Journal of Latinos and Education

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/hjle20

Finding Hispanic Serving Institutions (HSIs) for STEM Education Best Practices: When a Picture Is Worth a Thousand Words

Omar S. López

JOURNAL OF LATINOS AND EDUCATION
https://doi.org/10.1080/15348431.2022.2051707

Finding Hispanic Serving Institutions (HSIs) for STEM Education Best Practices: When a Picture Is Worth a Thousand Words

Omar S. López

Department of Organization, Workforce, and Leadership Studies, Texas State University

ABSTRACT

The present study illustrates how select data can be organized to guide researchers to HSIs proficient at graduating Hispanics with STEM bachelor's degrees to investigate best practices that less proficient HSIs can adopt for program improvement. The Integrated Postsecondary Education Data System (IPEDS) from the National Center for Education Statistics (NCES) was the data source. The primary analytic consisted of the scatterplot, supplemented by Pearson correlation r and regression analysis. While the findings failed to support the Hispanic undergraduate Pell rate as an explanatory variable for Hispanic STEM degree production capacity as the response variable, in a new light, the findings were an ideal model for initiating best practices research. Guidelines on initiating a "thousand word" discourse on best practices among HSI stakeholders, common defining moments one should anticipate at site visits, as well as the limitations and assumptions of the approach are presented. Based on the data, if low performing HSIs met the minimum benchmark level identified, the model predicted an increase of 17,392 or 50.7% additional Hispanics with STEM degrees for the US academic, technical, and professional workforce.

KEYWORDS

Best practices; IPEDS; Hispanic serving institution; STEM degrees

Colleges and universities have played an increasingly important role in providing college access and degree attainment for Hispanics in science, technology, engineering, and mathematics (STEM). At the forefront in the effort have been High Hispanic Enrollment (HHE) institutions, also known as Hispanic Serving Institutions (HSIs). According to the National Science Board [NSB] (2018), HHE institutions are degree-granting, nonprofit colleges and universities where full-time equivalent Hispanics represent 25% or more of the undergraduate enrollment. The literature commonly refers to the terms "HHE" and "HSI" interchangeably, but there are differences (Hegji, 2018). An HHE institution becomes HSI-eligible when its low-income undergraduate Hispanic student enrollment in need of financial aid meets or exceeds the proportional threshold of 50%. If so, an HHE institution qualifies to apply for federal grants as an HSI under select federal Title statutes (Hispanic Association of Colleges and Universities [HACU], 2020a). Thus, all HSIs are HHE institutions, but not vice-versa. For this reason and as a matter of practicality, the present study will use the term HSI to include HHE institutions unless otherwise stated.

Unfortunately, Congress has not kept up with funding HSI-designated institutions under these federal Title programs (HACU, 2020b). At first, federal funding grew from 1998 to 2004 under Title V, which defined and authorized the federal programs for HSIs. Then funding leveled off until 2007 while the number of HSIs and Hispanic college students continued to grow. Federal funding did increase dramatically in 2008 with the legislation of the HSI STEM program, but with the recession soon after in 2009, funds declined and never recovered while HSIs and Hispanic enrollments increased even more rapidly.

CONTACT Omar S. López OL14@txstate.edu Department of Organization, Workforce, and Leadership Studies, Texas State University, 601 University Dr, San Marcos, TX 78666

In response, Congress increased recently HSI funding to $212.12 million for fiscal year 2020 by adding 14.8% ($27.32 million) to the $184.8 million budget level in 2019 (HACU, 2020c), however, whether it closes any HSI-funding gaps in the foreseeable future is not certain. As of 2019, there were 523 HSIs and 328 "emerging" HHE institutions with 10 to 24% Hispanic enrollments and growing, and two-thirds of all Hispanic undergraduate students in the nation were enrolled at HSIs (Excelencia in Education, 2019).

Within the context of these historical events and trends, the present study illustrates how select data can be organized for identifying high performing HSIs for further research into best practices in increasing STEM bachelor's degrees awarded to Hispanics. The bachelor's degree level was chosen for analysis simply for illustrative purposes.

In doing so, the approach proposed outlined in the present study is urgent, significant, and timely for three reasons. Stakeholders have placed more accountability on federally funded institutions in graduating more students with STEM degrees because of the nation's increasing demands for a quality, highly-skilled workforce competent in STEM fields, which has driven U.S. innovation and productivity in the global economy (Committee on STEM Education of the National Science and Technology Council, 2018). Meanwhile, the history of Congress inconsistently funding Title programs suggests HSIs will need in the future to rely more on their own to find ways to increase graduation of STEM degreed Hispanics with the same resources – or less, despite the recent increase in federal funding of HSI programs for 2020. Lastly, colleges and universities face many tough decisions down the road to maintain institutional sustainability in an uncertain future due to the world-wide pandemic, and an "HSI" designation does not inoculate an institution from threats to its continued survival. Increasing pressure from accountability, unreliable access to resources, and threats to institutional sustainability – the proposed study mitigates these issues by guiding researchers to HSIs proficient at graduating Hispanics with STEM degrees to investigate best practices that less proficient HSIs can adopt and thereby, increase collectively Hispanics graduating with STEM degrees for the US academic, technical, and professional workforce.

Background

Bachelor's degree accounted for 70% of all STEM degrees awarded (n = 130,751) to Hispanics in 2017 (NSB, 2019, Table S2-7). The number of STEM bachelor's degrees awarded to Hispanics rose steadily from 27,980 in 2000 to 91,550 in 2017 – based on an average year-to-year percentage increase of 7.3% (SD = 3.4%). As a share of total bachelor's degrees awarded to Hispanics, however, STEM degrees have remained relatively flat. Of the bachelor degrees awarded in 2017 to Hispanics, 35.5% (n = 91,550) were in STEM fields, compared to 31.6% (n = 27,980) in 2000. The average year-to-year percentage increase from 2000 to 2017 for non-STEM bachelor degrees was 6.2% (SD = 1.7%), and for STEM bachelor degrees at 7.3% (SD = 3.4%).

Increasing STEM degree awards to Hispanics

No single strategy has been shown to contribute exclusively to HSIs graduating Hispanics with STEM degrees. Rather, the literature identifies a waterfront of practices researchers suggest are broadly relevant to student academic success. With regards to advising, for example, institutions need to provide students with timely, scheduled guidance with general academics and STEM discipline specific coursework (Estrada et al., 2016). Because Hispanics believe in giving back to their community as part of their personal identity, advising also needs to include campus-life, non-academic opportunities like community service where they can integrate STEM learning with local or regional needs (Stephens et al., 2012). Here, peer-mentors are essential to Hispanic students' staying on course toward college completion (Pentyala & Dilger, 2016).

Faculty's instructional practices at the discipline-level are yet another important factor, particularly in improving engagement, self-efficacy, performance, and degree attainment among Hispanic students (Eddy & Hogan, 2014). For faculty in HSIs, this means teaching Hispanic students using culturally responsive instruction where their cultural background and prior learning experiences guides the instructor's curriculum, active learning strategies, and assessments (Gay & Banks, 2010). Augmenting faculty instructional practices are opportunities for Hispanic students to engage on research projects. This allows them to think broadly across experiences – in class and out-of-class – by reflecting on ideas and actions requiring the integration of different perspectives (Haeger & Fresquez, 2016). Most central to Hispanic students' academic success is a campus climate free of racism, discrimination, and harassment toward students of color (Hurtado et al., 2012).

Two problems limit such studies. While they describe what practices HSIs should do, they do not prescribe how HSIs should do them. Moreover, one cannot determine if the researchers identified the practices in HSIs most proficient at graduating Hispanics with STEM degrees, casting doubt on the efficacy of the practices to transform less proficient HSIs into proficient ones. To solve these problems requires a different type of research, one intended to be purposeful and built on field-based studies of best practices at HSIs where enough empirical evidence exists to indicate proficiency in graduating Hispanics with STEM degrees. The following illustrates one practical way to illuminate such evidence.

Data and methods

The Integrated Postsecondary Education Data System (IPEDS) from the National Center for Education Statistics (NCES) was the primary data source for the present study. Located within the U.S. Department of Education's Institute of Education Sciences, the NCES is the federal government's entity for collecting and analyzing data related to education in the United States (National Center for Education Statistics [NCES], 2020a). The IPEDS data analyzed consisted of the 12-month Enrollment, Completions, Student Financial Aid, and Institutional Characteristics collections for 2018 (NCES, 2020b). Other data sources included STEM Classification of Instructional Programs (CIP) codes maintained by the U.S. Veterans Benefits Administration (2020) for educational benefits.

Measures

The study analyzed degree-granting institutions with 1,800 or more undergraduate enrollment, awarding five or more undergraduate STEM bachelor's degrees to Hispanics, and with 25% or more undergraduate Hispanic enrollment. In the IPEDS Completions file, an institution had one or more records, each one with a unique CIP code representing a field of study for a degree, the total number of students earning the degree by ethnicity, and a variable indicating the award-level (e.g., bachelor's). Based on the 2018 IPEDS data, the study focused on the following response and explanatory variables to model undergraduate Hispanic STEM degree production in HSIs.

STEM degree production capacity

The response variable consisted of STEM degree production capacity, a measure reflecting the maximum sustainable level of STEM degrees an institution can achieve relative to its operation. Such capacity is calculated by taking an HSI's ratio of Hispanics graduating with STEM degrees to its total Hispanic enrollment times 1,000, resulting in a number with units of measure in STEM/K. Based on this construct, HSIs with high STEM degree production capacity measures can graduate more Hispanics with STEM degrees per 1,000 Hispanics students enrolled compared to HSIs with lower capacity levels.

Hispanic undergraduate (UG) Pell Rate

The explanatory variable consisted of an institution's Hispanic undergraduate (UG) Pell rate. Authorized under the federal Title IV statute, Pell is a financial aid grant program for low income students enrolled in a 4- or 5-year bachelor's degree program, an associate's degree program, or a vocational or technical program below the baccalaureate (Hegji, 2018). Thus, the more students qualified and receiving Pell grants, the more of these students can attend and complete college. In this context, one would postulate HSIs with high Hispanic UG Pell rates to graduate more Hispanics proportionally also with STEM degrees than HSIs with low Hispanic UG Pell rates.

Methods

To investigate the IPEDS data, the primary analytic consisted of the scatterplot, a common tool researchers use when they want to visually assess if changes in an explanatory variable relate to changes in a response variable measured on the same observation (Moore & Notz, 2021). The explanatory and response variables' values are represented on a horizontal x-axis scale and a vertical y-axis scale, respectively, and when plotted, create a data point in Cartesian coordinate space. There are three attributes associated with a scatterplot pattern: direction, form, and strength of the relationship between the two variables. Direction refers to whether the overall pattern of the observations move from the lower left to upper right or from the upper left to lower right of the graph. Form refers to the pattern's functional shape (e.g., straight line, curved, no discernable pattern, etc.). Strength of the relationship between the two variables refers to how close the points in the plot follow a straight-line form. A strong relationship between two variables exists when the points fall closely on a straight line; a weak relationship exists when the points are randomly scattered. Thus, researchers visually assess the overall scatterplot pattern by these attributes.

Researchers can also assess empirically the overall pattern by using Pearson correlation r, a statistic for measuring the direction and strength of the linear association between two quantitative variables (Moore & Notz, 2021). The Pearson correlation r calculates to a number between −1 and 1, where a value of 0 indicates no relationship between the two variables. As the r value increases from 0 to 1, the measure indicates a stronger positive linear relationship where one variable increases in value so does the other. Conversely, as the r value decreases from 0 to −1, the measure indicates a stronger negative linear relationship – as one variable increases in value the other declines in value. The extreme values where r equals 1 or −1 indicate a perfect linear relationship where the points fall exactly on a straight line. Figure 1 shows examples of scatterplots with near-perfect Pearson correlation r measures.

These two scatterplot patterns are important in evaluation of education programs for two reasons. Based on some supposition, stakeholders commonly envision an explanatory variable measuring the extent of their program's interventions will cause some systematic and predictable change in a measurable response variable, as depicted in these two scatterplots. Whether the stakeholders imagine scatterplot A or B, however, depends on the nature of the response variable. If the response indicates the extent an intervention impedes some outcome to occur, then stakeholders envision scatterplot A. For example, as math tutoring hours (X) increases, there should be decreases in the

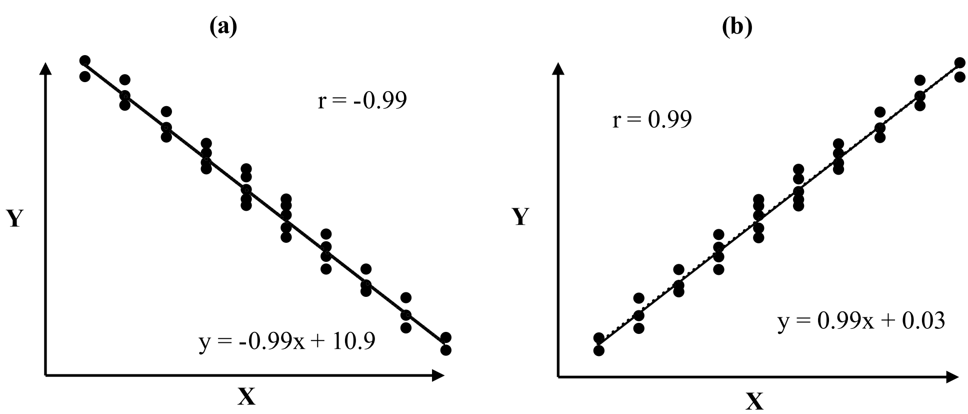

Figure 1. Scatterplot examples.

college algebra failure rate (Y). If the response indicates the extent an intervention promotes some outcome to occur, then stakeholders envision scatterplot B. Here, as math tutoring hours (X) increases, there should be increases in the college algebra pass rate (Y). Thus, the scatterplot (A) and (B) response variables are the antithesis of each other. Other examples of such response variables include dropout rate versus matriculating rate, retained rate versus promoted rate, and non-graduated rate versus graduated rate, to name a few.

The two scatterplots are also important for another reason. If a graphed data resembles either one of these scatterplots, researchers know the explanatory variable (X) will be statistically significant in predicting the response variable (Y) thereby providing some level of generalizability for policy and practice. In scatterplots (A) and (B), the x parameter estimates are statistically significant ($p < .0001$) indicating a one-unit change in X will result in an average response percentage change of −0.99 and 0.99, respectively. Applying this to the examples, a one-unit increase in math tutoring hours will result in a change of −0.99% in the average college algebra failure rate. In comparison, the same one-unit increase in math tutoring hours will result in a change of 0.99% in the average college algebra pass rate.

Results

Table 1 provides a profile of the HSIs in the present study. Among the 147 institutions, Hispanics represented on average 49.2% (SD = 25.2%) of total enrollment, almost twice the 25% threshold required for HHE designation. Of the bachelor's degrees conferred to Hispanics in 2018, on average 15.3% (SD = 9.3%) were in a STEM field. The table also shows STEM degree production capacity, as the response variable, with an average of 40.7 (SD = 24.1) STEM degrees awarded to Hispanics per 1,000 enrolled Hispanics. More so, the Hispanic UG Pell rate explanatory variable had an average of 50.7% (SD = 15.7%), the threshold required for HSI-eligibility. Lastly, the explanatory and response variables had a wide range of values, an important attribute discussed later for best practices research.

Scatterplot visual assessment

Figure 2 shows a scatterplot of STEM degree production capacity by Hispanic Undergraduate (UG) Pell Rate for the 147 HSIs.

Note the overall pattern of the data points in the scatterplot. The direction of the points is somewhat from lower left to upper right, suggesting a positive relationship between Hispanic STEM degree production capacity and Hispanic Undergraduate (UG) Pell Rate. However, the form of the data points does not define anything remotely like the straight trend-line shown in the figure, but rather, appear scattered around further suggesting the strength of the relationship is weak between the two variables. To confirm this visual interpretation, a Pearson correlation r analysis indicated a negligible positive association between the two variables ($r(147) = .07856$, $p = .3442$).

Table 1. 2018 HSI profile (n = 147).

Institutional Attributes	μ	SD	Min	Median	Max
UG Enrollment	14,369	14,990	1,802	8,377	88,475
UG Hispanic Enrollment	6,555	7,903	519	3,923	59,977
%UG Enrollment	49.2	25.2	25.5	38.0	100.0
Hispanic Bachelor's Degrees	1,765	2,084	10	974	15,490
Hispanic STEM Bachelor's Degrees	233	279	5	134	1,821
%Hispanic Bachelor's Degrees	15.3	9.3	1.0	13.9	50.0
Response Variable (Y):					
STEM Degree Production Capacity	40.7	24.1	0.2	39.9	100.0
Explanatory Variable (X):					
Hispanic UG Pell Rate	50.7	15.7	17.0	48.0	94.0

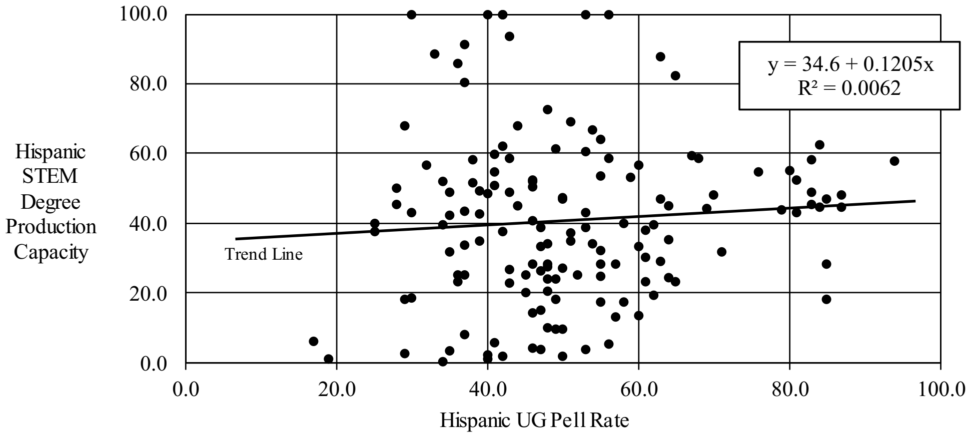

Figure 2. Hispanic STEM degree production capacity by Hispanic UG Pell Rate.

The trend line shown in the graph represents the equation: y = 34.6 + 0.1205x, where y = Hispanic STEM Degree Production Capacity and x = Hispanic UG Pell Rate. Regression analysis showed the Hispanic UG Pell Rate was not significant ($\beta = 0.1205$, SE = 0.127, t(0.95), $p = .3442$, 95% CI [−0.130, 0.371]) as a predictor of Hispanic STEM Degree Production Capacity. R-squared equaled nearly zero (0.0062), which means Hispanic UG Pell Rate explained almost none of the variation in Hispanic STEM Degree Production Capacity. More so, a Shapiro-Wilk test of the regression's residuals showed a significant departure from normality, W(147) = 0.955047, $p < .0001$, suggesting the regression model's results were inadequate to explain the relationship between the explanatory (Pell rate) and outcome (capacity) data.

Discussion

If only the select IPEDS data had shown a pattern of HSIs like scatterplot (B), and further substantiated by Pearson correlation r analysis and inferential statistics, then one could recommend using these results to promote expanding the Pell grant program as policy and practice to increase Hispanic STEM degree production capacity. A costly solution, but a solution, nonetheless.

In retrospect, one might revise the supposition behind the scatterplot analysis. As cited earlier, the more students qualified and receiving Pell grants, the more of these students can attend and complete college. If so, one would postulate HSIs with high Hispanic UG Pell rates to graduate more Hispanics with STEM degrees than HSIs with low Hispanic UG Pell rates. But this was not indicated in the IPEDS scatterplot. Some HSIs with high Hispanic UG Pell rates had lower Hispanic STEM degree production capacity than others with low Hispanic UG Pell rates but higher Hispanic degree production capacity. As unpopular as it suggests, throwing money at a problem does not always result in a desired outcome.

Another option would be to select other variables to analyze. In a sample of 152 studies of higher education efficiency, Mojahedian et al. (2020) identified 199 explanatory and 175 response measures, and organized them into 7 and 5 categories, respectively. Categories with the most explanatory measures included budget and costs (61), academic staff (45), and student enrollment (29). Categories with the most response measures consisted of publications (47), revenue, e.g., grants (45), and student outcomes, e.g., graduation rate (37). Similarly, there are plenty of explanatory and response variables to choose from the following IPEDS data collections (NCES, 2020b).

- Institutional Characteristics (4 files; 376 variables)
- Admissions and Test Scores (1 file; 39 variables)

- Fall Enrollment (6 files; 117 variables)
- 12-Month Enrollment (2 files; 43 variables)
- Completions (4 files; 110 variables)
- Graduation Rates (4 files; 110 variables)
- Outcome Measures (1 file; 28 variables)
- Student Financial Aid and Net Price (2 files; 343 variables)
- Finance (3 files; 332 variables)
- Instructional Staff/Salaries (2 files; 85 variables)
- Fall Staff (4 files; 113 variables)
- Employees by Assigned Position (1 file; 13 variables)
- Academic Libraries (1 file; 31 variables)

These are all options available for future research. Meanwhile, based on the results from the visual assessment and statistical analysis, one would conclude the select IPEDS data for the present study appears to have no value in guiding policy or practice toward improving Hispanic STEM degree production capacity among HSIs. Before making such a conclusion, however, further consideration is warranted – except in a new light.

When a picture is worth a thousand words

For illustrative purposes, let us divide the 147 HSIs into two groups and display the points again in a scatterplot, as shown in Figure 3.

The data points represented by a filled-in circle were HSIs below the select threshold of 50 Hispanics graduating with STEM bachelor's degrees per 1,000 enrolled Hispanics (i.e., < 50 STEM/K). The data points represented by an open circle were HSIs at or above the threshold. The 50 STEM/K threshold selection was based on two criteria. First, the HSIs at or above the threshold should have a range of Pell rates covering 90% or more of the Pell rates for HSIs below the threshold. Second, the HSIs at or above the threshold should represent between 15 to 33% of the total HSIs in the scatterplot. This latitude given to the criteria should be enough to accommodate a wide range of possible scatterplot patterns, while providing HSIs below the threshold with one or more HSIs at or above the threshold with comparable Pell rates to investigate for best practices.

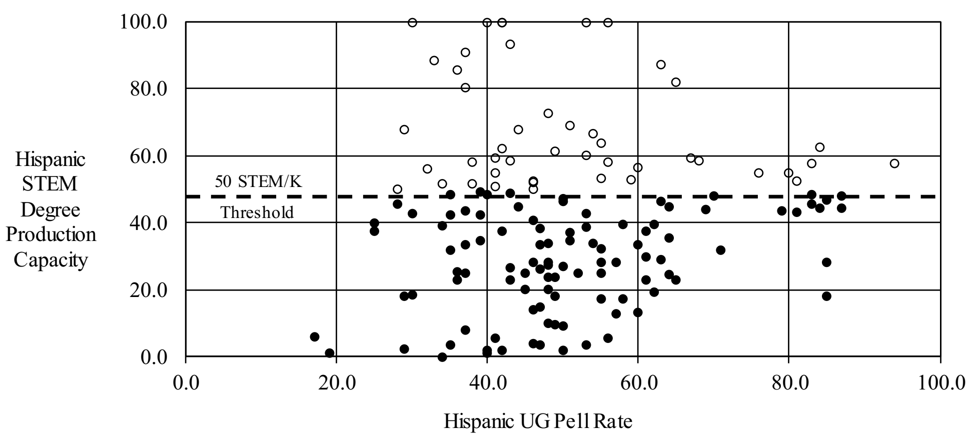

Figure 3. Benchmark Scatterplot.

Selected from a few trials at different thresholds, the 50 STEM/K benchmark sufficiently met the criteria. Among the 101 HSIs below the threshold the Pell rate ranged from 17 to 87%. Of these HSIs, 96% (n = 97) had Pell rates within the 28 to 94% Pell rate range for the 46 HSIs at or above the 50 STEM/k threshold. Of the 147 HSIs in the scatterplot, the 46 HSIs at or above the threshold represented 31.3% in the scatterplot.

Now, imagine you are at an HSI below the threshold with a given Hispanic UG Pell Rate. If you can find HSIs above the threshold comparable to your Pell rate, would it not lead you to wonder: If those HSIs have comparable Hispanic Pell rates as we do, what practices could they be doing different than us that equate Pell grant resources with higher Hispanic STEM degree production capacity?

This type of inquiry defines best practices research and requires the following conditions. First, a supposition to support a rational or plausible relationship between select explanatory and response variables. In the present study, that higher rates of Pell grants awarded to Hispanics should result in more STEM degrees awarded to Hispanics seemed plausible enough to at least explore the data with a scatterplot, but there could be alternative suppositions. For example, research has consistently shown when compared to middle-income students, low-income students are less likely to complete their college education due to a myriad of financial, social, and college readiness issues (National Student Clearinghouse Research Center, 2018). In this context, one would postulate HSIs with high Hispanic UG Pell rates to award fewer STEM degrees to Hispanics than HSIs with low Hispanic UG Pell rates. Yet, looking at the same Figure 3 benchmark scatterplot, one would still wonder how HSIs above the 50 STEM/K threshold produced higher levels of STEM degrees awarded to Hispanics, despite some also having high Hispanic undergraduate Pell rates like those at 60% or more.

A second best practices research condition is a scatterplot pattern with little direction, no form resembling a line or curve, and a weak relationship between the explanatory and response variables. Such attributes describe a scatterplot pattern with data points widely distributed across the Cartesian coordinate space, as indicated by the variable dispersion characteristics in Table 1 descriptive statistics. Associated with this condition is a Pearson correlation r equal to or close to zero, indicating little or no correlation between the explanatory and response variables.

Initiating the "thousand word" discourse on best practices

In other words, best practices researchers seek a scatterplot much like the one in Figure 3. Note the HSIs at or above the 50 STEM/K threshold and let us refer to them as Benchmark HSIs. For HSIs below the threshold, let us refer to them as Rising HSIs. Benchmark HSIs define possible standards for program improvement at Rising HSIs in graduating more Hispanics with STEM degrees. Thus, begins the "thousand word" discourse on best practices among HSI stakeholders. To do so, a Rising HSI would first organize a team consisting of 5 to 7 administrators or staff from various institutional functions like recruiting, financial aid, academic advising, and student support services, as well as 3 to 4 STEM faculty from select programs. The team would then select Benchmark HSIs comparable to its Hispanic undergraduate Pell rate based on the team's consensus of what "comparable" HSIs means to them. Here, one can start wide (e.g., ± 10% rate) and then narrow the range, if desired, as the selection process proceeds.

Once selection process completes, the President of the Rising HSI would initiate contact with the Presidents of the Benchmark HSIs to request permissions for site visits to implement a best practices study. If approved, these Presidents at the Benchmark HSIs would notify their administrators and faculty at select departments to expect the Rising HSI team to proceed with initial contact and scheduling for site visits.

During a site visit, the Rising HSI team could use an unstructured approach and initiate the conversation around a basic thematic question: "To what do you attribute your production of STEM degree awards to Hispanics?" From there, one should expect a plethora of open-ended questions related to best practices beginning with why, how, where, and when, and possibly arranged by organizational level (classroom, department, college, institution, system-level) or by function as defined by the Rising HSI team members.

In comparison, a more structured approach might use something like Garcia and Koren's (2020, pp. 3–4) multidimensional framework for assessing institutional "servingness" of Hispanic students to organize the site-visit discussions. Aside from any approach, there are two requests one should make throughout the site visit after hearing a completed response: "Please show me evidence, an artifact of what it looks like when you refer to this best practice?" and "May I have a copy, take a photo or video of this artifact?" The need for artifacts is important because others who stayed behind at the Rising HSI will want evidence of what the practices look like operationalized at the Benchmark HSIs.

Common defining moments in best practices research

What might one learn from a Benchmark HSI? It all depends on what one asks of its representatives, but if the site visit is proceeding well, eventually there will be three defining moments during the best practices investigation. The first comes when one realizes all HSIs basically do the same things. Second, what makes the difference in institutional performance is not what institutions do, but how they do it – e.g., how they advise students, how they support students' academic success, how they create a community of learners, how faculty teach using culturally responsive instruction – i.e., how they "serve" Hispanic students.

The third defining moment occurs when one realizes the practices discovered during a site visit are coming from colleagues with superior Hispanic STEM degree production capacity – but with a comparable Pell rate. Simply knowing so during a site visit, one can sense a rise in the credibility and importance of the practices discovered as possibilities for program improvement. Expect for these three defining moments to emerge at all organizational levels and functions with regards to promoting Hispanic academic success.

Limitations and assumptions

Like any analytic technique, the scatterplot approach presented has limitations and assumptions. One of the limitations of a scatterplot is its inability to show the relationship for more than one explanatory and response variable at a time. In the real world, one would also scatterplot other explanatory variables relevant to an HSI's production of STEM degrees – and other response variables, like the capacity to graduate students of other backgrounds with STEM degrees and at different levels (e.g., master's).

Scatterplots also do not work well with categorical data, continuous variables where the actual values have been grouped into contiguous intervals (e.g., age grouped into intervals 0–10, 11–20, 21–30, etc.), or large numbers of observations beyond what the plot area can visually accommodate. Using such data causes overplotting where the data points stack on top of each other making it difficult to see the full quantity of observations in regions of the graph, as well as to visually assess the data. Preferably, avoid using categorical and interval data in scatterplots. For large numbers of observations, one solution is to first use a random sample of the data points to give a general idea of the pattern before using the full data collection. Of course, one can also try to decrease the size of the symbols used to denote an observation so fewer overlaps occur.

A common phrase in statistics associated with scatterplots is "correlation does not imply causation," i.e., one cannot assume either variable is responsible for changes in the other. In using the scatterplot approach as proposed in the present study, however, one assumes with purposeful intention, causality in assigning Hispanic UG Pell Rate and Hispanic STEM degree production capacity as the explanatory and response variable, respectively. This is where having a clear, well-articulated supposition is important for selecting the explanatory variable, if it is to have the credibility for Rising HSI stakeholders to believe there is enough empirical evidence for best practices research at Benchmark HSIs.

Another assumption has to do with defining comparability in the Pell rates between a Rising HSI and Benchmark HSIs. When a Rising HSI team cannot find a Benchmark HSI with an exact Pell rate match, they must expand to within a range plus or minus of its Pell rate until a Benchmark HSI appears in the process. When this occurs, a Benchmark HSI also becomes a "Best in Class" where one assumes its best practices are still most applicable for adoption by comparable Rising HSIs seeking program improvement. If the expansion extends too far either way (±) from the exact Pell rate, however, the assumption may no longer be valid. Thus, the Rising HSI team must take great care when defining comparability in selecting Benchmark HSIs.

Conclusions

Imagine if all the Rising HSIs were able to improve their Hispanic STEM degree production capacity to the 50 STEM/K minimum benchmark threshold. Based on the 2018 IPEDS data, the 147 HSIs combined awarded STEM bachelor's degrees to 34,295 Hispanics. By increasing Rising HSIs' capacity to the minimum benchmark threshold, they would have awarded a total of 51,687 – an increase of 17,392 or 50.7% additional Hispanics with STEM degrees for the US academic, technical, and professional workforce.

What is the likelihood of such increases occurring? Consider what awaits future researchers in the IPEDS data – the opportunity to produce similar analysis using different explanatory and response variables for other levels (associate's, master's, and doctorate levels) and for each level, further disaggregated by gender. Stated simply, we do not lack IPEDS data for HSI research, but still, it remains just that – data. What transforms it into useful information is the willingness to organize and analyze it in illuminating ways where one can find best practices for program improvement. The opportunity is there to be taken.

Author's Contributions

All contributions to the manuscript were done by the author of the manuscript.

Acknowledgments

The author thanks anonymous reviewers for their useful comments and suggestions, which contributed toward improving the quality of this study for publication.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Omar S. López http://orcid.org/0000-0001-8952-4035

Availability of Data and Materials

The Integrated Postsecondary Education Data System (IPEDS) files from the National Center for Education Statistics (NCES) are available at https://nces.ed.gov/ipeds/datacenter/DataFiles.aspx.

References

Committee on STEM Education of the National Science and Technology Council. (2018). *Charting a course for success: America's strategy for STEM education*. Executive Office of the President of the United States.

Eddy, S. L., & Hogan, K. A. (2014). Getting under the hood: How and for whom does increasing course structure work? *Cell Biology Education*, *13*(3), 453–468. https:doi.org/10.1187/cbe.14-03-0050

Estrada, M., Burnett, M., Campbell, A. G., Campbell, P. B., Denetclaw, W. F., Gutiérrez, C. G., Hurtado, S., John, G. H., Matsui, J., McGee, R., Moses-Okpodu, C., Robinson, T. J., Summers, M. F., Werner-Washburne, M., & Zavala, M. (2016). Improving underrepresented minority student persistence in STEM. *CBE: Life Sciences Education*, *15*(3), 1–10. https://doi.org/10.1187/cbe.16-01-0038

Excelencia in Education. (2019). *Hispanic serving institutions (HSIs): 2017-18*. https://www.edexcelencia.org/research/data/hispanic-serving-institutions-hsis-2017-2018

Garcia, G. A., & Koren, E. R. (2020). Connecting research, practice, and policy to define "servingness" at Hispanic serving institutions. In G. A. Garcia (Ed.), *Hispanic serving institutions (HSIs) in practice: Defining servingness at HSIs* (pp. 1–20). Information Age Publishing.

Gay, G., & Banks, J. A. (2010). *Culturally responsive teaching: Theory, research, and practice* (2nd ed.). Teachers College Press.

Haeger, H., & Fresquez, C. (2016). Mentoring for inclusion: The impact of mentoring on undergraduate researchers in the sciences. *CBE: Life Sciences Education*, *15*(3), 1–9. https://doi.org/10.1187/cbe.16-01-0016

Hegji, A. (2018). *The higher education act (HEA): A primer* (Publication No. R43351). Congressional Research Service. https://fas.org/sgp/crs/misc/R43351.pdf

Hispanic Association of Colleges and Universities. (2020a). *Hispanic-serving institution definitions*. https://www.hacu.net/hacu/HSI_Definition.asp

Hispanic Association of Colleges and Universities. (2020b). *About Hispanic serving institutions (HSIs)*. https://hacuadvocates.net/abouthsis?0

Hispanic Association of Colleges and Universities. (2020c). *Fiscal year 2020 appropriations for HSIs and applications for new awards*. https://www.hacu.net/NewsBot.asp?MODE=VIEW&ID=3146

Hurtado, S., Alvarez, C. L., Guillermo-Wann, C., Cuellar, M., & Arellano, L. (2012). A model for diverse learning environments: The scholarship on creating and assessing conditions for student success. In J. C. Smart & M. B. Paulsen (Eds.), *Higher education: Handbook for theory and research* (pp. 41–122). Springer.

Mojahedian, M. M., Mohammadi, A., Abdollahi, M., Kebriaeezadeh, A., Sharifzadeh, M., Asadzandi, S., & Nikfar, S. (2020). A review on inputs and outputs in determining the efficiency of universities of medical sciences by data envelopment analysis method. *Medical Journal of the Islamic Republic of Iran*, *34*(42), 1–12. https://doi.org/10.34171/mjiri.34.1

Moore, D. S., & Notz, W. I. (2021). *The basic practice of statistics (loose-leaf)* (Nineth ed.). Chapter 4. W.H. Freeman and Company.

National Center for Education Statistics. (2020a). *About us*. https://nces.ed.gov/about/

National Center for Education Statistics. (2020b). *IPEDS complete data files*. https://nces.ed.gov/ipeds/datacenter/DataFiles.aspx

National Science Board. (2018). *High-Hispanic-enrollment institutions: A typology. In science and engineering indicators 2018* (Publication No. NSB-2018-1, Sidebar, pp. 2-15). National Science Foundation. https://nsf.gov/statistics/2018/nsb20181/assets/nsb20181.pdf

National Science Board. (2019). *Higher education in science and engineering: Supplemental materials* (Publication No. NSB-2019-7, Table S2-7). National Science Foundation. https://ncses.nsf.gov/pubs/nsb20197/

National Student Clearinghouse Research Center. (2018). *High school benchmarks – 2018: National college progression rates*. https://nscresearchcenter.org/wp-content/uploads/2018_HSBenchmarksReport_FIN_22OCT18.pdf

Pentyala, S., & Dilger, J. (2016). Minority students and STEM careers: Will mentoring help? *Journal of Health Education Research & Development*, *4*(2), 1–5. https://doi.org/10.4172/2380-5439.1000175

Stephens, N. M., Fryberg, S. A., Markus, H. R., Johnson, C. S., & Covarrubias, R. (2012). Unseen disadvantage: How American universities' focus on Independence undermines the academic performance of first-generation college students. *Journal of Personality and Social Psychology*, *102*(6), 1178–1197. https://doi.org/10.1037/a0027143

U.S. Veterans Benefits Administration. (2020). *STEM designated degree program list effective January 1, 2020*. U.S. Department of Veterans Affairs. https://benefits.va.gov/gibill/docs/fgib/STEM_Program_List.pdf