

IGE: Narrative Identity in STEM: Storytelling as a Catalyst for Graduate Student Success

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Graduate education in science, technology, engineering, and mathematics (STEM) has traditionally prioritized technical expertise while often overlooking professional identity development, sense of belonging, and psychosocial barriers such as impostorism. These factors are critical to graduate student persistence and success. This National Science Foundation (NSF) Innovations in Graduate Education (IGE) project seeks to address these gaps by implementing and studying a cohort-based storytelling intervention designed to humanize the STEM graduate experience. In collaboration with a national nonprofit organization specializing in science storytelling (The Story Collider), the project equips STEM graduate students with tools to craft and publicly perform personal narratives that reflect their lived experiences in graduate education. Grounded in narrative identity theory, Self-Determination Theory, and reflective practice, the intervention targets core psychological needs of autonomy through identity development, relatedness through belonging, and competence through confidence and impostor feelings. By integrating storytelling into graduate education, the project aims to foster positive cultural change in STEM learning environments while advancing theory and practice in graduate education.

Major Project Goals: The overarching goal of this project is to enhance professional identity development, sense of belonging, and graduate student success in STEM through an evidence-based storytelling pedagogy. The project is guided by three core hypotheses. First, participation in storytelling workshops will enhance STEM graduate students' professional and researcher identities while reducing feelings of impostorism. Second, storytelling performances will decrease stereotypical perceptions of STEM professionals among public audiences. Third, engagement in personal storytelling will support graduate student retention and facilitate successful transitions into STEM careers. To achieve these goals, the project pursues four primary objectives: (1) develop a scalable storytelling curriculum in collaboration with a national science storytelling nonprofit; (2) implement the curriculum with STEM graduate students; (3) assess the impact of storytelling on student participants and public audiences; and (4) disseminate the curriculum and student stories through open-source platforms, workshops, webinars, and public performances.

Research Instruments: A mixed-methods research design is employed to examine the project's hypotheses and research questions. Quantitative data are collected using pre- and post-surveys with validated instruments measuring professional identity, including STEM identity and researcher identity [1], sense of belonging measured as social fit [2], and impostor phenomenon [3]. Across Years 1 and 2, these scales demonstrated strong internal consistency, with Cronbach's alpha values ranging from 0.81 to 0.95.

Audience perceptions of STEM professionals are measured before and after public storytelling performances using the Warmth and Competence Scale [4], which assesses perceived friendliness, trustworthiness, and capability, and the Nerd-Genius Stereotype Scale [5], developed and validated in prior research on scientist stereotypes, captures perceptions of scientists as socially distant "nerds" or innately gifted "geniuses."

Qualitative data include written personal narratives and semi-structured interviews with participants. These data are analyzed using inductive and abductive coding approaches, and mixed-methods triangulation is used to examine relationships between narrative characteristics, identity development, belonging, and impostorism. While the study uses a pre- and post-intervention design without a control group, convergence across data sources strengthens confidence in observed trends and informs future research directions.

Significant Results: Across two years of implementation, the project has produced converging quantitative and qualitative evidence demonstrating the potential of storytelling to support STEM graduate student identity development and to influence public perceptions of STEM professionals.

Quantitative Findings (Years 1 and 2). In Year 1, paired-sample analyses of pre- and post-survey data from 38 graduate student participants revealed improvements in both STEM identity and researcher identity. STEM identity increased from a mean of 5.78 (SD = 1.00) to 6.01 (SD = 0.98, $t(37) = 1.56$, $p < 0.10$), while researcher identity increased from a mean of 5.43 (SD = 1.14) to 5.72 (SD = 1.11, $t(37) = 1.83$, $p < 0.05$). Sense of belonging, measured as social fit, showed a small decline from a mean of 3.79 (SD = 0.56) to 3.71 (SD = 0.48, $t(37) = 1.40$, $p < 0.10$). Impostor phenomenon scores decreased from a mean of 3.30 (SD = 0.91) to 3.14 (SD = 0.86, $t(37) = 1.89$, $p < 0.05$).

In Year 2, analyses of 31 complete cases indicated statistically significant gains in STEM identity. While researcher identity did not reach statistical significance when examined independently in Year 2, analyses of the aggregated dataset across Years 1 and 2 ($N = 70$) revealed statistically significant increases in researcher identity. Sense of social fit again showed a significant decline in Year 2, prompting ongoing investigation into how reflective identity work may temporarily surface tensions in belonging during graduate education. Such temporary declines in perceived social fit may reflect heightened awareness of structural and interpersonal challenges rather than reduced engagement or commitment. Impostor phenomenon scores demonstrated small but directionally consistent reductions in Year 2, though these changes were not statistically significant.

Qualitative Findings from semi-structured interviews and written personal narratives collected across Years 1 and 2 provide deeper insight into how storytelling influences graduate students' professional identity development, sense of belonging, and perceptions of competence in STEM. Analyses indicate that the core activities of the storytelling intervention, namely writing, sharing, and refining personal stories, enabled participants to engage in deliberate reflection and active meaning-making about their lived experiences in graduate education.

Narrative analyses revealed that identity, belonging, and competence were deeply interwoven within participants' accounts rather than experienced as isolated constructs. Participants frequently described critical turning points, such as moments of failure, transition, affirmation, or support, that prompted shifts in how they viewed themselves as STEM professionals and influenced their sense of fit within academic environments. These turning points were often accompanied by strong emotional responses and served as anchors for reconstructing professional identity.

Across narratives, participants actively reframed challenges including academic struggle, career uncertainty, international transition, and personal hardship as formative experiences. Many stories followed redemptive trajectories in which periods of doubt or marginalization contributed to resilience, renewed motivation, and increased confidence. Through this reflective process, participants described reduced impostor feelings and greater acceptance of struggle as a normative component of graduate education.

Participants also reported that hearing peers' stories fostered empathy, normalized struggle, and strengthened interpersonal connections within the cohort (social identity). This shared vulnerability supported a growing sense of belonging, even as reflective identity work occasionally surfaced tensions related to social fit. While some participants noted challenges related to emotional vulnerability or public performance, these experiences were generally viewed as constructive and meaningful when supported through coaching and structured reflection.

Audience Quantitative Findings (Years 1 and 2). Audience surveys administered before and after public storytelling performances assessed perceptions of STEM professionals. In Year 1 (N = 12), audience members reported no change in perceived competence, which remained high at 4.9 on a 5-point scale, but demonstrated a statistically significant increase in perceived warmth from 4.2 to 4.8 ($p < 0.05$). No measurable change in nerd-genius stereotypes was observed in Year 1.

In Year 2 (N = 9), audience results again showed no change in perceived competence, but revealed statistically significant increases in perceived warmth as well as reductions in nerd-genius stereotypes. Although these outcomes were not explicitly hypothesized at the outset of the project, they suggest that storytelling performances humanize STEM professionals and can shift public perceptions by increasing perceived warmth and reducing stereotypical views.

Impact: This project demonstrates the potential of storytelling as a scalable and innovative pedagogical approach to transforming STEM graduate education. By addressing emotional and psychological dimensions of graduate training, the intervention contributes to professional identity formation, reduces barriers associated with impostorism, and fosters more inclusive learning environments. Public storytelling performances extend the project's impact beyond graduate education by challenging societal stereotypes and broadening perceptions of who belongs in STEM. The open-source storytelling curriculum enables adoption and adaptation by other institutions, supporting broader dissemination and sustainability. Collectively, this work advances theoretical understanding in narrative identity and graduate education while offering practical strategies for fostering inclusive, supportive, and human-centered STEM cultures.

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