Studio, often called a makerspace, equipped with hardware, software, and other resources to facilitate hands-on, collaborative learning activities. This studio served as a hub for experiential learning, providing students with opportunities to engage in discipline-specific and interdisciplinary projects, explore real-world applications of STEM concepts, and develop skills that are essential for success in STEM careers. Many students come to college believing that learning is about finding the "right" answer rather than engaging with complex, nuanced problems [7]. Experiential learning challenges that mindset, pushing students to develop problem-solving skills, adaptability, and the ability to reevaluate assumptions, which are all essential skills in today's workforce.

Faculty outcomes have also been notable. Post-training surveys indicated that 87% of STEM faculty reported increased confidence in integrating UDL into their teaching, and 73% noted positive shifts in student engagement. Classroom observations confirmed more active participation and higher persistence in redesigned courses. Faculty also reported that cross-departmental collaboration during redesign efforts fostered a stronger culture of innovation within OLLU's STEM division.

3.2 Expanding academic support resources

In addition to course redesign, OLLU expanded its academic support resources to provide comprehensive assistance to students, particularly those who may face challenges in STEM education. This includes the EXL STEM Studio, equipped with state-of-the-art technology and resources, to support experiential learning activities. This included computers, software, 3D printers, a laser engraver and cutter, a CNC routing machine, a large format poster printer, presentation lightboards for making videos, and other equipment that enabled students to engage in hands-on projects, explore real-world applications of STEM concepts, and develop skills essential for success in STEM careers.

EXL STEM Studio modules were developed to provide supplemental learning opportunities for students in core STEM courses. These modules were designed to reinforce key concepts, provide additional practice, and encourage students to explore STEM topics in greater depth. The modules were available online and in the EXL STEM Studio, allowing students to access them at their convenience and engage in self-directed learning.

OLLU also provided customized and contextualized financial wellness and literacy modules to help students develop financial planning skills, understand financial aid options, and make informed decisions about their finances. These modules were integrated into the First-Year Seminar course and selected STEM courses, ensuring that students received timely and relevant information about financial literacy.

Finally, internships and field experiences provided students with valuable opportunities to apply their knowledge in real-world settings, gain practical experience, and develop professional skills. OLLU expanded STEM internship and field experience opportunities by partnering with local businesses, industries, and organizations. This provided students with a broader range of options to explore their interests, gain practical experience, and develop skills that are essential for success in STEM careers.

4 IMPLEMENTATION AND EVALUATION

4.1 Implementation plan

OLLU has developed a comprehensive implementation plan to ensure the successful execution of the project and the achievement of its objectives. The plan outlines the timeline for key activities, the roles and responsibilities of project staff and faculty, and the strategies for monitoring progress and making adjustments as needed.

Timeline for Key Activities:

- **Year 1:** Focus on implementing the UDL framework and incorporating EXL and Writing to Learn techniques in core STEM courses.
- **Year 2:** Expand academic support resources by establishing the EXL STEM Studio and creating discovery learning modules.
- **Year 3:** Continue course redesigns and expand internship and field experience opportunities.
- **Year 4:** Focus on institutionalizing project activities and ensuring their sustainability beyond the grant period.
- **Year 5:** Complete all project activities and conduct a final evaluation to assess the overall impact and make recommendations for future action.

Roles and Responsibilities:

- **Project Director:** Oversee all aspects of the project, including implementation, evaluation, and reporting.
- **Course Redesign/Faculty Development Specialist:** Lead the course redesign process, provide faculty training, and coordinate the development of EXL STEM Studio resources.
- **EXL STEM Studio Facilitator:** Manage the EXL STEM Studio, assist students with experiential learning activities, and coordinate the development of discovery learning modules.
- **STEM Internship Coordinator:** Develop and expand internship and field experience opportunities for students in STEM degree programs.
- **Faculty:** Participate in course redesigns, implement UDL and EXL strategies, and contribute to the development of EXL STEM Studio resources.

4.2 Monitoring progress and making adjustments

In addition to the implementation plan, OLLU has developed a comprehensive evaluation plan to assess the project's effectiveness and its impact on student outcomes. This plan outlines the evaluation design, the data collection and analysis procedures, and the reporting and dissemination strategies. The evaluation will be outcomes-based, utilizing a mixed-methods approach that incorporates both quantitative and qualitative data. It will also be both formative and summative, with ongoing formative evaluation informing adjustments to project activities and summative evaluation assessing the overall impact and making recommendations for future action. Data collection will include quantitative data on student retention, graduation rates, STEM degrees awarded, course success rates, and financial literacy,

as well as qualitative data from faculty and student surveys, focus groups, and interviews. The collected data will be analyzed using descriptive statistics, statistical analyses, and qualitative data analysis techniques. Reporting and dissemination will involve annual reports, a final report summarizing the overall impact, and dissemination of findings through presentations, publications, and reports to stakeholders.

4.3 Evaluation

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4.4 Data visualization and impact highlights

In addition to retention and course pass rate data, future reports will incorporate additional figures, including:

- Pre- and post-redesign success rates for redesigned courses.
- Growth in internship/field placement participation over five years.
- Flow diagram of integrated program strategies (UDL, EXL, Writing to Learn, Academic Support, Internships).

These visuals will provide a clearer, multi-dimensional picture of program outcomes and the interaction among interventions.

5 EXPECTED OUTCOMES AND CONCLUSION

5.1 Expected outcomes

The project is expected to result in significant improvements in STEM education outcomes for Hispanic students at OLLU. Anticipated outcomes include improved

student retention and graduation rates, particularly for students pursuing STEM degrees, resulting from the project's comprehensive approach to course redesign and academic support. By improving academic performance and persistence in STEM programs, the project is also expected to increase the number of STEM degrees awarded to Hispanic students, contributing to a more diverse and inclusive STEM workforce. Additionally, the project's focus on creating a more inclusive and supportive learning environment is expected to enhance the overall quality of STEM education and support services for Hispanic students at OLLU.

5.2 Initial outcomes

In 2023 (the third year of the program), OLLU enrolled 1,147 undergraduates, including 123 who majored in STEM fields. Retention rates from 2022 to 2023 increased for all students, especially for STEM students (See Figure 1). For Hispanic students across all majors, the retention rate increased by 6%. There was a significantly larger increase in retention rates for all students in STEM fields from 56% to 75%, suggesting that the impact of redesigning STEM courses is bearing fruit. Notably, the retention rate for Hispanic students in STEM fields increased by a remarkable 21 percentage points (from 55% to 76%) between 2022 and 2023, demonstrating a significant improvement and highlighting the potential effectiveness of targeted retention programs for minority students in STEM. In addition, the project's effectiveness is evidenced by a positive trend in the success rate, with an increase of more than 5 percentage points across all courses that have been redesigned. As the ongoing redesign of STEM courses continues, it is expected that retention rates will further improve in years four and five of the grant.

The grant aimed to redesign 17 STEM courses using UDL principles over five years. In the first four years, all STEM faculty completed UDL training, and UDL was incorporated into 20 redesigned courses, surpassing the original goal. The project's effectiveness is evidenced by a positive trend in the success rate, with an increase of more than 5 percentage points across all courses that have been redesigned. For example:

- **MATH 2412:** 82% all (up from 63%), 71% Hispanic (up from 62%)
- **PHYS 1401:** 90% all (up from 82%), 88% Hispanic (up from 72%)
- **PHYS 1402:** 100% for all and Hispanic students (up from 90% and 87%)

Classroom observations by the Faculty Development Specialist confirmed increased student engagement as faculty implemented UDL-informed strategies, including writing-to-learn activities, project-based learning, and alternative assessments. These approaches yielded in-class engagement rates of 90–100% in redesigned courses.

The grant also strengthened other non-classroom experiential learning opportunities. In 2023, funding supported 12 internships and research experiences involving 32 STEM students, triple the number from the second year of the grant.

Taken together, these outcomes demonstrate that OLLU's STEM initiatives are not only meeting but surpassing their goals, laying a strong foundation for sustained student success.

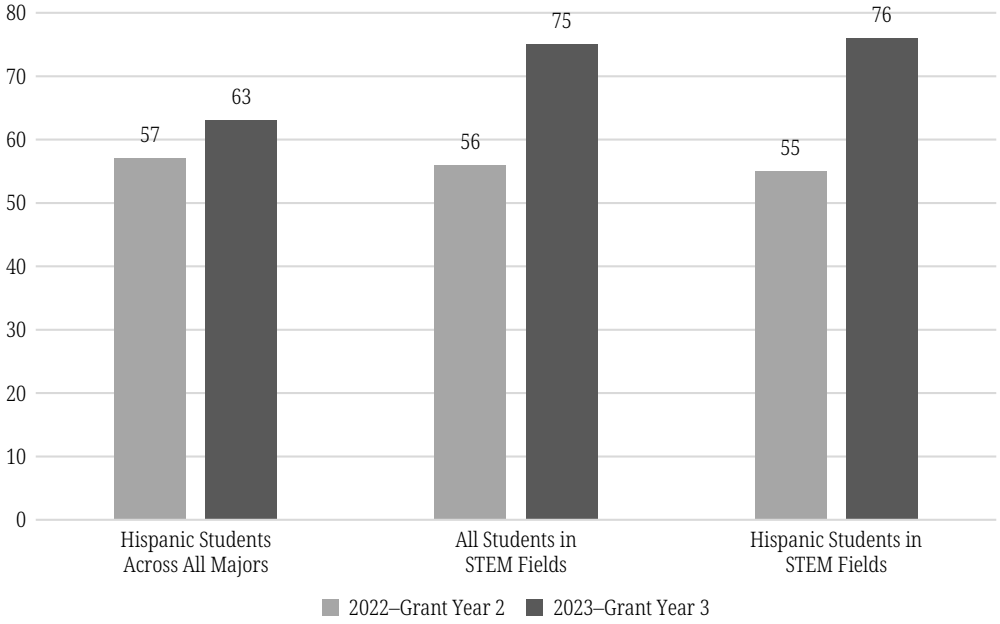

Fig. 1. Percent of retained students

5.3 Sustainability and scalability

A critical consideration is ensuring the sustainability of these initiatives beyond the Title V grant period. OLLU has already begun embedding redesigned STEM courses into the permanent curriculum approval process, ensuring institutional adoption. Budget allocations have been adjusted to maintain EXL STEM Studio operations, and faculty development workshops are now part of the annual professional development cycle.

Scalability is also being considered: the EXL/UDL framework is being piloted in non-STEM disciplines, such as business and social sciences, with early indicators of positive student response. These steps suggest a long-term institutional commitment to sustaining and expanding the project's innovations.

5.4 Future directions

Building on the success of the DHSI initiative, OLLU is exploring several next steps:

- Expanding EXL and UDL-based redesign to all gateway courses, not only in STEM.
- Incorporating emerging technologies, such as artificial intelligence and data science, into STEM curricula to ensure students' career readiness.
- Strengthening longitudinal tracking of alumni outcomes to assess the long-term career impacts of redesigned courses.
- Partnering with other HSIs to develop a consortium focused on evidence-based STEM pedagogies for Hispanic student success.

These future directions underscore OLLU's commitment to continuous improvement and its role as a national model for advancing equity in STEM education.

5.5 Conclusion

This project represents a significant investment in the success of Hispanic students in STEM at OLLU and has the potential to serve as a model for other HSIs nationwide. By implementing evidence-based strategies and innovative approaches, the project aims to address the persistent challenges faced by Hispanic students in STEM and create a more equitable and inclusive learning environment. The project's potential for long-term impact on Hispanic students in STEM is substantial. By improving their academic performance, persistence, and graduation rates, the project can contribute to increasing the representation of Hispanics in STEM fields and fostering a more diverse and inclusive STEM workforce. Furthermore, the project has broader implications for promoting equity and diversity in STEM fields. By demonstrating the effectiveness of comprehensive support programs and inclusive teaching practices, the project can inspire other institutions to adopt similar approaches, thereby contributing to the creation of a more equitable and inclusive STEM education ecosystem for all students.

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