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An Empirical Study of Career Talk Incorporation in Science, Technology, Engineering, and Mathematics Education

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Abstract: Guest speaker presentation is an important strategy for expanding career pathways in Science, Technology, Engineering, and Mathematics (STEM) education, particularly for underrepresented students at Hispanic-Serving Institutions (HSIs). With support from a U.S. Department of Education grant, this study was designed to examine the merits of career talks by STEM professionals at California State University, Bakersfield. Text analytics were conducted to extract the key features of guest speaker presentations, and survey data were gathered to assess the clarity, informativeness, and relevancy of career talks for student engagement. The incorporation of qualitative and quantitative approaches is guided by Social Cognitive Career Theory (SCCT) to reconfirm the guest speaker's impact on student learning for career pathway expansion. The results demonstrate efforts to strengthen STEM career preparation at this Hispanic-Serving Institution.

Keywords: Career Talk; STEM Education; Mixed Methods.
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Introduction

At the turn of this century, nearly half of bachelor's degree students in Science, Technology, Engineering, and Mathematics (STEM) switched majors or left college in the United States (see Hunter, 2019). To address this challenge, it has been advocated that guest speakers be incorporated into STEM education to strengthen student subject belonging (Al-Qudah et al., 2018). The change also fits the national interest in pursuing STEM workforce diversity, which leads to more emphasis on career preparation at minority-serving institutions (National Science Foundation, 2017). Meanwhile, the U.S. Department of Education funded a campus initiative titled *An Equitable Pathway to In-Demand STEM Careers* (Grant No. P031C210093, PI: Charles Lam), aimed at equipping Hispanic students with knowledge and skills for pursuing employment in STEM fields. As part of a broader institutional strategy to improve career readiness among underrepresented students, guest speaker presentations were incorporated to expose students to real-world STEM pathways. These sessions were intentionally designed to expand student horizons beyond the university setting by connecting academic learning to professional opportunities and lived career experiences. Outreach efforts like guest speaker sessions are particularly important because, as Periathiruvadi (2013) noted, one of the most significant barriers for underrepresented students in STEM is the "lack of opportunities outside [of school]" to engage with professionals and explore real-world applications of their studies (p. 42).

Given the increasing use of guest speaker presentations to support STEM career development, this study investigates how such talks are perceived by students at an HSI, with a focus on their clarity, informativeness, and relevance in relation to students' understanding of potential career pathways. Specifically, guest speakers were carefully selected to reflect the diverse backgrounds and lived experiences of the student body at California State University,

Bakersfield. This cultural alignment was intentional, as previous research suggests that the relevance and impact of such presentations may vary depending on institutional context and student demographics. For the outcome evaluation, Eugene and Potter (2023) asserted that successful presentations should be informative, clear, and relevant to students—three qualities essential for effective communication in career education. These dimensions often work together, with informativeness playing a central role in enriching student knowledge (Brief, 2023), while clarity supports understanding (Tufte & Tufte, 2006), and relevance links content to students' real-world interests and goals (Falk & Dierking, 2016). Ultimately, however, it is the specific presentation features in both linguistic and thematic aspects that drive students' positive or negative reactions. Accordingly, this study is guided by two empirically grounded research questions (RQ) designed to investigate the structure and impact of guest speaker presentations in STEM education at an HSI:

RQ1: What are the most frequent linguistic and thematic features occur most frequently in STEM guest speaker presentations delivered at an HSI?

RQ2: How do these features relate to students' perceptions of clarity, informativeness, and relevance in supporting STEM career preparation?

These questions are addressed through a mixed-methods framework. RQ1 is examined through qualitative text analytics of transcribed speaker presentations using natural language processing (NLP), while RQ2 draws on aggregated data from a student survey that captures overall impressions of presentation quality across sessions.

The following sections outline the theoretical and empirical foundations for this study, detail the mixed-methods design, present key findings from text analytics and student feedback, and conclude with implications for practice and future research.

Literature Review

Theoretical Framework

Social Cognitive Career Theory (SCCT), developed by Lent, Brown, and Hackett (1994), is an extension of Bandura's broader Social Cognitive Theory. SCCT focuses specifically on how individuals develop career interests, make choices, and achieve performance outcomes. The theory emphasizes the interplay of self-efficacy beliefs, outcome expectations, and personal goals, which are shaped by learning experiences and contextual supports or barriers. SCCT also considers how factors like race, ethnicity, gender, and socioeconomic status influence career development through access to resources and opportunities.

In the context of STEM education, SCCT provides a powerful lens for understanding how students—especially those from underrepresented backgrounds—form and pursue career goals. As Shulman (2022) notes, guest speakers serve as live examples of role models, allowing students to observe real-world applications of STEM knowledge. Guest speakers from similar backgrounds can also offer cultural insight, mentorship, and encouragement that

contribute to building self-efficacy and reducing perceived barriers (Periathiruvadi, 2013; Byars-Winston et al., 2010).

While SCCT emphasizes vicarious learning and contextual support, the effectiveness of guest speakers in promoting STEM persistence among underrepresented students may be influenced by multiple layers of identity. Research shows that students often respond most positively when role models share visible or perceived characteristics, such as race, ethnicity, or language, which can signal deeper cultural understanding and reduce perceived social distance (Zirkel, 2002; Byars-Winston et al., 2015). However, even when exact ethnic matching is not present, students may still benefit from speakers who hold minority status or have navigated systemic barriers in similar ways. In one large-scale study, minority students reported increased motivation and engagement when exposed to diverse STEM mentors, regardless of whether those mentors were racially identical to them, suggesting that shared experience of marginalization can also foster connection and inspiration (Syed et al., 2011). These benefits are typically less pronounced among white students, who often have greater access to aligned role models through existing networks and institutional privileges (National Science Foundation, 2017). This asymmetry underscores the need for culturally responsive interventions in minority-serving institutions, where students may otherwise lack access to relatable career models.

This theoretical framework directly influenced the structure and focus of the current study. The guest speaker presentations were designed to activate SCCT components: increasing student confidence through relatable success stories (self-efficacy), highlighting tangible pathways and rewards (outcome expectations), and prompting students to envision and plan future careers (goal setting). Accordingly, the research questions and mixed-methods design were developed to examine both the content of guest presentations and their perceived clarity, informativeness, and relevance—three qualities that align closely with SCCT's emphasis on accessible, motivating learning experiences.

Importantly, SCCT also highlights the role of vicarious learning and social persuasion—two mechanisms through which individuals develop career-related self-efficacy by observing others and receiving encouragement. These processes are especially powerful when the role models are perceived as relatable or culturally congruent, which makes their success feel attainable to students (Byars-Winston et al., 2010; Lent et al., 2016). For students from underrepresented backgrounds in STEM, seeing professionals with similar life experiences can reduce psychological barriers and foster a stronger sense of belonging. Guest speakers serve as accessible and often inspirational figures who can speak directly to both the *content knowledge* and *contextual challenges* students may face in pursuing STEM careers. In this study, guest speakers were intentionally selected to reflect the socioeconomic and cultural backgrounds of the student population, thus aligning with SCCT's emphasis on the social context of career development.

Although career exploration and mentorship programs have been studied in STEM settings, most of this work has focused on students at Predominantly White Institutions (PWIs). For instance, studies by Crisp and Cruz (2009) and Packard (2016) have examined mentorship in STEM at PWIs and documented general benefits in student confidence, persistence, and career clarity. However, few of these studies have focused specifically on the impact of

guest speaker presentations, and even fewer have examined these interventions at HSIs, where the sociocultural context and student needs can differ significantly. This gap is notable given that Hispanic students are more likely to be first-generation college students and to face structural challenges—including limited access to professional role models, economic constraints, and lower social capital in navigating academic systems (Garcia, Núñez, & Sansone, 2019; National Science Foundation, 2017). These factors contribute to disparities in STEM persistence and graduation rates compared to their white counterparts. By examining guest speaker talks within an HSI, this study addresses an important but underexplored area in the literature, responding to the unique needs of a growing and historically underserved student population in STEM.

In promoting diversity, SCCT also considers guest speakers as valuable sources of social support for mentoring minority students. By sharing their own experiences and providing guidance, guest speakers create a network of support for students. This social support system is essential to overcome the isolation of minority students and help them gain a sense of belonging in the competitive STEM workforce (Dost, 2024).

Furthermore, SCCT acknowledges the influence of cultural context and systemic obstacles undermining career development. Guest speakers from minority backgrounds can provide insights into cultural challenges and structural barriers in school-to-work transition. Career talks can help introduce minority students to professional organizations, mentorship programs, and network constructions for STEM employment.

According to SCCT, all these factors "help shape the learning experiences that fuel personal interests and choices" (Lent et al., 1994, p. 107). Career talks can equip students with strategies and resources to navigate complex barriers, such as financial hardship, limited access to professional networks, stereotype threat, and a lack of culturally relevant mentorship—challenges commonly faced by underrepresented students in STEM fields (Byars-Winston et al., 2010; Syed et al., 2011). Based on the literature review, SCCT is employed as a paradigm to guide this investigation of career talk effectiveness at an HSI. In evaluating the effectiveness of STEM guest speaker presentations, three criteria—informativeness, clarity, and relevance—have emerged as particularly important for student learning (Eugene & Potter, 2023; Brief, 2023). Informativeness refers to the delivery of new, useful, or actionable content that supports students' knowledge acquisition and career exploration. Clarity involves the presenter's ability to communicate complex ideas in a way that is easily understood, particularly by audiences unfamiliar with STEM jargon (Tufte & Tufte, 2006). Relevance reflects the degree to which students can connect the content to their own goals, experiences, or career aspirations (Falk & Dierking, 2016). These three criteria have often been applied in evaluating instructional effectiveness but have not been widely examined in the context of guest speaker presentations—particularly within minority-serving institutions.

Additionally, research on STEM education for underrepresented students emphasizes the need for culturally responsive interventions. Studies have shown that students from Hispanic and other minority backgrounds often face a combination of structural barriers and psychosocial obstacles, including lack of role models, feelings of isolation, and limited exposure to real-world applications of STEM (Byars-Winston et al., 2010; National Science Foundation, 2017). Guest speaker presentations that reflect the cultural and socioeconomic backgrounds of the

student body can help mitigate these challenges by enhancing students' sense of belonging and relevance, which are foundational in the development of self-efficacy and career identity (Periathiruvadi, 2013; Shulman, 2022). These findings reinforce the decision to design this study within the framework of SCCT and to select guest speakers with lived experiences similar to those of the student population.

Together, the literature on presentation quality and culturally relevant pedagogy informed the development of the two research questions in this study: one aimed at analyzing presentation content through text analytics, and the other at exploring student perceptions of effectiveness through clarity, informativeness, and relevance. In this study, SCCT is used as the guiding theoretical framework to interpret how guest speaker presentations may influence student development in STEM, particularly through self-efficacy, outcome expectations, and contextual support. This framework informs the research questions and the design of the mixed-methods approach but is not itself a method of data analysis. Instead, SCCT provides the conceptual lens through which findings—both linguistic and perceptual—are interpreted.

Empirical Approaches

Text analytics has emerged as a new and powerful research tool in data science that encompasses a suite of computational techniques aimed at extracting meaningful information from unstructured textual data. Central to these techniques are NLP and machine learning, which collaboratively facilitate the aggregation, analysis, and interpretation of qualitative data. In particular, NLP is positioned as a subfield of artificial intelligence that focuses on the interaction between computers and human language (Stryker & Holdsworth, 2024). Machine learning involves training algorithms on data to automatically categorize text, identify patterns, extract relevant information, and make trend predictions (Barba, 2020). In combination, text analytics becomes a useful tool that leverages NLP to interpret human language and machine learning to analyze and derive insights for evaluating educational programs.

Due to its capacity to process vast amounts of unstructured text, the advancement of text mining has demonstrated tremendous potential for systematic examination of qualitative feedback in empirical studies. For instance, Dake and Gyimah (2023) applied sentiment analysis to educational data, providing insights into students' emotional states during presentations. Ferreira-Mello et al. (2019) also provided an overview of educational text mining applications, highlighting their role in uncovering the essence of educational data. Huang et al. (2020) further discussed the use of text analytics to examine large-scale educational data for student engagement. These past examples provided additional background on text analytics applications in educational research.

Besides its intellectual merit, the impact of text mining has expanded in recent years. For instance, a study by Yang et al. (2023) utilized text mining to analyze educational studies, providing insights into how scholars employ text mining in their research. By examining the transcripts of presentations, researchers can identify prevalent themes, jargon usage, and the complexity of language. This kind of analysis can aid in understanding how effectively guest speakers convey complex ideas to students.

It has also been generally agreed that "Compared to information obtained through surveys and interviews, the information provided by video analysis tends to be more objective" (Wang et al., 2023, p. 6). As a result, the adoption of text analytics holds immense value for video information extraction (Ranjan & Mishra, 2022). In comparison to traditional methods in qualitative investigations, R can process large datasets, such as the ones from career talk videos, much faster than manual coding. More importantly, it can ensure consistent result replications and has robust packages for data visualization (Chandrasekar et al., 2024). Built on the power of computational linguistics and machine learning, text mining techniques have largely revolutionized the way researchers aggregate a rich source of information from unstructured data to summarize presentations of STEM inquiries (Baker & Yacef, 2009). To date, however, studies have yet to be conducted to extract the essential information from guest speaker preparations. To support the result replication from this study, details of the data selection, information cleaning, and R-based analytics are elaborated in the method section.

Combined, the reviewed literature highlights two critical knowledge gaps. First, while text analytics has been widely applied in educational settings, its use in analyzing STEM guest speaker content remains underexplored. Second, although SCCT provides a robust theoretical lens, few studies connect presentation content with student perceptions in underrepresented populations. These gaps informed the research questions that guided this investigation.

Methods

Study Context and Design

This study was conducted as part of an existing grant-supported initiative at an HSI focused on expanding equitable STEM career pathways. The research was based on a series of virtual guest speaker presentations delivered through an introductory STEM course. These presentations were already scheduled as part of the course and were not influenced by the researcher. The guest speakers—professionals in various STEM fields—shared their career journeys, challenges, and practical advice with enrolled students.

The presentations were hosted and recorded on Zoom, capturing both the guest speakers and the student attendees as they participated in the virtual sessions. The recordings included speaker presentations, student questions, and audience reactions when visible. All videos were automatically archived in Zoom's cloud storage and subsequently downloaded for research use. These recordings were then transcribed for analysis. No additional recordings outside the Zoom platform were used, and the archive refers specifically to these stored Zoom videos.

Data Selection

The first step in the research process was to design a feasible approach for data collection. To strengthen the impact of this investigation, it is important to note a learning gap in which Latino students often face unique challenges in STEM career development. Given the important role of HSI in addressing diversity in higher education, choosing an institution with a strong serving mission can shed light on the unique challenges and strengths of guest speaker

presentations. While HSIs reach a minimum of 25% student enrollment in Hispanic groups, California State University, Bakersfield (CSUB) retained 60.8% of its full-time equivalent student ratio to support Latino graduate students, far above the 36.7% average ratio across the United States in Academic Year 2023-2024 (Excelencia in Education, 2024). Built on the data indicator for strong Latino student services, career talk videos were selected from CSUB to address RQ1. Accordingly, the recorded video sessions were retrieved from Zoom and transcribed verbatim using Otter.ai, an AI-based transcription platform, to ensure transcription accuracy and consistency. Otter.ai has been widely adopted in research and educational settings due to its relatively high transcription accuracy, typically ranging from 85% to 95%, depending on audio quality and speaker clarity. To improve validity, all transcripts were manually reviewed for accuracy and corrected where necessary. In terms of confidentiality, Otter.ai applies encryption protocols during data transmission and storage and offers user-level access controls. However, since de-identified data may be used to improve its AI models and some information may be shared with third-party vendors, all transcriptions were handled in accordance with institutional guidelines for research ethics and data privacy. The transcription files were subsequently exported in .txt format for compatibility with R scripts and subsequent preprocessing steps of data cleaning.

Information Cleaning

After transcription, the next phase involved cleaning the data, an indispensable step for improving the reproducibility of research outcomes from text analytics (Upadhye, 2020). Techniques such as tokenization, stemming, lemmatization, and stopword removal were applied to strengthen the format uniformity. More specifically, each token (word) was defined as a sequence of alphanumeric characters. A heuristic approach was taken to trim prefixes and suffixes through word stemming to reduce the tokens to their root forms. Tokens were further simplified into the base structures in a lemmatization process to ensure that the resulting configuration is a valid word in English. Stop words (e.g., "and," "the," "is") were removed using predefined stop word lists from the stopwords package in R. Custom stop word lists were applied to exclude terms that are not analytically meaningful, such as filler words (e.g., “okay,” “um,” “yeah”) and overly general verbs (e.g., “do,” “make,” “get”), which do not contribute to thematic analysis (Upadhye, 2020). Text cleaning also involved converting all characters to lowercase, removing numbers, punctuations, and special symbols, as well as replacing contractions with their expanded forms (e.g., "isn't" → "is not"). Correction of misspellings and wrong data entries added another layer of protection for maintaining data integrity.

Overall, the data cleaning process addressed noise, enhanced consistency, corrected errors, and facilitated reproducible workflows to make the analyses both reliable and replicable. Tokenization and text preprocessing standards adhered to best practices in NLP, enabling accurate, reproducible, and insightful analysis of presentation transcripts from academic competitions (Upadhye, 2020). By integrating precise transcription methods with robust text analytics techniques in R, this study ensured the comprehensive processing of textual data.

In summary, the data choice was designed to foster more inclusive career talk support at an HSI. The ability to achieve consistent results using quality data and reliable methods is also a general cornerstone of scientific research,

which demands the reduction of irrelevant information, inconsistencies, discrepancies, and non-standard abbreviations. Cleaning processes like text restructuring, tokenization, stemming, lemmatization, stopword removal, and spell-checking help mitigate these issues, leading to more accurate analyses. Upadhye (2020) emphasizes that text data cleaning is a crucial preprocessing step in NLP and text data analysis aimed at improving the quality, reliability, and usability of textual information.

Method Choice

A multimodal analytical approach was used to capture the layered nature of guest speaker presentations and student responses. The transcripts provided access to the linguistic and thematic patterns in speaker discourse, while visualizations such as word clouds and token frequencies allowed for exploratory pattern recognition and emphasis detection. Additionally, the inclusion of aggregated student survey responses introduced a complementary perspective on how the presentations were received. This combination of representational modes reflects both the complexity of the learning environment and the multifaceted nature of career identity formation, aligning with SCCT's attention to both personal and contextual influences.

Building on the cleaned transcripts and the institutional context, the next step was to analyze the data using both text mining and student feedback surveys to address the research questions. While student feedback about guest speaker presentations was gathered from a participant survey (RQ2), the text analytics added more tools for analyzing guest speaker presentations on STEM career preparation, and thus, provided valuable insights into their informativeness, clarity, and relevance to college students pertaining to the objective of extracting the substance of career talks in RQ1.

This study was led by Principal Investigator Charles Lam with grant funding from the U.S. Department of Education administered by the CSUB Auxiliary (2021) for Sponsored Programs. As part of the grant implementation, an introductory STEM course was developed to feature a series of guest speaker presentations focused on STEM career exploration. This course provided a structured setting to implement and evaluate the guest talks in alignment with the grant’s goal of strengthening STEM career preparation for underrepresented students. In Academic Year 2021-2022, a total of 251 students signed up for five guest speaker sessions, each lasting approximately one hour. To support role modeling in line with SCCT, guest speakers were intentionally selected to reflect the socioeconomic and cultural backgrounds of these CSUB students. The text mining process was handled by an R package application. More specifically, a lexical dispersion plot (LDP) offers a visual display of the word distribution across the text (Svartzman et al., 2020). Career talks can be assessed by LDP on whether critical topics are consistently and adequately addressed throughout a guest presentation. In LDP, "each strike along the word offset axis signals that a specific word is mentioned within the corpus of data" (Hutchinson, 2019, p. 56), which makes the density of strikes an important outcome. For the overall content coverage, it does not matter whether the word appeared relatively early or late as long as it occurred. Hence, the occurrence time is not labeled on the axis of the relative token index to avoid unnecessary distraction. This practice follows the LDP literature to focus on the strike density.

As Amin et al. (2022) asserted, LDP allows researchers to determine “how many times the word (or multiple words) occurs from the beginning to the end of the text” (p. 25).

Beyond the token tracking in LDP, text analytics was further extended to a broad summary of multiple documents in a word cloud plot. With the size of each word indicating its frequency, the plot supports visualization of the primary topics and concepts in guest speaker presentations to assess whether the content aligns with students' interests and the objectives of STEM career preparation. As Mostafa et al. (2023) noted, “A wordcloud plot is an appealing visual tool that can be used to summarize textual data” (p. 12434).

Another feature of text mining hinges on keyness plot construction. “Unlike frequency counts, the keyness of a word does not necessarily anticipate a high, but rather an unusual, frequency” (Đurović, 2023, p. 188). Keyness plots enable comparison between a special guest speaker presentation and others to reveal unique terms or concepts emphasized by the speaker, providing insights into the presentation's distinctiveness and potential added value for students. Koch et al. (2022) and Weinberg (2021) recommended the keyness method for contrasting unique features of career talks. In addition, a plot of the most frequent words (MFW) is needed to visualize repeated themes through text data aggregation (e.g., Kostelej & Bagić Babac, 2022). Besides displaying the frequencies of the most commonly used words, the topic occurrence in each text corpus can be plotted in bar charts to offer a straightforward overview of the dominant themes and subjects in the presentation. Therefore, the information can be useful in evaluating whether the career talk aligns with the intended learning outcomes for STEM career preparation.

In summary, an R package, Quantitative Analysis of Text Data (quanteda), was developed by Benoit et al. (2018) at Oxford University and employed in this study for key information extraction in RQ1. As indicated by Benoit et al. (2018), quanteda was considerably faster and more efficient than other R and Python packages in processing large text data. The data collection was protected by a research protocol of the Institutional Review Board. Besides showing key features of the career talks through text mining, quantitative data were gathered from student feedback to evaluate the performance of guest speakers. According to Elmore (2015), mixed methods can lead to well-rounded data collection and result validation.

In addition to transcript analysis, student feedback was collected using a post-session survey designed to assess perceptions of clarity, informativeness, and relevance in the guest speaker presentations. The survey included three Likert-scale items adapted from prior literature on instructional quality (Eugene & Potter, 2023; Tufte & Tufte, 2006), each rated on a five-point scale. While the survey was brief, it was developed in consultation with instructional design staff and reviewed by the institutional research office to ensure content validity and alignment with the project’s learning outcomes. The results were aggregated to protect participant confidentiality and to reflect the overall trends in student feedback across the five speaker sessions. Combining linguistic analysis, visual plotting, and student feedback enabled a more comprehensive understanding of speaker impact, consistent with SCCT's emphasis on both cognitive and contextual learning cues.

Results

Figures 1–5 are presented to illustrate different aspects of the guest speaker content and student perceptions. Each figure was selected to highlight a distinct analytic focus: subject coverage (Figure 1), keyword placement (Figure 2), verb themes related to teaching and research (Figure 3), workforce relevance (Figure 4), and overall keyword prominence (Figure 5). Together, these visualizations contribute to a more nuanced understanding of how the presentations aligned with student needs and SCCT-informed constructs.

After NLP's text tokenization, stopping-word/punctuation cleaning, and dictionary stemming, an LDP was drawn using the quanteda package. By design, LDP has strikes along the horizontal axis to signal the mentioning of a specific word within the corpus of data (Hutchinson, 2019). In Figure 1, the relative token index is represented by the strike count to track STEM topics covered during career talks. Some of the tokenized terms, such as scienc[e], are shown as truncated words in R computing to reduce the matrix sparsity and save the computing random memory space.

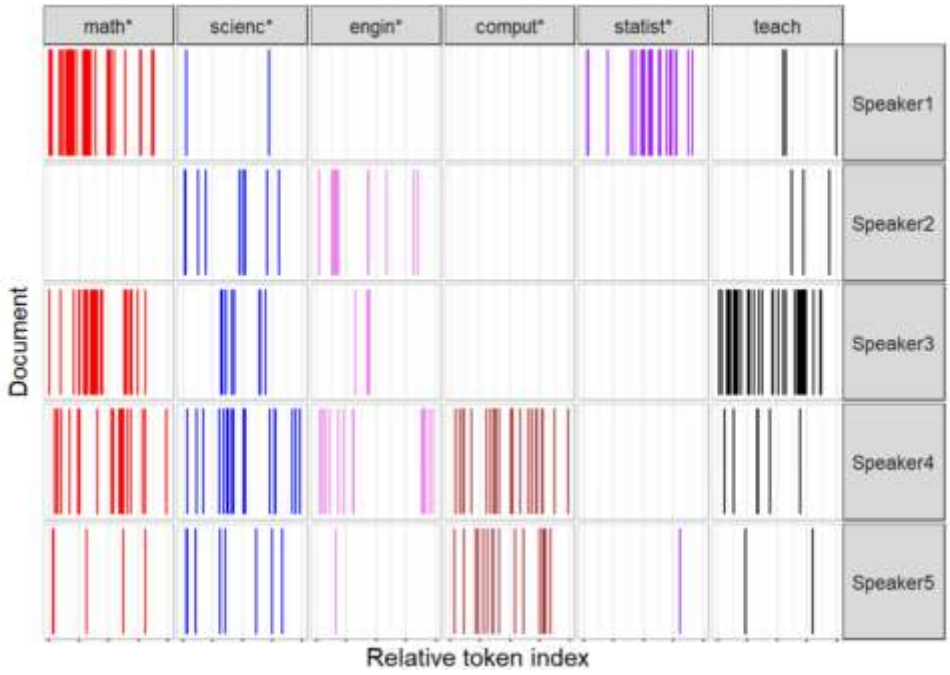
Although all speakers mentioned the prefix "scienc*", Speaker 1 clearly stressed preparation in math and statistics (Figure 1). Likewise, Speaker 2 placed more focus on science and engineering. Thus, specific keywords were extracted to characterize different career talks. For the result quantification, as Katre (2019) noted, "Lexical Dispersion Plots effectively depict how multiple topic keywords appear throughout the corpora" (p. 8579). The broad subject spectrum in career talks can help expand student horizons on the pathway configuration across STEM fields. In reference to SCCT, frequent mentions of these terms throughout these presentations suggest a consistent focus on building self-efficacy, which is critical for STEM careers.

For information aggregation, "A wordcloud plot is an appealing visual tool that can be used to summarize textual data" (Mostafa et al., 2023, p. 12434). In Figure 2, frequently mentioned words are highlighted across the career talk sessions to gain an overall picture of the topic coverage. As shown by tokens of larger size, the focus of career talks was placed on employment- or education-related keywords, such as 'job', 'work', 'teach', and 'research'. The presence of 'teach' may initially seem unexpected in the context of STEM careers; however, many guest speakers discussed pathways that included teaching in K–12 schools, postsecondary education, or public science communication, reflecting the reality that STEM professions also include significant educational and mentoring roles. Thus, its prominence aligns with the speakers' emphasis on real-world STEM applications and career pathways that blend research, practice, and teaching. The career connection to STEM education can enhance students' sense of belonging and resilience, according to SCCT (Dost, 2024), instilling an awareness of responsibility that will lead students to raise their aspirations. In addition, preparation terms like 'internship' indicate actionable steps for achieving career goals. The outcome expectations are revealed by 'phd' and 'dr' terms to encourage students in goal setting and milestone identification. Therefore, Figure 2 shows the career talk alignment with the grant intention to strengthen STEM education and develop sustainable on-ramps for the career pathways. Enlightened by SCCT, these plots offer deeper insights into how guest speaker presentations scaffold career-related themes. The results suggest that the guest speaker sessions contributed to students' increased

confidence and clarity in navigating STEM career pathways, as reflected in the emphasis on career-relevant language in speaker presentations and students' positive survey responses. For other tokenized terms in Figure 2, the topic identification was echoed by a keyness plot in Figure 3.

Figure 1

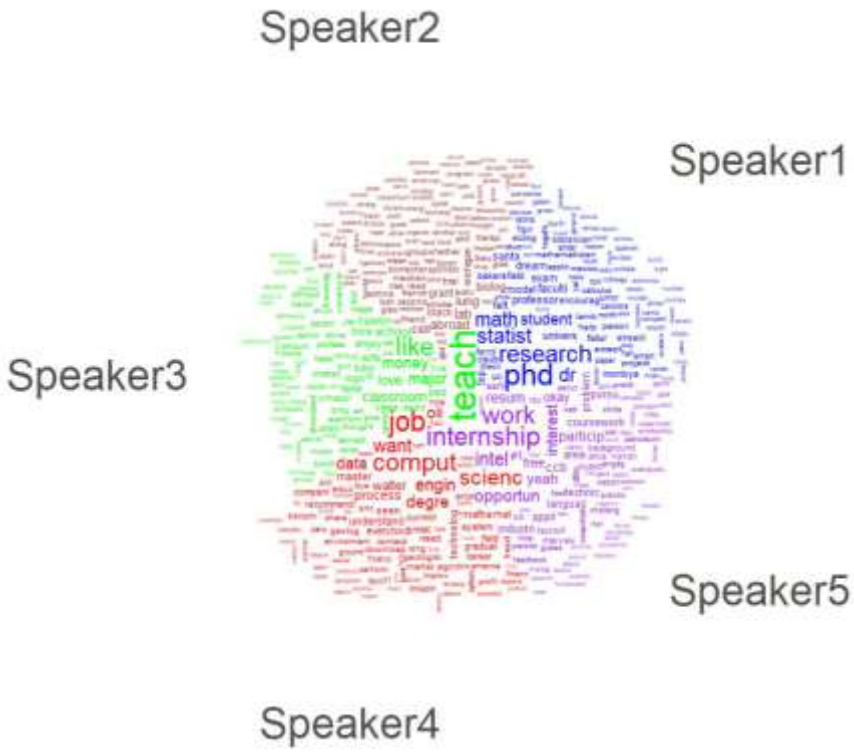
Dispersion of Subject Coverage in Career Talks



By design, "Keyness analysis introduces the term 'key word', which is a word that occurs in a text more often than we would expect to occur by chance alone" (Rao & Taboada, 2021, p. 30). In Figure 3, Speaker 1 explicitly identified himself as a Latino professional and framed his career journey through both educational and cultural lenses. While other guest speakers also came from underrepresented or diverse backgrounds, Speaker 1 was the only one who foregrounded his Hispanic identity during the presentation, offering students a culturally reflective narrative that distinguished his talk from others in the series. He also reiterated Ph.D. with other terms, such as Dr. and UC [University of California], to promote student aspiration. The cultural impact was further delineated by more emphases on terms of 'model' and 'dream' while the reference group of other guest speakers generically noted 'interest' and 'opportun[ity]' in career talks.

Figure 2

Word-Cloud Plot on Key Components of Career Talks



It should be noted that the keyness plot adopted a χ^2 measure to contrast the content features (Koch et al., 2022). In theory, the minimum possible χ^2 value is zero when the words appear simultaneously in the two documents (Culpeper, 2009). Figure 3 shows the χ^2 value of no less than 20 across all tokens for Speaker 1, which suggests significantly different token compositions than the ones by other speakers. Per SCCT, content differentiation can help expand student's understanding of the motivation factors that impact their career paths in the STEM fields.

These features are corroborated by a plot of the top impact words for each presenter. Figure 4 shows frequencies in a bar chart to display the most frequent words in a corpus pertaining to different STEM knowledge acquisitions and applications. Furthermore, the repeated themes can be visualized in an MFW plot (Kostelej & Bagić Babac, 2022). As shown in Figure 4, guest speakers frequently used words such as 'work', 'job', 'research', 'teach', 'math', 'phd', 'internship', and 'want' to emphasize workforce readiness. Among these, 'work', 'want', and 'job' emerged as the top three impact words, highlighting a strong focus on career development in STEM.

Figure 3

Impact of Cultural Promotion Between Speaker1 and Other Presenters

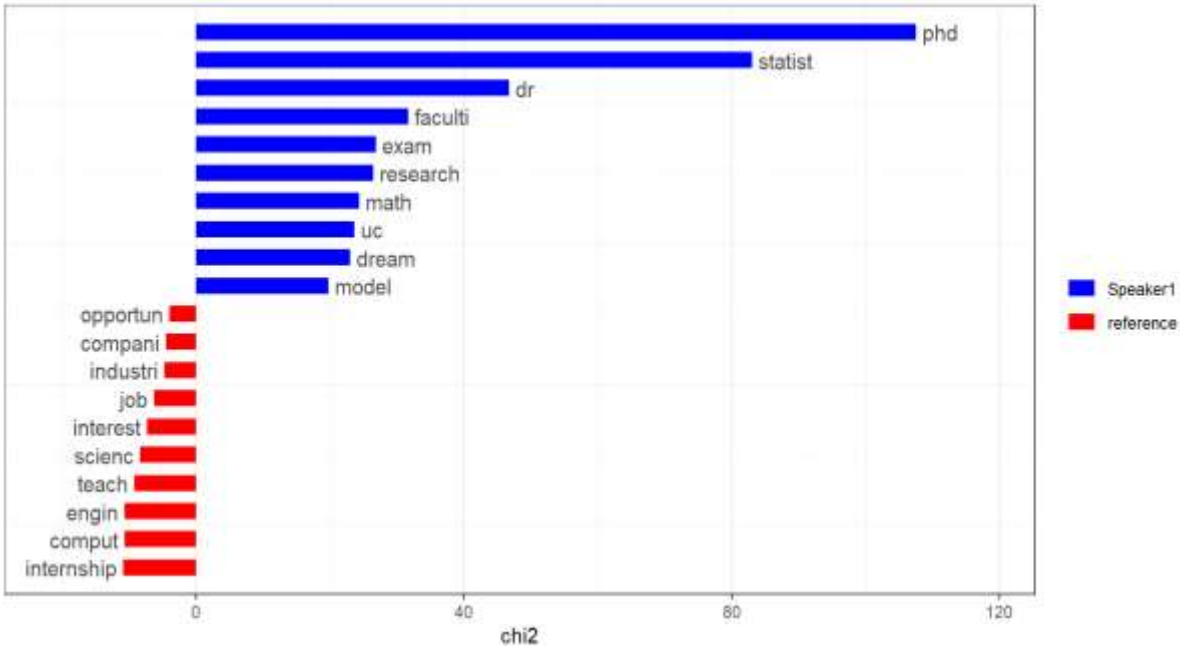


Figure 4

Indicators of Motivation Attribute in Guest Talks

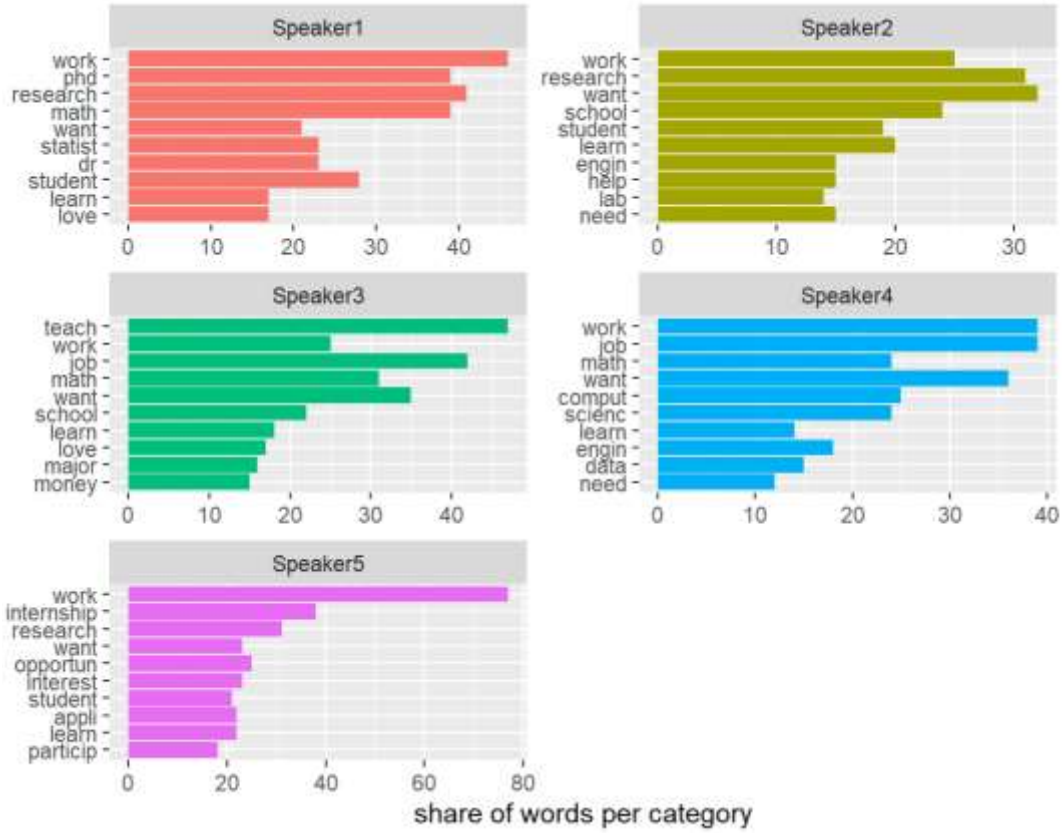
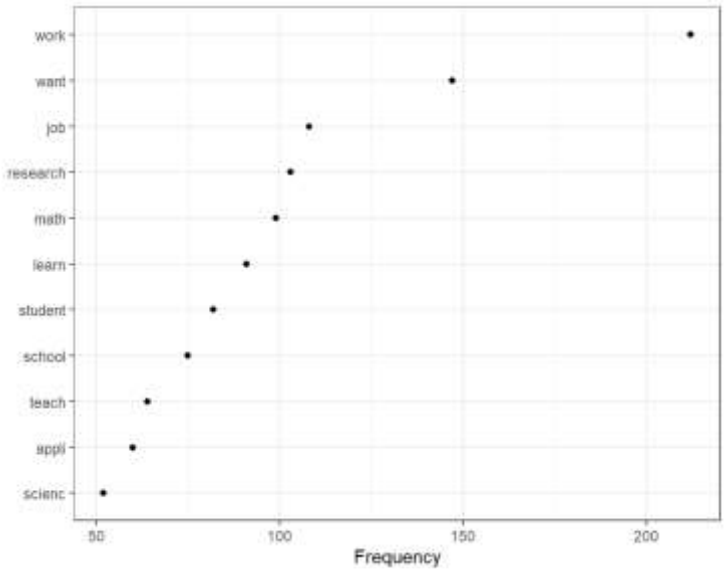


Figure 5

Top Impact Words Across Career Talks



Despite the variations in content coverage, the aggregated emphases across these career talks highlighted ‘work’, ‘want’, and ‘job’ as three of the most frequently mentioned words in Figure 5. While words like ‘but’ and ‘and’ were excluded as stop words during preprocessing, ‘want’ was retained due to its contextual importance in expressing student motivation and goal setting, as in statements such as “You have to want this job” or “I want to succeed in this field.” Unlike typical filler words, ‘want’ was used meaningfully by speakers to convey desire, aspiration, and intentionality—core concepts aligned with SCCT's emphasis on outcome expectations and personal agency in career development. The result is backed by SCCT’s recognition of empowerment from the guest speaker’s employment stories for supporting the resilience of what students want in career development.

Table 1

Summary of Survey Ratings for Guest Speaker Presentations

Survey Item	Mean
Relevance of the presentation to STEM career consideration	4.03
Informativeness of the presentation	4.53
Clarity of the presentation	4.74

Note. Responses were measured on a 5-point Likert scale, where 5 = strongly agree and 1 = strongly disagree.

In summary, the patterns identified in Figures 1–5 reflect consistent thematic and linguistic features supporting RQ1. To address RQ2, Table 1 summarizes responses from 73 students who completed a brief, anonymous post-session survey. The aggregated results, presented using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), show that students rated the presentations highly on all three dimensions: clarity, informativeness, and relevance. These perceptions further validate the alignment between guest speaker content and student expectations. All the results were above 4, suggesting that the presentations were clear, informative, and relevant to students. These findings substantiate a commonly acknowledged value of career talks, "Guest speakers and mentors make the learning engaging and more relevant" (Robinson, 2018, p. 21).

Discussion

This discussion reflects on how the study's design, informed by SCCT and guided by two research questions, produced insights into the value and impact of STEM career talks at an HSI. By addressing the linguistic and thematic elements of guest presentations (RQ1), and comparing them to students' perceptions of clarity, informativeness, and relevance (RQ2), the findings offer preliminary insights into the value of guest speaker interventions in STEM career preparation.

Analysis of presentation transcripts using text analytics revealed frequent use of terms tied to employment, education, and preparation—such as "work," "job," "internship," and "Ph.D." These recurring features reflect consistent messaging around career readiness and self-efficacy, which are central constructs in SCCT. When mapped against student survey feedback, these themes aligned well with high ratings for clarity, relevance, and informativeness, suggesting a strong relationship between the speakers' content and students' positive reception. Perhaps because of the lack of proper research tools, like the quanteda package, for in-depth text mining, few researchers have attempted to investigate information extraction in a clear and concise manner. In this regard, the impact of this investigation can be discussed on both the substance and methodology fronts.

Ultimately, STEM workforce preparation directly affects the U.S. interest in the global market competition. Without the addition of feasible interventions, such as career talks, the past pattern is likely to continue, and nearly half of bachelor's degree students cannot complete a STEM degree as they originally planned (Hunter, 2019). Guest speakers can offer immense practical guidance for students to navigate the complex landscape of job demands and expand career pathways following the footsteps of their role models. In the context of an HSI such as CSUB—where over 60% of students identify as Hispanic—this alignment is particularly important. Guest speakers were intentionally selected to reflect similar socioeconomic, cultural, and professional backgrounds, and this congruence may help explain the high student ratings across clarity, relevance, and informativeness. The frequent emphasis on terms like "work," "job," and "internship" across speaker transcripts also suggests a practical orientation likely to resonate with first-generation or working-class students navigating unfamiliar career landscapes. This alignment between speaker background and student demographics likely contributed to the strong sense of relevance perceived by participants.

Although exposing students to in-demand careers and diverse career role models can bring them new possibilities, inspiration, and motivation, guest speakers often use their own personalities and interests to help students develop specific career decision-making skills—such as identifying personal interests, setting professional goals, evaluating career options, and navigating barriers in STEM fields. Thus, text analytics addresses the need to analyze unstructured data from individualized stories (Zainudin et al., 2020). Alternatively, delimiting the method to traditional qualitative studies is unlikely to make the findings replicable (Sarkar, 2019). The methodology advancement of this investigation hinges on its employment of the R scripts, which are built on a well-established package for result reconfirmation. To gain an overall picture through content aggregation, innovative methods from natural language processing (NLP) and machine learning processes in text mining are required.

In addition, the merit of career talks is verified by clarity, informativeness, and relevance of guest speaker presentations. Although the survey response rate is often beyond anyone's control, 73 students answered three-fold questions. The high average ratings in Table 1 not only indicate effective career talks but also demonstrate the consistency of guest speaker choice to match the diverse student interests. While the current study does not directly measure inspiration or long-term motivational impact, it focuses on clarity, informativeness, and relevance—three core dimensions of presentation quality identified in the literature as precursors to student engagement and learning (Eugene & Potter, 2023; Brief, 2023). These dimensions are not only observable and measurable through student feedback but also align with SCCT's emphasis on outcome expectations and self-efficacy as drivers of career decision-making.

In this context, clarity supports understanding complex content, informativeness enriches students' knowledge of career options, and relevance helps students connect the content to their own aspirations. Although the term "inspiration" was not explicitly measured, these three elements reflect key aspects of how students experience and internalize motivational content within a culturally responsive STEM learning environment. By connecting personality traits and interests, students begin to build self-efficacy in career decision-making as they are more confident in engaging in career consideration (Lent et al., 2016). The mechanism is sustainable in broadening the impact of guest speakers as role models for future STEM professionals to continue sharing successful experiences in STEM career exploration. These findings suggest that when career talks are purposefully aligned with student identities and delivered in engaging, relevant language, they can become a vital tool in broadening

STEM participation at HSIs and beyond.

It is important to distinguish between inspiration and career development in interpreting the impact of guest speaker presentations. While guest speakers may indeed inspire students through storytelling and personal connection, this study focuses more concretely on aspects of career development as defined by SCCT—specifically, increasing student self-efficacy, outcome expectations, and awareness of career-related opportunities and pathways. Career development, in this context, refers to the process by which students gather information, form goals, and build confidence in navigating their professional futures. The clarity, informativeness, and relevance of the presentations—as evaluated through student feedback and speaker discourse—are meaningful indicators of this

developmental process, even if long-term outcomes were not directly assessed in this study. Therefore, the guest speaker sessions aligned well with the study's intended focus on SCCT-related constructs, particularly in fostering student perceptions of clarity, informativeness, and relevance in career planning.

While these findings offer meaningful insight into the potential role of guest speaker presentations in fostering clarity, relevance, and informativeness, they are best interpreted within the specific context of this Hispanic-Serving Institution. The study does not claim universal generalizability regarding career development or pathway expansion. Instead, it contributes exploratory evidence supporting how such interventions can be aligned with SCCT principles to address localized student needs and inform future inquiry.

Like all empirical research, this study has limitations that warrant attention. While the findings provide meaningful insights into the effectiveness of career talks at an HSI, they are based on short-term measures—specifically, aggregated student feedback on clarity, informativeness, and relevance. The study did not include direct measures of long-term outcomes such as career persistence or self-efficacy development over time. Nor did it disaggregate findings by demographic subgroups or academic level. Additionally, the survey was brief and limited in scope, focusing only on perceived quality, not actual behavioral or academic outcomes. These limitations highlight the need for future longitudinal studies to track changes in students' career goals, academic choices, or professional success after exposure to career talks. Further research could also explore differences across diverse student populations and institutional types, helping tailor guest speaker interventions more precisely to local needs.

Conclusion

Overall, the success of these presentations may rest not only in their content but also in their cultural resonance with the HSI student population. By selecting guest speakers who mirror students' lived experiences and career aspirations, the project addressed both the cognitive and cultural dimensions of STEM career development. Grounded in Albert Bandura's Social Cognitive Theory, SCCT emphasizes the interplay of self-efficacy, outcome expectations, personal goals, and contextual factors, as confirmed by the career talk findings in Figures 1-5, to facilitate the expansion of career pathways for STEM majors. More specifically, Figure 5 revealed that terms such as "work," "job," and "want" were among the most frequently used words in guest speaker presentations. These words emphasized the speakers' efforts to communicate practical goals and motivational messages about pursuing and succeeding in STEM careers. This pattern aligns with Byars-Winston et al. (2010), who argue that career interventions—such as guest speaker talks—can shape students' outcome expectations and perceived value of STEM pathways, key constructs in SCCT. The value of pursuing a Ph.D. was emphasized in the career talk shown in Figure 3, particularly by the guest speaker who identified as Latino and framed his academic and cultural background as part of his STEM journey. By discussing doctoral training as a meaningful and attainable goal, the speaker provided a relatable example of persistence and success, offering students a model that may enhance their confidence in pursuing advanced STEM pathways.

In addition, SCCT, developed by Lent et al. (1994), provides a robust framework for understanding contextual support behind career persistence. Besides the STEM subject coverage illustrated in Figure 1, career talks have addressed 'research' and 'internship' in Figures 2 and 4 to bridge the gap between theoretical knowledge and practical application in regular coursework. Experiential learning not only prepares students for real-world challenges but also merges career interests with extracurricular offerings. Student feedback from the post-session survey provided evidence that the guest speaker sessions were perceived as clear, informative, and relevant—three qualities that reflect effective communication and alignment with SCCT-informed goals of increasing student exposure to real-world professionals, job pathways, and confidence-building content. According to Byars-Winston et al. (2015), discussion of accessible resources can empower students to navigate systemic challenges and increase their persistence in STEM career pursuits.

Overall, this study's findings demonstrate that STEM guest speaker presentations at an HSI consistently emphasize themes relevant to career development, including job acquisition, advanced degrees, and real-world applications. These features were revealed through text analytics and confirmed to align with high student ratings on presentation quality, addressing RQ1 and RQ2 respectively. The alignment between thematic content and student perception supports the idea that guest speakers—especially when culturally aligned and contextually relevant—can be a powerful tool in broadening STEM career pathways. The mixed-methods design, informed by SCCT, illustrates how computational approaches such as NLP can complement student feedback to assess intervention impact. By grounding research questions in analyzable elements of language and perception, this framework offers a replicable model for evaluating career readiness strategies at institutions serving diverse student populations.

As a result, the text analytics suggest that guest speaker presentations appear to be a promising intervention for enhancing students' awareness of STEM career options and supporting foundational aspects of career development, such as self-efficacy and outcome expectations. However, further research is needed to examine long-term impacts and generalize findings across institutional contexts. Future practices may incorporate immediate or near real-time feedback mechanisms—such as post-session polls, embedded live surveys, or follow-up reflections—to enhance interaction and gather more nuanced insights into how students experience and respond to career talks. These tools can help speakers adapt to future sessions while providing institutions with timely indicators of student engagement and perceived relevance. The intellectual merit of a mixed-method approach has been demonstrated in this study to enrich research literature about the applicability of SCCT and text analytics in understanding and improving career development pathways in an HSI setting. By offering both theoretical and practical contributions, this study illustrates how guest speaker presentations—when strategically designed and evaluated—can help create more inclusive and effective STEM career pathways for diverse student populations

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