The Role of STEM Self-Efficacy, Research Confidence, and Belonging in Student Development: Fostering STEM Workforce Development Through an Institutional STEM Conference

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Background

The United States science, technology, engineering, and mathematics (STEM) workforce stimulates innovation and provides significant contributions to the nation. As science and technology advance, increasing demand for technically skilled employees follows. Today, almost a quarter (24%) of the U.S. workforce is employed in STEM occupations (NCSES, 2023).

Representation of different groups based on sex, race or ethnicity, and disability status varies throughout the STEM workforce, with representation in STEM occupations unevenly distributed for these groups compared to all the working age population (NCSES, 2023). As the workforce demand in STEM continues to increase, along with a push for better representation among different groups, interventions to support STEM student career development are needed.

Although research has demonstrated the impact of research experiences on degree and career plans, the benefits of attending and presenting research at professional conferences has been minimally investigated (Casad, et al., 2016). These few studies highlight the effectiveness of student professional conferences as an intervention that increases representation and success of underrepresented minority (URM) students in science. As travel to national conference is cost-prohibitive for many students, *we sought out to investigate the impact that a student-focused institutional STEM conference intervention would have on student science self-efficacy, research confidence, sense of belonging in STEM. We also evaluated additional outcome measures related to education and career attainment.*

The 2023 TXST STEM Conference

Texas State University hosted the inaugural annual TXST STEM Conference on Friday, March 24th, 2023 at the LBJ Conference Center. The TXST STEM Conference focused on the achievements of our students from a range of STEM fields, who are the NEXT contributors to and leaders of the STEM workforce.

The conference program featured a theme of inclusion and belonging in STEM, building off our past Texas State Women in Science and Engineering (WiSE) Conference and the HSI-focused STEM Undergraduate Research Experience (SURE) Symposia.

The TXST STEM Conference provided both student and faculty-focused sessions and workshops; undergraduate and graduate poster presentations, highlighting student research, design, and internship/co-op experiences; an exhibitor hall; networking luncheon; and a professional headshot lounge.

Survey methodology (Casad, et al., 2016) was used to conduct a study investigating student attendees' perception of the conference as well as the impact of conference participation on student STEM identity, research confidence, sense of belonging, and career goals. Data from the surveys (n=41 students) are shared here along with overall conference participant demographics.

Survey Results

Table 1. Conference attendees by type

Attendee Type	n
High School Student	15
Undergraduate Student	73
Graduate Student	73
Postdoctoral Researcher	3
Faculty	42
Staff	21
Community Member	2
Total	234

Table 2. Survey Respondents (*n*=41)

Demographics	n	%
Race/Ethnicity		
Black/African American	4	10%
Pacific Islander or Alaska Native	0	0%
Asian American	14	34%
Hispanic or Latina/o	14	34%
Native American	1	2%
Caucasian	12	29%
Gender Identity		
Woman	25	61%
Man	15	37%
Non-binary	1	2%
First-Generation College Student	18	44%
Undergraduate Student Classification		
Freshman	3	7%
Sophomore	4	10%
Junior	3	7%
Senior	11	27%
Graduate Student Classification		
Master's	16	39%
Doctoral	4	10%
Transfer Student	3	7%

Scholarship at the 2023 TXST STEM Conference
- The conference served as an opportunity for students to gain valuable research presentation skills as,
  - 76% of the respondents presented a poster presentation
    - 71% of undergraduate respondents presented a poster
      - 31% first presentation
    - 85% of graduate respondents presented a poster
      - 10% first presentation

Networking
- The majority of survey respondents (68%) said they communicated with more than 10 faculty, staff, or students while at the TXST STEM conference.

Overall satisfaction at the 2023 TXST STEM conference and feeling a part of the scientific community is very high.
- 93% either agreed that attending the TXST STEM conference was a worthwhile use of their time.

Survey Results

Table 3. Bivariate correlations (Pearson's *r*) and linear regression were used to assess the relationships between science self-efficacy (Self-Efficacy), research confidence (Confidence), and sense of belonging in science (Belonging) on student outcomes and STEM Identity.

	Full Sample			
Predictor Outcome	*r*	*p*	*r²*	*n*
Pursue STEM Degree				
Self-Efficacy	0.643**	<0.001	0.414	40
Confidence	0.758**	<0.001	0.574	40
Belonging	0.458**	0.003	0.210	40
Pursue Graduate School				
Self-Efficacy	0.521**	<0.001	0.271	39
Confidence	0.623**	<0.001	0.388	39
Belonging	0.362*	0.024	0.131	39
STEM Identity				
Self-Efficacy	0.175	0.272	0.031	41
Confidence	0.360*	0.021	0.130	41
Belonging	0.159	0.321	0.025	41

Chi-squared analysis among undergraduate student respondents revealed trends related to student outcomes:

Association between calculated average **sense of belonging and intentions to attend the next conference** was found ($X^2(12) >= 21.113$, p=0.049).

Association between the calculated **intention to pursue a STEM degree and the number of presentation awards received** as a TXST student was found ($X^2(16) >= 28.933$, p=0.024).

Association between self-identified **STEM identity and the number of experiential learning experience semesters completed** as an undergraduate student at TXST ($X^2(20) >= 31.500$, p=0.049).
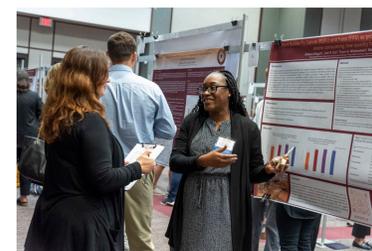
Figure 1. A student poster presenter at the 2023 TXST STEM Conference.

Student's confidence in being a scientist and retention in their field is very high:
- 85% indicated that their confidence to explain their research topic to other scientists increase a lot/little
- 87% indicated that their confidence to present a research presentation or poster increased by a lot/little
- 75% indicated their confidence to persist in science even though they may be considered a "minority" in their field increased a lot/little

Survey Results
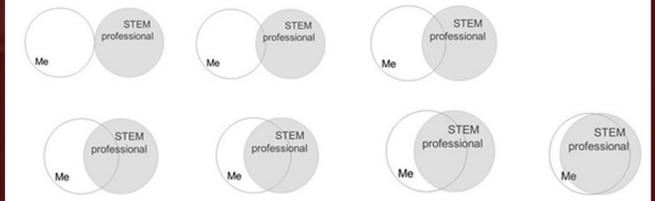
Figure 2. The single-item STEM Professional Identity Overlap measure (McDonald et al., 2016).

Student identification as a STEM professional.
- Most respondents (59%) reported more than 50% overlap in identities.

Students indicated they were uniquely impacted by the STEM conference through open-ended responses.
- *"It allowed me to feel the confidence of other professionals in STEM"*
- *"It helped me stay the course"*
- *"It helped me get my research out there and be able to talk to other people about my profession"*
- *"It made me more confident in my ability to present research"*
- *"I feel more established as a women in STEM"*
- *"I learned more about opportunities after graduating with a Bachelor of Science"*

2024 TXST STEM Conference

Due to the success and level of student participation in the 2023 TXST STEM Conference, the 2024 TXST STEM Conference will be held April 8-12th in a **hybrid format**. Virtual offerings April 8-11th, 2024 will expand the program contents and enhance accessibility of the conference to students, faculty, and staff in the TXST STEM Community. **The theme for the 2024 Conference is: One Health.** Similar assessment will be conducted following this conference.

Acknowledgements

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McDonald, M. M., Zeigler-Hill, V., Vrabel, J. K., & Escobar, M. (2019). A Single-Item Measure for Assessing STEM Identity. Frontiers in Education, 4(78). https://doi.org/10.3389/feduc.2019.00078

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