The Third Evaluation Report:

Strengthening STEM Education for Latinx Students at CSUB*

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* This project received $599,590 funding each year for a total of $2,997,950 in five years from the U.S. Department of Education (award number P031M190029).

Contents

Abstract

California State University, Bakersfield (CSUB) has been implementing a Title Vb grant, "Promoting Excellence in Graduate Education and Increasing Hispanic STEM Related Degree Completion," to continue *strengthening the STEM program support* for students of Latino origin and *developing a Graduate School-Going culture* across the campus. In Year 3, the grant team has completed five tasks: (1) Assessing the quality and capacity of the faculty mentoring program; (2) Maintaining weekly management meetings to sustain program operation; (3) Hosting another annual Grad Slam to showcase student research; (4) Participating in 50 Virtual Grad Fairs to promote the graduate programs; and (5) Delivering effective workshops to strengthen student support. In addition, the grant funded a Graduate Student-Faculty Collaborative Research program and supported 12 Faculty Fellows to enhance STEM mentorship for 15 students, of which seven had Hispanic ethnicity. At the institutional level, partnerships have been established between CSUB and two universities to expand education pathways for graduate studies. Guided by the project logic model and a well-established Results-Based Accountability framework, quantitative and qualitative data have been gathered to triangulate evaluation results across different components of the grant support. The report ends with a *Conclusion* section to review the past recommendations and adduce new recommendations for project improvement.

The Third Evaluation Report:

Strengthening STEM Education for Latinx Students at CSUB

California State University, Bakersfield (CSUB) has completed the third year of its five-year grant, *Promoting Excellence in Graduate Education and Increasing Hispanic STEM Related Degree Completion*, funded under Title V, Part B (Title Vb) provision of the U.S. Department of Education (Award Number P031M190029). The Promoting Postbaccalaureate Opportunities For Hispanic Americans (PPOHA) Program is designed to address a two-fold purpose of expanding (1) postbaccalaureate opportunities for, and academic attainment of, Hispanic students; and (2) the postbaccalaureate academic offerings to enhance the program quality and help Hispanic and low-income students complete postsecondary degrees at Hispanic Serving Institutions (HSI).[1]

To document the impact of PPOHA project funding, the grant team has delineated a well-designed mechanism to sustain "evaluation of the efficacy and effectiveness of the various activities and strategies" (see p. 39 of the grant proposal). In fulfillment of this expectation, the third annual report is divided into five sections. Section 1 provides an overview of the evaluation framework according to a logic model of the grant proposal and a paradigm of Results-Based Accountability. Section 2 confirms the completion of proposed activities in Year 3. Section 3 presents assessment findings to justify the effectiveness of project support. Section 4 is devoted to information extraction from transcribed Grad Slam videos to showcase student research presentations. The report ends with a *Conclusion* section to clarify new recommendations for program improvement next year.

[1] https://www2.ed.gov/programs/ppoha/ppoha-abstracts09.pdf

Overview of the Evaluation Framework

Development of the evaluation framework is primarily grounded on two considerations, i.e., *following professional practice* and *meeting local needs*. Based on a thorough review of professional practice in the current research literature, a Results-Based Accountability (RBA) model, also known as the Outcome-based Accountability (OBA) model in Europe, is adopted to guide the evaluation of project performance in Year 3. The paradigm meets the needs of this service grant because of its emphasis on population accountability of the program funding. As Orme (2021) elaborated,

> Outcomes Based Accountability, or "OBA", is a trademarked system developed by Mark Friedman since the early 1990s and most fully expressed in his 2005 book *Trying Hard Is Not Good Enough*. It was originally developed as "Results Based Accountability" or RBA: the two titles refer to the same system. OBA is one of a number of approaches which seek to place the wellbeing of a population at the heart of policy and decision-making. (p. 4)

More importantly, the RBA framework has been proven to be a usable and replicable process that can be adapted to many settings (Hopkins et al., 2019). In Davis, Allen-Milton, and Coats-Boynton's (2019) observation, "RBA is a measure of accountability that has successfully been used to improve the performance of programs, agencies, and service systems" (p. 52). Davis et al.'s (2019) review further revealed the model's relevance in evaluating student support at educational institutions:

> In following this simple RBA guidance to assess accountability, school administrators, teachers, and social workers/counselors should work to ensure that performance measures for schools are based specifically on the students for whom schools serve and only

measure the services that can be provided by schools to support students. (p. 55)

In higher education, the literature shows the adoption of RBA measures in assessing program effectiveness (Hood, Grant, Jones, & Goldacre, 2016; Iwamoto, 2018; Williams, 2020). In particular, Yusef, Nelson, and Dix-Richardson (2019) employed RBA to evaluate STEM programs at minority-serving colleges and universities. Critical features of RBA, as Chamberlain, Golden, and Walker (2010) highlighted, include:

- Population accountability, which is about improving outcomes for a particular population within a defined geographical area;
- Performance accountability, which is about the performance of a service and improving outcomes for a defined group of service users.

Both are important to evaluating the PPOHA grant support for Hispanic students.

In supporting program evaluation, the RBA framework attached great importance to three key questions:

(1) How much did the project accomplish?

(2) How well did the project perform?

(3) Is anyone better off?

In this report, the first question is addressed in the next section to summarize the task completion assured by the grant proposal for Year 3. The second question is answered in the subsequent section to analyze assessment data on program quality. The third question is disentangled by text analytics to extract information on the improvement of student research competence. Grad Slam videos are transcribed from STEM project presentations to support an in-depth examination of the grant impact in a time dimension (Chamberlain, Golden, & Walker, 2010).

The question identification also fits a *program theory-driven* approach to ensure a good evaluation process that directly addresses the *theories of change* anticipated for a local program (Donaldson, 2007). In the research literature, "Sometimes terms like program logic, **logic models** and logical frameworks are used as equivalents to **program theory** (PT) or intervention theory" (Leeuw & Donaldson, 2015, p. 469). For this PPOHA project, a logic model is included in the grant proposal to specify the result domains as *outputs, outcomes,* and/or *impacts*. In alignment with the three critical questions from RBA, the *output* counts indicate "how much" has been completed by the project in Question 1. The *outcome* assessment evaluates "how well" the program performed in Question 2. While the quantity and quality considerations have addressed performance accountability for this project, the *impact* tracking creates an indicator of student wellbeing to describe the "better off" status of the population accountability in Question 3.

In summary, program evaluation is expected to follow four standards, *utility, feasibility, propriety,* and *accuracy* (Yarbrough, Shulha, Hopson, & Caruthers, 2010). The *utility* consideration is addressed by the RBA framework to guide the identification of key research questions for result reporting. The *feasibility* criterion is met by the *program theory-driven* approach to fit the evaluation design with a logic model of the grant proposal. The *propriety* standard is upheld by IRB's approval of a data gathering protocol to ensure compliance of the project evaluation to federal, state, and local laws and regulations. The *accuracy* standard is followed by triangulating credible evidence from tracking the annual task completion, assessing program effectiveness, and reporting the funding impact.

Fulfillment of Year 3 Tasks

Activities in Year 3 are designed to contribute to the attainment of dual goals of the grant:

1. Enhance and create additional capacity for the CSUB STEM graduate programs, which

facilitates increased enrollment, provides needed student support, improves research facilities, and engages faculty to better serve Hispanic graduate students through degree completion.

2. Develop a university-wide Graduate School Going (GSG) culture through a robust and comprehensive program that encourages, supports, engages, and prepares students to pursue graduate education.

To increase program enrollment and strengthen student support, the PPOHA grant team hired a Graduate Advisor and student assistants to sustain outreach efforts. The staff participated in 50 Virtual Grad Fairs throughout the year to promote the graduate programs. In improving research facilities, the program added $75,000 to augment funding in the *supplies* category. Meanwhile, the equipment budget was moved from Year 3 to Year 2 to reduce the budget spending.

More progress has been made in faculty engagement to better serve Hispanic graduate students, as illustrated by the completion of (1) *assessing the quality and capacity* of the faculty mentoring program and (2) *implementing Graduate Student-Faculty Collaborative Research programs* (GCRP). Per the description on page 50 of the grant proposal, GCRP was originally designed as a Summer Research program. Six research projects were sponsored by the PPOHA grant in the Summer of 2022. Through the faculty-student engagement in Year 3, GCRP has been extended to support STEM inquiries in regular semesters, which led to the completion of 21 projects during the academic year.

In addition, progresses have been made in *external partnership building* and *internal workshop offerings* to enhance GSG culture. More specifically, institutional partnerships are established with the Keck Graduate Institute (KGI) and the University of California, Merced

(UCM) to offer special incentives for CSUB students. The KGI incentives include expedited review, guaranteed interview, scholarship priority, preference for seats in Summer Programs, and waiver of application fee, standardized test scores, and one letter of recommendation. The agreement with UCM allows CSUB faculty to serve on the student advisory committee and participate in research collaborations, as well as other "sustainable and inclusive" pathway building for doctoral studies.

Internally, the grant funding has been employed to offer university-wide workshops for encouraging, supporting, engaging, and preparing students to pursue graduate education. Ten workshops are provided at the Graduate Student Center (GSC) in Year 3 to address practical issues of graduate school readiness, such as mental, cultural, research, financial, and material preparations (see below for Workshops 1, 2, 5, 6, 7, and 8) and general features of program support (see Workshops 3, 4, 9, and 10), including California Pre-Doctoral Scholars Program (Pre-Doc) and the California State University Chancellor's Doctoral Incentive Program (CDIP):

1. Expectations of Graduate School Application (24 participants)
2. New Graduate Student Orientation: Spring 2022 (47 participants)
1. New Graduate Student Orientation: Fall 2022 (78 participants)
2. Money Matters for Graduate Programs (36 participants)
3. Finances of Graduate Education (35 participants)
4. Mental Illness and Recovery (18 participants)
5. Creating a Culture of Research (22 participants)
6. Graduate Research Practice and Process (23 participants)
7. PreDoc and CDIP (25 participants)

The total participant count across 10 workshops adds to 338, far above the minimum count of 135 assured on page 51 of the grant proposal. Furthermore, the grant sponsored participation in the Graduate Studies Summit for 66 CSUB students. Training sessions have been provided to prepare students for Grad Slam, an event to showcase the excellence of research and creative activities across the campus. Participant counts are listed in Table 1.

Table 1: Number of Attendees in Grad Slam Training and Presentation Sessions

Activity	Term	Session	N
Training	Fall, 2021	Grad Slam 101	18
		Grad Slam 201	20
		Grad Slam 301	36
Presentation	Fall, 2021	Grad Slam 2021	34
	Spring, 2022	Grad Slam 2022 (first round)	273
		Grad Slam 2022 (second round)	175

In summary, the information tracking in this section has addressed the first RBA question on *how much* was accomplished by the project in Year 3. The summary of task completion, particularly with the GCRP project engagement and GSC workshop offerings, clearly shows the *quantity of work* exceeding the milestones assured by the grant proposal.

Effectiveness of the Grant Implementation

While data tracking in the last section has shown adequate service coverage, Michael Friedman (2015), developer of the RBA model, insisted that *Trying Hard Is Not Good Enough*. Thus, program performance needs to be assessed to further reflect program quality. The quality emphasis also echoes a recommendation from the Council of Graduate Schools to "strengthen and advance the quality of graduate study at the University [CSUB]" (Augustine, 2022, p. 1). In this section, quality indicators are derived from the Title Vb Faculty Fellow Reports, Faculty Fellows Collaboration Survey, Graduate Studies Summit Survey, and evaluation data from the 10 Graduate School workshops on page 9 of the report.

Students' Feedback about Effective Mentorship Support

The faculty mentorship support for graduate students is funded to strengthen the quality of STEM research projects that require documentation of mentorship meetings between mentors and mentees. Twelve faculty members were selected as Title Vb fellows this year from departments of Biology, Computer Science, Geology, Nursing, and Psychology. Although Psychology is housed outside of the School of Natural Sciences, Mathematics and Engineering (NSME) at CSUB, the cross-school support fits what has been proclaimed by the university president, i.e., "Grants and programs throughout the university's four schools seek to improve Latinx representation, particularly in STEM professions" (Zelezny, 2022, p. 3).

In Year 3, students provided feedback about the mentorship meetings in faculty reports. Some of the results have been listed below to illustrate the mentorship impact from student perspectives:

- Students were thrilled with the meetings; this included the topics and group dynamics from the lab meetings and the progress from the individual meetings. They also each have continued to regularly express to me how much they appreciate my attention and dedication to their well-being, studies, and professional development. The topics were of great interest to the students, and they expressed excitement about the upcoming topics, schedules, and goals.
- I have received very positive feedback from the students about our meetings. They express how appreciative they are about how much time I am always willing to spend, the discussions that we have, and the guidance that I have helped provide them. They have enjoyed discussing papers and research and having more meta-discussions about mentoring. Overall, the agendas and topics discussed in our lab and individual meetings

continue to be of great interest to the students.

- For each meeting, students expressed extreme satisfaction regarding the topics, agendas, and content of the discussions. They indicated that they feel heard and supported in their endeavors. They also indicated that they appreciate that they are able to help craft our meeting agendas and that I am understanding of the time changes that they have sometimes needed to make to our meeting schedules due to their work commitments.
- Dr. Luis Vega, Interim Associate Dean of Graduate and Undergraduate Studies, said that the students in attendance had indicated their appreciation for providing information about research and our own experiences.
- Overall, students have enjoyed the agendas and topics discussed in our lab; and individual meetings.

A review of additional student comments revealed general feedback that the biweekly meetings were "useful" and "motivating" to help mentees "stay on task." The mentorship has benefited students in multiple aspects, such as progress monitoring, Grad Slam presentation, research discussion, lab assistance, and expectation adjustment. Through the one-to-one meetings, the mentorship platform has created new opportunities for STEM faculty to pay individualized attention to student needs that cannot be addressed collectively in a classroom setting.

The mentorship arrangement has enhanced program support for minority students. As Rabinowitch (2019) indicated, "Language barriers may limit NNES [non-native English Speaking] students' effective communication with professors, and may lead some students to minimize and even evade communication with faculty" (p. 23). The barrier could have hindered student progress. The Faculty Fellow reports showed instructors' dedication to removing the

language obstacle for Latino students in STEM education. As a faculty member noted,

> At the very beginning, the students from different departments cannot totally understand each other, because the different understating of the same English word from different discipline perspective. After a while, we decided to use "elementary English" to describe the problem and the potential solution. Both sides of the students are very happy with this communication method.

In summary, the student feedback indicates that the PPOHA grant support has not only strengthened research collaboration between mentors and mentees across different departments, but also effectively reduced the language barrier in STEM learning which particularly benefited graduate students of Latino origin.

Faculty Fellow's Report on Partnership Building

Built on the positive evidence from each Faculty Fellow (FF) report, the grant team created an opportunity to examine partnership building. Because the whole could be larger than the sum of its parts, effective faculty collaboration can help broaden the funding impact.

In the third year, FF completed a survey to identify their collaboration partners in teaching, research, or mentoring *within* and *beyond* their departments. A Newdraw software is employed to depict the *within-department* network in Figure 1. Because "Cruz" is the last name of two faculty members (Alberto C. Cruz in Computer Science and Anna Cruz in Geology), the node has superficially forged a connection between these departments. Another anomaly hinges on an excessive claim of network connections by one FF in Nursing (see the bottom-right cluster of Figure 1). With the exclusion of her partnership structure, the number of nodes drops from 45 to 30. Likewise, 25 additional nodes were introduced by partnership links in a network between departments (Figure 2).

Figure 1: Partnership Building Initiated by Title Vb Faculty Fellows with Department

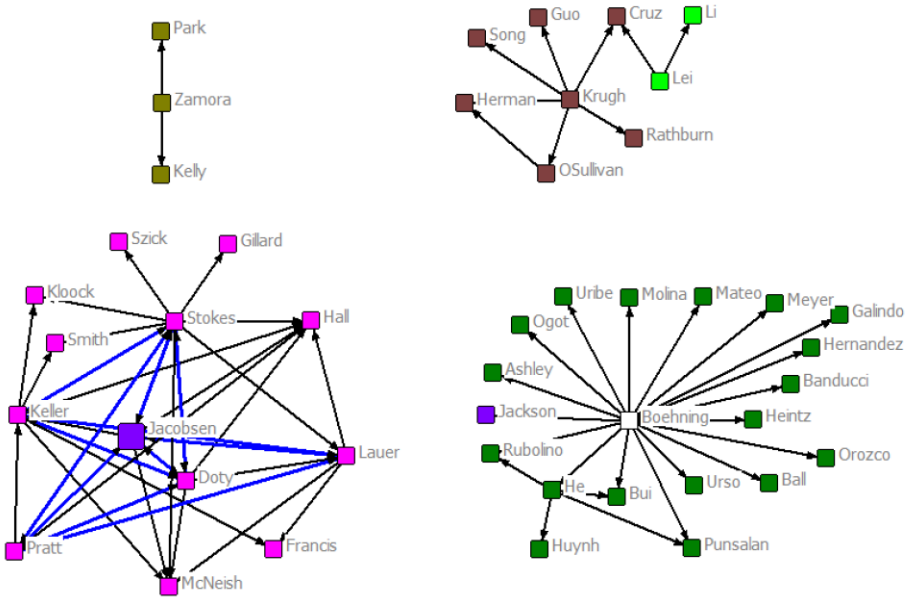
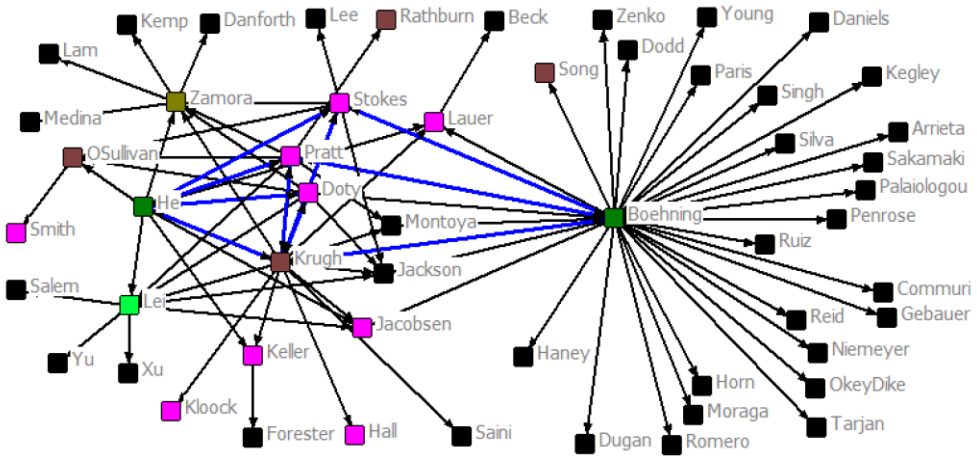


Figure 2: Partnership Building Initiated by Title Vb Faculty Fellows Between Departments



Color coding has been applied to the nodes to differentiate faculty affiliations in Biology (■), Computer Science (■), Geology (■), Nursing (■), Psychology (■), or other departments (■). The Co-PIs are differentiated by node ■ to keep their leadership roles more visible in Figure 1. The *within-department* network shows more node connections in these departments with a higher FF density. In particular, the density is the highest in Biology for housing half of the FF this year. After excluding the aforementioned node with excessive connections, the Nursing and Geology networks show more connections at Nodes “Krugh” and “He”, the two program

directors. These networks are centered around the key members to confirm their pivotal roles. Another example of the leadership impact is demonstrated by Co-PI Jackson and Jacobsen's involvement in the most connected Biology and Nursing networks. The support for network centrality has been advocated by the research literature. As Ramanadhan et al. (2012) pointed out, "Networks that are highly centralized can spread information and resources effectively from the influential members" (p. 3).

The stability of a network depends on mutual agreement on the partnership status between the key players. In Figures 1 and 2, the reciprocal links are highlighted by blue lines to represent bilateral connections between network nodes. The within-department network shows all the mutual partnerships in Biology (Figure 1), and most of the reciprocal links between departments are also partnered with Biology faculty members (Figure 2). Since the "reciprocation rate is inversely related to the barrier level in these networks" (Singhal et al., 2013, p. 1), the faculty network in Biology, with more FF support, demonstrates less barrier due to the partnership mutuality. Networks in other departments feature unilateral connections. According to Kuhnt and Brust (2014), these networks can be more adaptive to the relation adjustments for network improvement.

It should be noted that STEM majors are not delimited to Biology, Computer Science, Geology, Nursing, and Psychology, and so is the scope of future FF recognition. In Goal 2 of this grant, the GSG culture enhancement is intended to be a university-wide drive. Beyond the network links in Figure 1, faculty of other departments are displayed in Figure 2 to portray the partnership extension across the campus. It shows that faculty from the other departments accounts for 68.5% of the total node composition. Based on an *average of two links per node* in both Figures 1 and 2, comparable partnership collaboration is supported by network computing

to generalize the network pattern to these nodes with no network data collection this year (Laramore, 2020). In retrospect, the development of the broad-based faculty collaborative value, along with the establishment of faculty-student mentorship in the previous section, has laid solid cornerstones to strengthen the GSG culture at CSUB.

Meanwhile, the faculty support has led to the GCRP teamwork in STEM inquiries. Five faculty fellows reported their participation in student project development. One of them wrote:

> I believe that this program established a feeling of camaraderie between the participating graduate students. ... A sense of belonging and community is essential for graduate student development and growth; being able to converse with other students and share experiences motivates the students and helps them gauge their progress.

In terms of the program outcome, another fellow observed,

> Knowing that this program offers many resources available to graduate students that makes the research project process manageable. I believe that the program encourages students to conduct research, regardless of the areas of study. During the Grad Slam there were many different types of research projects presented.

A student echoed,

> This program has been beneficial in a multitude of ways. The Grad Slam competition was a rewarding experience and instrumental in providing me with the confidence to discuss my research. Engaging with my fellow Grad Slam participants and watching everyone discuss their research was very enriching. Collaborating on my research with my mentor has provided me with important skills and knowledge to enhance my career. I'm very fortunate to have received this grant and the opportunities it has provided.

To further examine the program's impact on student learning outcomes in this report, a separate

section is devoted to the Grad Slam evaluation, and more discussions are added to the GCRP outcome assessment in the *Conclusion* section.

Positive Feedback from Graduate Studies Summit Survey

A Virtual Graduate Studies Summit is hosted in Fall 2021 to offer a series of workshops on the opportunity to pursue graduate education at CSUB. "Featured topics include how to find the right program, preparing for testing requirements, methods to solicit strong references and crafting a winning personal statement".[2] Sixty-six participants were given a chance to provide feedback in seven sessions:

- Graduate Program Alumni Panel Presentation
- Finding the Right Program for you
- Discovering CSUB's Graduate Programs
- Soliciting Strong References
- Crafting a Winning Personal Statement and Resume/CV
- Preparing for Graduate/Profession at School Testing
- Funding Graduate School
- Information for International Students

On a five-point scale with 1 representing *extremely useful* and 5 for *not at all useful*, a mean rating of 1.26 was obtained from 27 respondents to indicate a worthwhile learning experience. In terms of the frequency count, more than 96% of the responses were in *extremely useful* or *very useful* categories. In addition, nearly all students strongly agreed that the session met their expectations. The majority (or 61%) of the respondents indicated that they were extremely likely to apply to a graduate school, given the information provided in the session. In

[2] https://news.csub.edu/csub-hosting-virtual-graduate-studies-summit

the comment section, students mentioned that the presentation was wonderful; the video was clear; the session was extremely helpful, very digestible, and informative, and "Everything has been great thank you". No negative comments appeared in the survey results. Altogether, the quantitative and qualitative indicators consistently suggest effective workshop offerings during the Graduate Studies Summit events.

Evaluation of GSC Workshops

In alignment with the dual goals of strengthening STEM education and promoting the GSG culture across the campus, the Title Vb funding sponsored 10 workshops in Year 3 (see pages 9 of this report). As indicated in the grant proposal, "While these workshops will be targeting STEM students, all CSUB graduate students will be welcome to attend" (p. 31). Feedback is gathered to assess the effectiveness of these workshops hosted at GSC. Table 2 shows the themes, respondent counts, and approval rates.

Table 2: GSC Workshop Offering and Feedback Respondent Count

Theme	Respondent Count	Approval Rate
Preparing a Personal Statement	12	92
Expectations of Graduate School Application	3	100
New Graduate Student Orientation: Spring 2022	6	83
New Graduate Student Orientation: Fall 2022	15	87
Money Matters for Graduate Programs	20	100
Finances of Graduate Education	10	100
Mental Illness and Recovery	6	50
Creating a Culture of Research	2	100
Graduate Research Practice and Process	5	100
PreDoc and CDIP	2	100

The approval rate is configured by a percent of the responses in *extremely useful* or *very useful* categories. The result shows a fluctuation in the approval rating due to variations in the respondent count. When the data contain 10 or more responses, the approval rating changes from 87% to 100%. Otherwise, the range is enlarged to 50%-100%. As a summary index, the

average approval rating across 10 workshops reaches 91.2%, indicating overwhelmingly positive feedback from the workshop survey.

To justify *how well* a STEM grant is performing, Moore-Russo, Kornelson, Savic, and Andrews (2021) encouraged "using multiple data sources that represent pertinent student, faculty, department, and administrative actions" (p. 345). Through administering the Faculty Mentoring Program, Title Vb Faculty Fellow Program, and GCRP for strengthening graduate student-faculty collaborative research across CSUB's STEM departments, multiple sources of data have been gathered from faculty mentor reports, Faculty Fellows Collaboration Survey, Graduate Studies Summit Survey, and the GSC workshop evaluation. Triangulation of the results from faculty and students consistently suggests quality program implementation in Year 3.

Enhancement of Student Research Competencies

While the examination of *task fulfillment* and *project effectiveness* in the previous sections has addressed the scope and quality of Title Vb grant support, this section is devoted to disentangling the third question of RBA, *Is anyone better off?* on the time dimension. In 2019, CSUB committed to supporting Grad Slam presentations to showcase student research competence. After the establishment of baseline performance, Grad Slam was held during the first three years of the grant funding. Hence, the enhancement of research competency has been tracked by the videorecording of these events to document the grant's impact on improving student performance.

Besides supporting STEM inquiries, Grad Slam features student presentations in research and creative activities across different academic fields. Accompanied by the support for Goal 2 of this grant to promote university-wide GSG culture, Grad Slam also creates an opportunity for

graduate students to hone their public speaking skills before a judge panel to demonstrate how well they engage the non-specialist audience, how clearly they communicate key concepts, and how effectively they focus and present their ideas within three minutes. The demand for communication skills may further benefit the network building among these emerging scientists and scholars during the event. Overcoming the weakness of public speaking could be particularly desired for Hispanic students as researchers identified "communication gaps as the major barrier that impeded [Latino] student achievement" (Good, Masewicz, & Vogel, 2010, p. 327).

In this report, video recordings from Grad Slams 2019, 2020, 2021, and 2022 are employed as empirical data to assess the enhancement of student competence in research presentations. In the past, qualitative research is a mainstream method for extracting in-depth messages from video analyses (Heath, Hindmarsh, & Luff, 2010). While each video segment illustrates the authentic performance of a Grad Slam participant, the inductive approach from qualitative inquiries could be biased and inconclusive even under the most promising tool of grounded theories (Konecki, 2021).

Fortunately, it is well-known that "Today's natural language processing systems can analyze unlimited amounts of text-based data without fatigue and in a consistent, unbiased manner."[3] The methodology advancement has overcome a seemingly insurmountable issue of result replicability from information extraction (Sarkar, 2019). More recently, the NLP-based text synthesis has been spearheaded by an R package, *Quantitative Analysis of Text Data* (quanteda). According to Benoit et al. (2018),

quanteda is an R package providing a comprehensive workflow and toolkit for

[3] https://www.linguamatics.com/what-text-mining-text-analytics-and-natural-language-processing

> natural language processing tasks ... Using C++ and multithreading extensively, quanteda is also considerably faster and more efficient than other R and Python packages in processing large textual data. (p. 774)

To date, the R package application has been widely adopted by large-scale assessment projects of the federal government (Caro & Biecek, 2017; Matta, Rutkowski, Rutkowski, & Liaw, 2018). With the quanteda tool, an innovative approach is taken in this section to handle the text analytics in three steps:

1. An online portal is adopted to transcribe the video content in text files;
2. Natural Language Processing (NLP) is applied to transform the unstructured text from Grad Slam into normalized data suitable for analysis by machine learning algorithms;
3. R scripts are developed to extract the overall features of the Grad Slam outcomes (see Appendix 1).

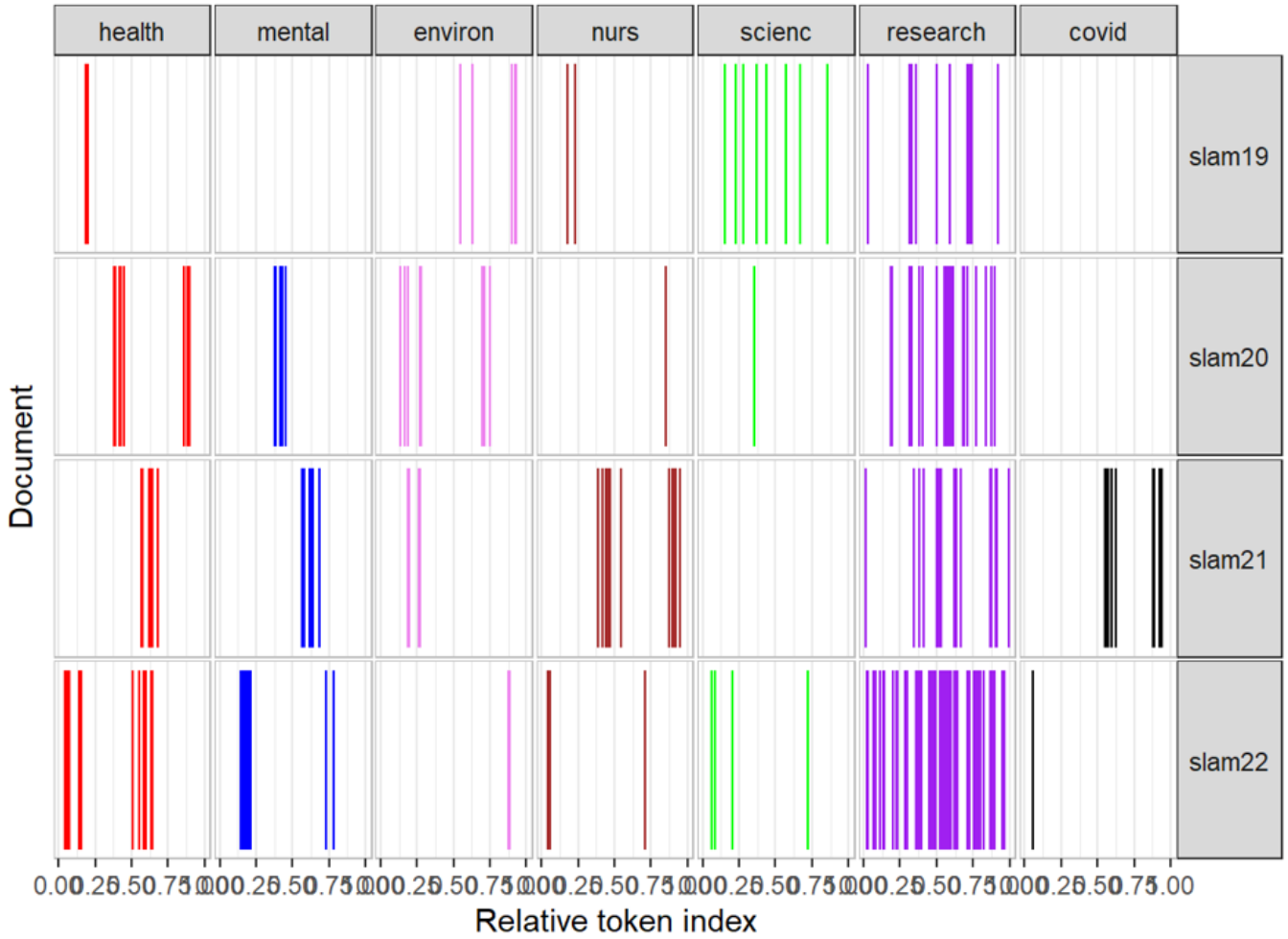
In complement with the results from text analytics, survey data are analyzed subsequently to assess the usefulness of CSUB workshops for Grad Slam preparation.

Findings from Text Analytics

After NLP's *text tokenization, stopping-word/punctuation cleaning*, and *dictionary stemming*, a Lexical Dispersion Plot has been drawn from the text data to compare frequently-mentioned words across the four Grad Slam events. In Figure 3, keywords stemming from the presentation content are tracked to show STEM topic coverage among the Grad Slam sessions. With the Title Vb funding, research projects in 2022, 2021, and 2022 consistently addressed topics in *mental health*, an area missed in Grad Slam 2019 prior to the federal grant support. In comparison to the baseline count in 2019, it is evident that the *health* domain has more project coverage during the first three years of the grant funding. The increase in *nursing* research

projects also coincided with the peak of *COVID* impact in 2021. As a tokenized item, *research* had the least coverage in Grad Slam 2019 and the most in Grad Slam 2022. Hence, the pattern in Figure 3 confirms a steady increase of *research* presentations in Grad Slam. Altogether, the grant funding during Years 1-3 is not only linked to the expansion of STEM topic coverage, but also contributed to the strengthening of research engagement of graduate students in their Grad Slam presentations.

Figure 3: Dispersion of Content Coverage in Grad Slams



In Figure 4, a word-cloud plot was generated to capture all tokenized terms for each year. As shown by the tokens of larger size, the word cloud plot indicates *research* as the primary feature of Grad Slam presentations in 2022, while *Pandem[ic]*gained more project coverage in

2021. Other tokenized terms in Figure 4 are closely related to student inquiries in biology, geology, and other STEM fields to echo the topic identification in Figure 3. In R computing, truncated terms, such as *Pandem* for *Pandemic*, are created to reduce the matrix sparsity.

Figure 4: Word-Cloud Plot on Key Components of Grad Slams

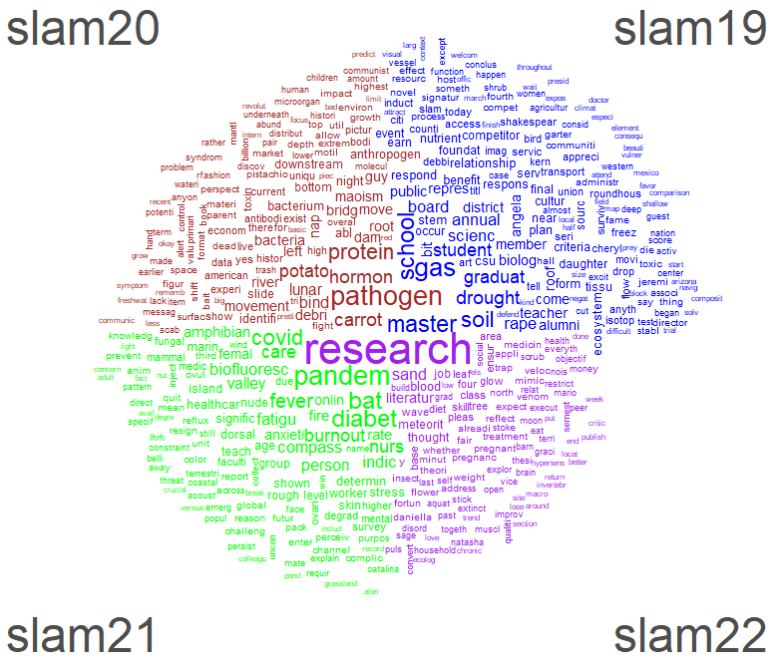
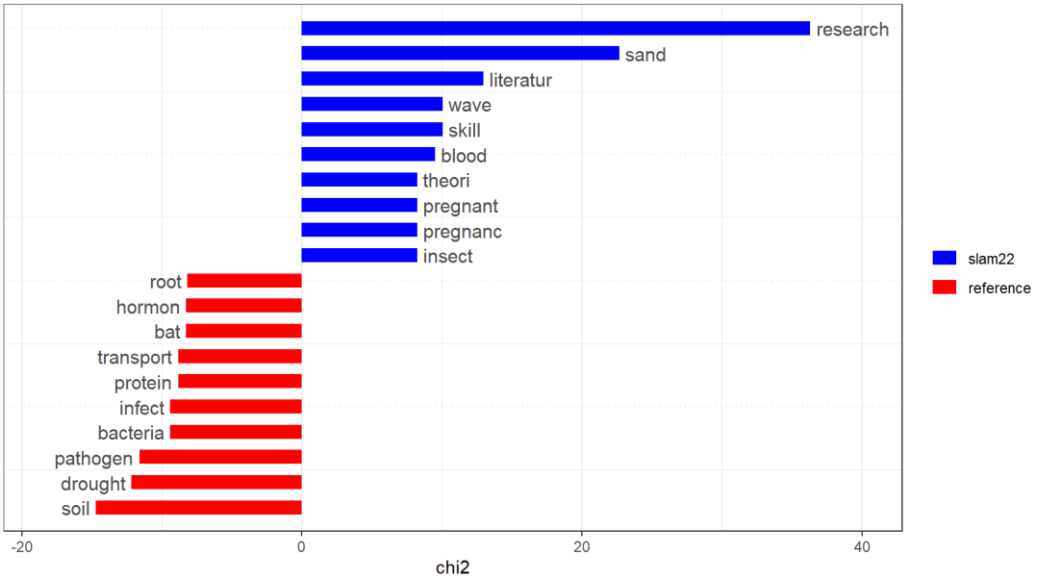


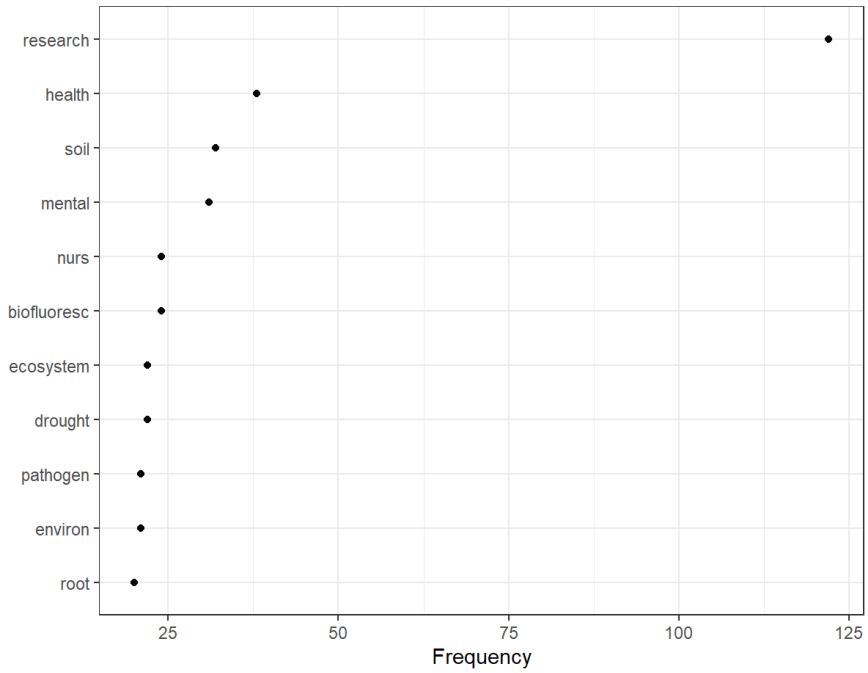
Figure 5: Contrast of Grad Slam 2022 on Year 3 Outcomes



As a report of the grant performance in Year 3, a keyness plot is created in Figure 5 to

contrast the features of Grad Slam 2022 against the characteristics of previous sessions. Besides tokenized terms in biology [e.g., *blood, insect, pregnant, preganc(y)*], physics and geology [e.g., *wave, sand*], the third-year results in 2022 include tokenized *literatur(e), research*, and *theori[es]* to show enrichment of confirmatory inquiries in student presentations. No such advancements were extracted from the videorecording of previous Glad Slam sessions.

Figure 6: Indicators of Motivation Attribute in Guest Talks



The common feature of Grad Slam is displayed by a plot of the top impact words in Figure 6. After the text data aggregation, tokenized terms show more project emphasis in the fields of biology, geology, and nursing, which seems to be aligned with the majority of the faculty fellow affiliations in these departments. As indicated on pages 16-17, faculty fellows extended support to help students prepare for the Grad Slam presentation.

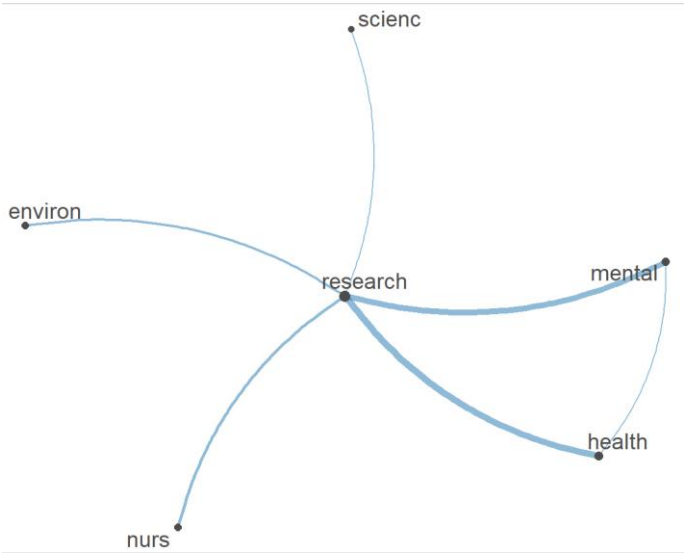
In a token-indicator relation plot, projects seemed to be connected between health and mental [health] in Figure 7. In contrast, *research* is positioned as the centroid to articulate different field-based inquiries for Grad Slam presentation. A faculty fellow's report below

appears to support the separation of tokenized terms among STEM subjects:

> Nursing is very different. The nursing graduate students are professionals coming back for specialized education so they can provide more healthcare accesses to patients. The Family Nurse Practitioner Program also has limitations due to ratio of faculties to students.

As a result, few students had their projects concurrently linked to multiple STEM fields of *scienc[e]*, *environ[ment]*, and *nurs[ing]*, which left *research* as the primary connecting point in the token-indicator relation plot (Figure 7).

Figure 7: Token-Indicator Relations in Grad Slam Projects



In summary, the results of text mining repeatedly indicated that Grad Slam presentations primarily focused on topics of STEM fields. With the Title Vb grant support, student presentations have expanded the topic coverage across more STEM domains (Figure 3). In addition, the projects have become increasingly research-centered (Figures 4-7). Findings from the information extraction have offered a clear answer to the third question of RBA, i.e., students have gained research competency and are better off due to the federal grant support in the past three years.

Feedback on Grad Slam Preparation

The ongoing improvement is inseparable from well-executed workshop offerings to prepare students for the Grad Slam competition. Typical feedback from different sessions of the Grad Slam preparation is listed in Table 2.

Table 2: Student Feedback about Grad Slam-Related Events

Events	N	Results
Grad Slam 2021	21	- 95% reported the topic "easy to understand" - 90% claimed "meeting their expectations"
Grad Slam 101	3	- 100% reported "extremely useful" or "very useful" - All believed that the event met their expectations
Grad Slam 201	1	- The respondent had a "very useful" response - Expectations have been met
Grad Slam 301	7	- 100% reported "extremely useful" or "very useful" - All believed that the event met their expectations
Grad Slam 2022	29	- 100% reported "extremely useful" or "very useful"

Besides the positive pattern, it should be noted that the latest data collection in Table 2 occurred with Grad Slam 2022, which showed the *usefulness* conclusion from more respondents. Aside from some suggestions on better time arrangements, the following comments were typical across the participant responses:

- Thank you so much for putting this workshop together today. It was very empowering, useful and practical.
- This is good to boost confidence. I wish we have more of this!
- Great experience. Learned so much about so many different topics.

In summary, the survey result aggregation and video-text analytics have resulted in adequate and credible evidence to suggest better student preparation for the Grad Slam presentations during a funding period of the Title Vb grant. While the previous sections addressed *program accountability* pertaining to the first two questions of Results-Based Accountability, the examination of **whether students are better off** in this section represents

more in-depth inquiries of student performance for justifying *population accountability* (Friedman, 2015). Ultimately, population accountability responds to a call to strengthen STEM education for Latino students that is clearly aligned with the original legislative intent of this PPOHA grant.

Conclusion

As an HSI, CSUB has over 60% of undergraduates identified as Hispanic or Latinx.[4] According to Renaud and Suarez-Renaud (2008), "While a significant percentage of Whites who attain their bachelor degrees will eventually move on to graduate school, only one percent of Hispanics and three percent of Blacks do" (p. 1). Although the rate might have increased recently, Rodriguez (2019) maintains that "Latinos exhibit lower rates of degree completion" (p. 17). The dual goals of this grant are focused on sustaining the capacity building of STEM education and strengthening GSG culture to better serve Hispanic/Latinx graduate students. As President Zelezny (2022) recapped,

> The goal [of PPOHA project] is to enhance and create additional capacity by increasing enrollment, providing needed student support, improving research facilities, and engaging faculty to better serve Hispanic/Latinx graduate students through degree completion. But the real mission is simple: To encourage more of our students to pursue graduate education. (p. 3)

In Year 3, a Co-PI of this grant contacted the university registrar to verify program support for 15 graduate students, and 46% of them belonged to the Hispanic group. Meanwhile, well-rounded services have been offered to strengthen graduate student recruitment (see ¶. 2 of page 8), enhance mentor-mentee collaboration (¶. 3 of page 11), expand faculty partnership

[4] https://news.csub.edu/csub-receives-3-million-grant-to-support-hispanic-students

building (Figures 1 &2), provide Grad Slam training (Table 1), increase GSC workshop offerings (¶. 2 of p. 9), overcome language barriers for Latino students (¶. 1 of page 13), and partner with other institutions to expand the program pathway (¶. 3 of page 8). The extensive service delivery and adequate program support are clearly justified by credible evidence from both qualitative and quantitative parts of the evaluation findings in this report. In addition, trend data from Grad Slam show ongoing improvement in STEM research competency among graduate student participants since the beginning of the Title Vb funding (Figures 3-5). Based on the RBA paradigm, the evaluation results support an unambiguous conclusion, i.e., satisfactory progress has been made in Year 3 toward attaining the dual goals of this grant funding.

Review of Past Recommendations

In the annual report last year, three recommendations were offered for program improvement:

- Expanding the mechanism of progress tracking to more STEM programs;
- Enhancing the program collaboration between this PPOHA project and the Title III grant to support the development of STEM careers for Latinx students;
- Incorporating a standard data collection platform for the overall result aggregation.

In preparing for the grant reporting this year, a Co-PI noted that "We are trying to track student progress in the other STEM programs."[5] The other Co-PI provided more detailed responses to the evaluator:

> Regarding Rate of Progress, we have taken your idea and our preliminary analysis of Biology and have been trying to implement this across our STEM-associated programs.

[5] Personal communication with Associate Vice President Debra Jackson on 2/27/2023.

> We discovered that record keeping and the tracking of student code (GRA1, GRA2, GRA3) hasn't been consistent and there are some problems with the data as it is entered and then pulled from PeopleSoft. Adrianne has been doing amazing work trying to clean up data and track information.[6]

In addition, the Co-PI reported the *rate of progress* (ROP) indicator as an outcome measure in a well-received presentation for STEM faculty at CSUB (Jacobsen, 2022). Hence, the grant team has addressed Recommendation 1 on expanding the ROP configuration.

For the second recommendation, a partnership has been created between Title Vb and Title III grants to support graduate students as mentors for the *Summer Undergraduate Research Experience* (SURE) program with a clear intent to facilitate the development of STEM careers for Latinx students in Title III. Thus, Recommendation 2 has been implemented by the grant team.

Since the delivery of the last evaluation report, a leadership change has occurred at GSC. A new Associate Dean was hired to engage in the platform standardization for evaluation data collection. It is worth noting that no hurdle has been encountered by the evaluator during the GSC data access. Hence, the third recommendation has been addressed this year.

In summary, the Title Vb grant team has paid attention to all recommendations from the last year. The impact is reflected by the expansion of student progress tracking, support for SURE service learning, and improvement in education data collection.

New Recommendations

Advocated by *Excelencia in Education*, a national organization with a mission to *accelerate Latino student success in higher education*,[7] "measurement of student progress" is

[6] Personal communication with Professor Anna Jacobsen on 2/22/2023
[7] https://www.edexcelencia.org/

listed as a criterion for "Examples of Excelencia" in strengthening Latina/o student education. Given the fact that Hispanic students often take a longer time for degree completion (Murphy, 2022), the first recommendation is for the grant team to **track the impact of various program supports for students of Latino origin**, in addition to the ongoing monitoring of academic progress of all graduate students in the STEM program pipelines. This recommendation is not only aligned with the PPOHA grant priority, but also grounded on a new recognition of the university's status as "CSUB ranked among top Hispanic-Serving Institutions."[8]

In addition, the pattern of Grad Slam presentation shows more research projects in biological sciences (Figures 3-5). Half of the faculty fellows are affiliated with the Biology department this year. While celebrating the exemplary achievements, the second recommendation is for the grant team to consider **expanding the success of faculty support and student engagement to other STEM subjects**. Development of the GSG culture could benefit from increasing the grant impact with a more balanced subject representation across all STEM fields.

In designing the GCRP Faculty Report, an attempt has been made to articulate indicators of project intervention and grant outcome with the following two questions:

- Did you attend any Title Vb faculty workshops, seminars, or discussions this year? If yes, which ones?
- How has this program supported the development of a graduate culture at CSUB?

While Title Vb faculty workshops, seminars, or discussions create rich learning opportunities for professional development, it remains unclear whether they are profound enough to significantly impact the campus culture. As a faculty fellow noted,

[8] https://news.csub.edu/csub-ranked-among-top-hispanicserving-institutions

> I don't believe this program fully supported the development of a graduate culture at CSUB—at least not for me. While we do have emerging scholars and practitioners who share a commitment to research, there's no sense of community. It's quite apparent that students who study under the same faculty member tend to congregate with each other instead of branching out and networking with others.

Based on the faculty responses, the third recommendation is for the grant team to **incorporate outcome measures that are more sensitive to the program support**.

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Appendix 1:

R Scripts for Information Extraction install.packages ("quanteda", "readtext", "quanteda.textstats", "rlang", "ggplot2", "quanteda.textplots")

```
library(readtext)
PPOHA <- readtext("D:/GradSlam/text/*", docvarsfrom = "filenames",
            docvarnames = "Year", encoding = "UTF-8")
library(quanteda)
d_corp1<-corpus(PPOHA)
PPOHA1<-tokens(d_corp1, what="word", remove_numbers=T, remove_punct=T,
remove_symbols=T, split_hyphens=T)
PPOHA1<-tokens_tolower(PPOHA1)
PPOHA1 <- tokens_select(PPOHA1, pattern = stopwords('en'), selection = 'remove')
PPOHA1 <- tokens_wordstem(PPOHA1)
d_corp1dfm<-dfm(PPOHA1)
library(quanteda.textplots)
library(ggplot2)
theme_set(theme_bw())
tplot <- textplot_xray(kwic(PPOHA1, pattern=c("health", "mental", "environ", "nurs", "scienc",
"research", "covid")))
tplot + aes(color = keyword) + scale_color_manual (values = c("red", "blue", "violet", "brown",
"green", "purple", "black")) + theme(legend.position = "none")
library("quanteda.textstats")
tstat1 <- textstat_frequency(d_corp1dfm)
ggplot(tstat1[1:11, ], aes(x = reorder(feature, frequency), y = frequency)) +
  geom_point() +
  coord_flip() +
  labs(x = NULL, y = "Frequency")
library(quanteda.textplots)
d_corp1_dfm<-dfm(PPOHA1)
d_corp1_dfm<-dfm_trim(d_corp1_dfm, min_termfreq = 3, verbose = F)
textplot_wordcloud(d_corp1_dfm, group = "Year", comparison=T, color = c("blue", "brown",
"green", "purple"))
PPOHA1<-quanteda:::tokens_group(PPOHA1, groups = Guest_Speaker)
PPOHA2<-tokens_keep(PPOHA1, pattern=c("health", "mental", "environ", "nurs", "scienc",
"research", "covid"))
PPOHA1dfm <- dfm(PPOHA2)
docvars(PPOHA1)
library(rlang)
fcmat_d1 <- fcm(PPOHA2)
dim(fcmat_d1)
feat <- names(topfeatures(fcmat_d1, 10))
fcmat_news_select <- fcm_select(fcmat_d1, pattern = feat)
dim(fcmat_news_select)
size <- log(colSums(dfm_select(PPOHA1dfm, feat)))
set.seed(144)
textplot_network(fcmat_d1, min_freq = 0.8, vertex_size = size / max(size) * 3)
```

```
textplot_network(fcmat_news_select, min_freq = 0.8, vertex_size = size / max(size) * 3)
d_corp1_dfm<-dfm(PPOHA1)
tstat_key <- textstat_keyness(d_corp1dfm, target ="slam22")
textplot_keyness(tstat_key, color = c("blue", "red"), n = 10)
library(manifestoR)
feature_frequencies_categories <- d_corp1_dfm %>%  textstat_frequency(n = 10, group = docid)
library(dplyr)
feature_frequencies_categories %>%
  mutate(cmp_code = factor(group)) %>%
  ggplot(aes(x = reorder(feature, frequency) , y = frequency, fill = cmp_code)) +
  geom_col(show.legend = FALSE) +
  labs(x = NULL, y = "share of words per category") +
  facet_wrap(~cmp_code, ncol = 2, scales = "free") +
  coord_flip()
```