

Article

From Student to Educator: How Faculty Experiences as Students Relate to STEM Teaching and Professional Identity in Higher Education

Rachel Ziminski ¹ and Yanfen Li ^{2,*} 

¹ School of Education, University of Massachusetts Lowell, Lowell, MA 01854, USA; rachel_ziminski@student.uml.edu

² Department of Biomedical Engineering, University of Massachusetts Lowell, Lowell, MA 01854, USA

* Correspondence: yanfen_li@uml.edu

Abstract

Efforts to improve student retention and degree achievement in STEM disciplines has increasingly highlighted the importance of faculty professional development and the adoption of evidence-based teaching practice. Despite teaching being a core faculty responsibility, formal pedagogical training is rarely required, and many faculty develop their teaching approaches based on their experiences as students or graduate teaching assistants. This quantitative study examines STEM faculty perceptions of receiving encouragement as students and their relationship with dimensions of their professional identity. Our findings suggest that encouragement aligns with faculty student- and self-related professional identity dimensions. These results underscore the need for structured professional development and early training in evidence-based pedagogy, including the cultivation of encouragement practices, to foster more inclusive, supportive, and effective learning environments in STEM.

Keywords: STEM education; encouragement; faculty professional identity; underrepresentation; professional development



Academic Editor: Zhongfeng Tian

Received: 20 August 2025

Revised: 14 November 2025

Accepted: 17 November 2025

Published: 19 November 2025

Citation: Ziminski, R., & Li, Y. (2025). From Student to Educator: How Faculty Experiences as Students Relate to STEM Teaching and Professional Identity in Higher Education. *Education Sciences*, 15(11), 1563. <https://doi.org/10.3390/educsci15111563>

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Most faculty receive training on research during the collegiate experience but gain teaching practice through training and professional development during their work experience (Brownell & Tanner, 2017; Connolly et al., 2018; Frey et al., 2020; Vergara et al., 2014). While teaching practice is only a component of the faculty profession, it is important for student retention. Isolating a research-based teaching practice found to positively impact student outcomes, *encouragement*, and exploring faculty perspectives on their professional identities may provide insight into the dimensions they value and provide opportunities in identifying professional development needs. Additionally, research on faculty members' experiences of receiving encouragement in college may indicate where exposure to encouragement in teaching practice relates to areas of professional identity. This study quantitatively explores the relationship between encouragement and professional identity dimensions of STEM faculty at a large public institution. We use a conceptual framework of professional identity and a recent positive psychology definition of encouragement to ground our research.

1.1. Conceptual Framework

The current study is guided by a conceptual framework of faculty professional identity developed by [Abu-Alruz and Khasawneh \(2013\)](#). The framework includes four dimensions of faculty professional identity: self-related, skill-related, work-related, and student-related. First, self-related identity applies to faculty members' commitment and dedication to their profession. In higher education, faculty with strong self-related identities may exhibit a passion for teaching, find joy in exchanging ideas and experiences with fellow faculty, view themselves as integral to the university, cherish the social recognition of their role, and foster harmonious and collaborative relationships with their colleagues to enhance the quality of their work ([Abu-Alruz & Khasawneh, 2013](#)).

Second, skill-related identity relates to faculty members' inclination toward continuous learning and excellence. Faculty members with high skill-related identities actively seek opportunities to expand their knowledge and teaching abilities, display a commitment to ongoing personal and professional growth, and aspire to become more knowledgeable and skilled educators ([Abu-Alruz & Khasawneh, 2013](#)). Third, work-related identity relates to faculty involvement in the university, including participation in curriculum decisions; dedication to the institution's mission, vision, and goals; comprehension of university policies and procedures; and a commitment to staying informed about current educational policies.

Fourth, student-related identity relates to creating and maintaining a flexible and nurturing learning environment. Faculty with strong student-related identities dedicate themselves to helping students apply their knowledge to real-life situations; establish trusting and caring relationships with students; support lifelong learning for students; tailor their teaching approaches to suit individual needs, interests, and abilities; and actively engage in discussions with colleagues regarding student progress ([Abu-Alruz & Khasawneh, 2013](#)). Figure 1 presents the conceptual framework and how receiving encouragement as a student relates to the four factors of faculty professional identity. The framework proposes that encouragement experienced during one's academic journey can influence the development of self-related, skill-related, work-related, and student-related dimensions of faculty professional identity.



Figure 1. Relationship of Receiving Encouragement as a Student and Faculty Professional Identity.

1.2. Literature Review

1.2.1. Professional Identity Development

Professional identity in the social sciences focuses on personal identity and how individuals perceive themselves. Per [Mead \(1934\)](#) and [Erikson \(1968\)](#), identity is dynamic and shaped by ongoing interactions with one's environment. These dynamics could impact professional identity, even in the early stages of career choice. Professional identity consists of core beliefs, values, and assumptions about what differentiates one's career from others ([Abu-Alruz & Khasawneh, 2013](#)). An individual's professional identity includes elements like professional values, positions, and roles ([Briggs, 2007](#)). A professional identity may provide individuals with a sense of belonging within the profession ([Davey,](#)

2013). However, professional identity undergoes continuous change over one's lifetime (Henkel, 2012).

An individual begins forming a professional identity when making a career choice. Lent et al. discussed career choice from a social–cognitive perspective (2019). The researchers developed the social cognitive career theory (SCCT), which addresses the significance of individual attributes (e.g., self-efficacy beliefs, outcome expectations, and goals) and contextual elements (e.g., support and barriers). Individual attributes and self-efficacy beliefs may impact career interests, decision-making, satisfaction, and performance (Lent & Brown, 2019). Sheu et al. (2010) used the SCCT as a theoretical framework to investigate career decision-making and found that self-efficacy indirectly influenced choice goals. Textual supports and barriers had indirect rather than direct roles in reaching choice goals and working through self-efficacy and outcome expectations. These findings showed the interplay between personal and contextual factors in the career decision process. Within the SCCT framework, faculty represent a contextual element that can either support or hinder student outcomes. When faculty use positive teaching practices (encouragement), students who experience these behaviors and subsequently enter academic roles may indirectly shape their own professional identities and teaching practices through processes of observational learning and role modeling.

1.2.2. Faculty as Professional Role Models

Although professional identity development is ongoing, some researchers point out that academics form pillars when they enter university as students. In college, students are “exposed to the worldviews, theories, skills, and languages embedded therein in the profession, influencing their identity development” (Barbarà-i-Molinero et al., 2017, p. 190). In the academic environment, faculty serve as professional models; later, they may be peers. Researchers in science, technology, engineering, and math (STEM) professional identity refer to this phase of development as adopting the knowledge, skills, ways of being, and values of those in the profession (Trede et al., 2012).

In the later stages of education, graduate students require active faculty involvement and support to prepare for faculty positions (Trede et al., 2012). Graduate students enhance their self-awareness and gain a deeper understanding of professional practice (Thiry et al., 2011), acquiring skills through coursework and laboratory experiences and experiencing the profession's culture and rewards (Brownell & Tanner, 2017). Additionally, peers in the sciences exemplify the “rules of membership” within the discipline. Research on lived experiences during graduate education for other populations within academia, such as underrepresented faculty, has provided insight into the dimensions of faculty professional identity.

1.2.3. Underrepresented Faculty Professional Identity

Disparities in accessing institutional knowledge do not emerge only during graduate school. Inequalities may persist in doctoral research, faculty advisor relationships, research and teaching positions, and professional development activities such as conference attendance and guest lecturing (Feldon et al., 2023; Gopaul, 2011, 2015, 2016; Wofford, 2021).

Some underrepresented minority (URM) doctoral students combat the dominant culture and feelings of isolation by building relationships across their programs as they navigate pathways to the professoriate (Portnoi et al., 2015). Underrepresented faculty with similar experiences to students may understand their students' need for relationships and belonging. Alarcón et al. (2023) found that Latinx engineering faculty included familial capital in their professional identities to nurture belonging for all students. Latinx engineer-

ing faculty used the concept of *familia* to implement equitable and inclusive pedagogical practices and to teach the whole student rather than merely act as technical experts in engineering. Based on the conceptual framework of the current study, these practices align with potentially all four dimensions of professional identity because they reflect core beliefs and values, but more specifically, they reinforce the self-related, work-related, and student-related dimensions. Understanding differences in the perspectives and experiences of diverse faculty helps illustrate how lived experiences influence professional identity, which in turn shapes how faculty adopt teaching practices that reflect their identities and values.

1.2.4. Teaching Practices and Training in STEM Higher Education

Teaching is not a formal or recommended component of doctoral training. Although some students become graduate teaching assistants, most STEM disciplines lack requirements for education scholarship. The importance of training future faculty to teach and calls for reform date back to the early 1900s. In seminal work on higher education scholarship, Boyer (1990) acknowledged the unequal weight given to research and teaching, introduced the idea of faculty assessment in teaching, and urged higher education leaders to address teacher preparation. Since Boyer's (1990) publication, many researchers have described the lack of teaching preparation and noted the profound disconnect between the training received in doctoral programs and the skills needed for academic careers (Brownell & Tanner, 2017; Connolly et al., 2018; Frey et al., 2020). More recently, graduate programs have incorporated teaching preparation programs for future faculty. While we did not examine these programs for our research, we looked at research-based teaching practices found to improve student outcomes to address faculty teaching professional development needs. In our study, encouragement is the teaching practice used to highlight how it may shape professional identity formation and the relationship it has with dimensions of faculty professional identity.

1.2.5. Encouragement in Teaching Practice

Several previous studies (Byars-Winston et al., 2017; Won et al., 2017; Wong et al., 2019) found that students' experiences of encouragement in academics positively predicted their levels of academic self-efficacy. According to Bandura (1982), verbal persuasion can influence students' self-efficacy, which refers to an individual's belief in their ability to successfully perform a specific task or achieve a goal. We propose that encouragement functions as a form of verbal persuasion and, based on existing research, understand that it influences students' self-efficacy. From a positive psychology perspective, encouragement is defined as "the expression of affirmation through language or other symbolic representation to instill courage, perseverance, comfort, inspiration, or hope in a person within the context of addressing a challenging situation or realizing a potential" (Wong, 2015, p. 182). Challenge-focused encouragement centers on the difficult situations that individuals face, while potential-focused encouragement centers on the potential that individuals possess. While challenge-focused encouragement helps individuals cope with current adversity, potential-focused encouragement helps individuals understand their value (Wong et al., 2019).

Within the academic environment, two recent studies measured student perceptions of encouragement and its effect on student self-efficacy (Hsu et al., 2021; Wong et al., 2019). The use of student self-efficacy as a barometer for student persistence is consistent in research. These studies found that receiving encouragement increases self-efficacy and outcome expectations (Hsu et al., 2021). For this study, encouragement was chosen as a measure of teaching practice because it plays a critical role in supporting student retention

and represents an evidence-based practice consistent with the profession's commitment to enhancing student outcomes.

1.2.6. Faculty Professional Identity Research

Limited research on faculty professional identity suggests that there are internal and external factors in faculty identity formation (Abu-Alruz & Khasawneh, 2013; Samuel & Stephens, 2000; Starr et al., 2006). Faculty, particularly those at research-intensive universities, have teaching and research responsibilities. However, these may be competing responsibilities, and faculty may prioritize them differently based on institutional and individual values (Brownell & Tanner, 2017; Han et al., 2021; Ramírez, 2022).

Scholars have not developed a formalized framework but have used various dimensions from K–12 research to investigate faculty professional identity. In a meta-study of the measurement tools for faculty professional identity, Hanna et al. (2019) found 59 dimensions used across 20 studies. The researchers identified little quantitative research on faculty professional identity, and the extant research had many conceptual and methodological issues. Therefore, there is a need for more research to develop a formalized framework for faculty professional identity. Based on the limitations of faculty professional identity research, we were only able to find one quantitative study (Abu-Alruz & Khasawneh, 2013) that included a survey instrument appropriate for measuring faculty professional identity.

1.2.7. Current Study

Despite the dual responsibilities of teaching and research that define the faculty profession, the preparation pathways are mostly asymmetrical. Given that effective teaching practices contribute to student retention, there is a compelling need to examine the relationship between these practices and faculty professional identity. The significance of this study lies in bridging the gap in understanding how teaching practices may shape the development of faculty professional identity and extending the application of encouragement as a teaching practice to improve student retention in STEM disciplines. This study situates faculty within professional identity theory, a framework that has received little research in this context, to advance understanding of the identity dimensions faculty value.

In the current study, we assess STEM faculty perspectives on receiving encouragement as a student and measure dimensions of faculty professional identity. Two established scales were updated for context and combined for use in this study. The first scale, the Academic Encouragement Scale (AES), was updated to reflect the perspective of a faculty member from the original scale, which reflected the perspective of a college student. The second scale, the Professional Identity Questionnaire (PIQ), has only been previously used in one study in Jordan, and job requirements of faculty may differ between countries. This posed an opportunity to use the scale in the United States and became one of our research questions. We provide more information about these two instruments in our methodology. The current study was guided by two research questions:

1. What is the relationship between receiving encouragement as a student and STEM faculty professional identity?
2. To what extent is the Professional Identity Questionnaire reliable and valid for measuring STEM faculty professional identity in United States higher education institutions?

2. Materials and Methods

The current study used a quantitative approach to collect data using a survey instrument. The authors' Institutional Review Board (IRB) reviewed the study and determined the activities exempt from IRB oversight. Even with the exempt determination, the study followed ethical human subject procedures.

2.1. Participants

Eligible participants were STEM faculty at a large public 4-year university classified as an R2 (doctoral universities: high research activity) research institution by the Carnegie Classification of Institutions of Higher Education in the United States. The sample comprised 52 STEM faculty in various stages in their careers, including professor (32.65%), associate professor (28.57%), assistant professor (26.53%), senior or master lecturer (4.08%), and lecturer (8.16%). Over half (59.18%) identified as men, 34.69% as women, and 6.12% preferred not to answer. Most respondents identified their race/ethnicity as White (75.51%), followed by Asian (14.28%) or the option prefer not to respond (12.24%).

2.2. Data Collection

Administration of a 40-item structured survey occurred online via Qualtrics survey software. Data collection occurred between 21 June 2022 and 3 July 2022. A total of 320 STEM faculty received invitations to participate via department listserv distribution, and each faculty received a reminder email two weeks after the initial invitation. The participants included in the study completed all items on the two scales (10 items on encouragement received as a student and 24 items on professional identity). Of the 52 participants, only 49 provided complete responses. Overall, 49 of the 320 invited faculty members completed the survey, yielding a response rate of 15%. The participants read and confirmed informed consent and eligibility upon entry to the online survey.

2.3. Instrument

The online 40-item survey took five minutes to complete. The survey had consent embedded into the introduction, along with the purpose of the study and the risks and benefits. For the first question, the respondents indicated their STEM discipline. Participants who did not identify with a STEM discipline were automatically directed to the end of the survey, ensuring that only eligible respondents completed it.

The remaining survey questions focused on three variables related to encouragement (AES; 10 items); professional identity (PIQ; 24 items); and participant demographics and characteristics (six items). Participant demographic and characteristics variables were academic rank, tenure status, highest degree earned, gender identity, age, and race/ethnicity.

2.3.1. Academic Encouragement Scale

Self-reported received encouragement underwent assessment with 10 questions (see Supplemental S1). Variables included challenge-based encouragement and potential-based encouragement items. For example, an item for assessing challenge-based encouragement was, “As a student, a professor encouraged me to believe in myself when I doubted my academic abilities.” Another item was, “As a student, a professor noticed I was doing well in school and encouraged me to dream bigger and aim higher.” This item was a means of assessing potential-based encouragement. Participants responded using a 5-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree).

2.3.2. Professional Identity Questionnaire

Self-reported professional identity variables included work-related (five items), student-related (seven items), self-related (eight items), and skill-related (four items) subscales (see Table 1). Participants responded using a 5-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree).

2.4. Data Analysis Process

Survey data were exported from Qualtrics to Microsoft Excel for cleaning and then imported into IBM's Statistical Package for Social Sciences (SPSS) 14 for analysis. Sixty

respondents (18.75%) completed the survey. Of the 60 responses, 52 were mostly complete, and 49 were fully complete (15%). To maintain consistency in interpretation, the AES and PIQ scales were reverse-coded so that higher values represented more positive responses: 5 = *strongly agree*, 4 = *somewhat agree*, 3 = *neither agree nor disagree*, 2 = *somewhat disagree*, and 1 = *strongly disagree*. This ensured that mean scores above the midpoint reflected more favorable or more positive attitudes and mean scores below the midpoint indicated less favorable or negative attitudes. Reverse scoring was implemented during data analysis to facilitate clear interpretation of results and to prevent confusion regarding the directionality of the scales.

Table 1. Items in the Professional Identity Questionnaire.

Q#	Question
Work-related subscale	
1	I am actively involved in the university curriculum decisions (planning, designing, leading and controlling).
2	I am committed to the university mission, vision and goals.
3	I have a thorough understanding of university policies and procedures.
4	I maintain updated knowledge about current educational policies.
5	I establish an effective support network for students.
Student-related subscale	
1	I create and maintain a flexible and harmonious learning environment for my students.
2	I help students apply what they have learned to their daily work life.
3	I establish a trusting and caring relationship with my students.
4	My students regard me as a role model because of my positive social values and my concern for local and global issues.
5	I find satisfaction supporting lifelong learning of students.
6	I tailor my teaching to fit the needs, interests, and abilities of my students.
7	I discuss the progress of my students with colleagues.
Self-related subscale	
1	I am committed and dedicated to the profession.
2	I have a strong passion for teaching.
3	I enjoy sharing my ideas and experiences with other faculty members in the field.
4	I can only see myself as a faculty member working in a university setting.
5	I enjoy the social recognition I get as a faculty member.
6	My students and colleagues regard me as an effective faculty member.
7	I promote harmonious and collaborative staff relationships to enhance the quality of work.
8	I feel part of a community of teachers.
Skill-related subscale	
1	I have passion for continuous learning and excellence.
2	It is important to me to develop my knowledge and teaching skills.
3	I demonstrate strong ongoing personal and professional growth.
4	I would like to be a more knowledgeable and skillful faculty member.

2.5. Data Analysis Method

Data analysis involved computing means and response frequencies for the AES and PIQ items. Cronbach's alpha coefficients were calculated to assess internal scale consistency and establish reliability. Correlation analyses were then conducted to examine the strength and direction of associations between the two scales and to explore the relationship between encouragement and faculty professional identity. An exploratory factor analysis (EFA) was conducted using the maximum likelihood extraction method with oblique rotation, as the underlying factors were expected to be correlated. The EFA assessed construct validity, with separate analyses for each subscale to examine the underlying factor structure.

3. Results

3.1. Frequency Distributions and Scale Reliability

The results showed relatively low average mean scores for receiving encouragement as a student ($M = 2.03$, $SD = 0.94$). There was a relatively high average mean score for faculty professional identity ($M = 4.22$, $SD = 0.75$). The results indicated relatively high scale reliability for encouragement ($\alpha = 0.91$) and professional identity ($\alpha = 0.87$). Table 2 presents the psychometric properties of the scales and subscales. The discrepancies between the mean scores of both scales underwent further correlation analysis. Due to the relatively low reliability of the work-related professional identity subscale ($\alpha = 0.57$), EFA results were used to identify potential problematic items within the subscale.

Table 2. Psychometric Properties for AES and PIQ Scales and Subscales.

Scales and Subscales	<i>M</i>	<i>SD</i>	Cronbach's α
Encouragement total score	2.03	0.94	0.91
Challenge-based	2.30	1.05	0.93
Potential-based	2.13	1.01	0.87
Professional identity total score	4.22	0.75	0.87
Work-related	4.07	0.87	0.57
Student-related	4.25	0.72	0.78
Self-related	4.15	0.77	0.73
Skill-related	4.53	0.65	0.85

3.2. Correlations

Pearson's correlation coefficient indicated the relationship between receiving encouragement as a student and STEM faculty professional identity items (see Supplemental S2). There were several associations between scales, resulting in moderate correlations. Table 3 presents the guidelines for interpreting the strength of Pearson's correlation coefficient (r). The next step in the analysis was reviewing the associations that resulted in moderate to strong correlations ($r = 0.30$ to 0.69), positively and negatively, to determine statistical significance ($p = 0.05$). Table 4 presents the statistically significant correlated dimensions.

Table 3. Guidelines for Interpreting the Strength of the Pearson Correlation Coefficient (r).

Strength of Relationship Between Variables	Positive	Negative
Weak	0.10 to 0.29	−0.10 to −0.29
Moderate	0.30 to 0.39	−0.30 to −0.39
Strong	0.39 to 0.69	−0.39 to −0.69
Very strong	0.70 to 1.0	−0.70 to −1.0

Table 4. Statistically Significant Correlated Dimensions.

Professional Identity	Encouragement	N	<i>r</i>	<i>p</i>
I establish an effective support network for students (W5)	Insist that students should strive for higher academic standards because they are capable (P3)	49	−0.37	0.008
I establish a trusting and caring relationship with my students (ST3)	Encourage students to believe in themselves when they doubt their academic abilities (CH1)	48	−0.39	0.006

Table 4. Cont.

Professional Identity	Encouragement	N	r	p
My students regard me as a role model because of my positive social values and my concern for local and global issues (ST4)	Encourage students to believe in themselves when they doubt their academic abilities (CH1)	48	−0.49	<0.001
	Remind students of their strengths when they are discouraged about a challenging academic task (CH3)	47	−0.49	<0.001
	Assure students that they are competent in dealing with their academic difficulties (CH4)	46	−0.53	<0.001
	Express confidence in students and tell them to keep trying in my course even though it is hard (CH5)	47	−0.39	0.006
	Point out students' strengths and suggest they pursue a new academic opportunity (P1)	48	−0.41	0.003
	Notice students doing well in my course and encourage them to dream bigger and aim higher (P2)	48	−0.41	0.003
I can only see myself as a faculty member working in a university setting (S4)	Insist that students should strive for higher academic standards because they are capable (P3)	48	−0.37	0.009
	Explain why they have the skills to succeed in college at an advanced level (P4)	48	−0.45	0.001
	Point out students' strengths and suggest they pursue a new academic opportunity (P1)	49	−0.42	0.002
	Explain why they have the skills to succeed in college at an advanced level (P4)	49	−0.37	0.009
I enjoy the social recognition I get as a faculty member (S5)	Say something positive to motivate students to consider a new academic goal (P5)	49	−0.40	0.004
	Express confidence in students and tell them to keep trying in my course even though it is hard (CH5)	47	−0.42	0.003
	Point out students' strengths and suggest they pursue a new academic opportunity (P1)	48	−0.37	0.008
	Say something positive to motivate students to consider a new academic goal (P5)	48	−0.39	0.005
I promote harmonious and collaborative staff relationships to enhance the quality of work (S7)	Explain why they have the skills to succeed in college at an advanced level (P4)	48	−0.38	0.006

3.3. Exploratory Factor Analysis

The EFA occurred with maximum likelihood with an oblique rotation based on scale correlation (Costello & Osborne, 2005). Kaiser-Mayer-Olkin and Bartlett's tests showed the dataset aligned with the factor analysis criteria (based on a 0.50 cutoff). EFA commenced

for the scale data with missing data excluded listwise. Each subscale underwent analysis to understand factors and construct validity.

The encouragement scale items had two factors. Factor 1 comprised five items that accounted for 57% variance, with factor loadings from 0.740 to 0.967. Factor 2 comprised five items that accounted for 74% of variance, with factor loadings from 0.671 to 0.960. The professional identity scale had seven factors. Factor analysis occurred for each subscale to determine items unrelated to the dimension.

Student-related, skill-related, and work-related subscales had one component each. The self-related subscale comprised three factors within eight items, accounting for 70% of the variance. Table 5 presents the factor loadings for the self-related subscale. The work-related professional identity subscale had low internal consistency ($\alpha = 0.57$). Therefore, Cronbach's alpha was the means of determining the candidate items for removal. Table 6 presents the item extractions with Cronbach's alpha for the work-related professional identity subscale.

Table 5. Factor Analysis Results for the Self-Related Subscale of Professional Identity ¹.

Self-Related Professional Identity Subscale Item		Factor Loading		
		1	2	3
7.	I promote harmonious and collaborative staff relationships to enhance the quality of work	0.963	0.020	−0.165
3.	I enjoy sharing my ideas and experiences with other faculty members in the field	0.762	−0.114	0.327
5.	I enjoy the social recognition I get as a faculty member	0.097	0.875	−0.082
4.	I can only see myself as a faculty member working in a university setting	−0.206	0.859	0.019
8.	I feel part of a community of teachers	0.427	0.459	0.111
6.	My students and colleagues regard me as an effective faculty member	0.199	0.383	0.270
2.	I have a strong passion for teaching.	−0.115	−0.052	0.937
1.	I am committed and dedicated to the profession.	0.119	0.088	0.797

¹ The extraction method was maximum likelihood with oblique (Oblimin with Kaiser normalization) rotation. Factor loadings by dimension are in bold.

Table 6. Cronbach's Alpha Test for Internal Consistency of Work-Related Professional Identity Subscale.

Subscale Items	Cronbach's α	Cronbach's α if Item Deleted
Overall (5 items)	0.57	
I am actively involved in the university curriculum decisions		0.57
I am committed to the university missions, vision, and goals		0.52
I have a thorough understanding of university policies and procedures		0.43
I maintain updated knowledge about current educational policies		0.45
I establish an effective support network for students		0.59

4. Discussion

The purpose of the current study was to assess the relationship between receiving encouragement as a student and STEM faculty professional identity. The study had two research questions:

1. What is the relationship between receiving encouragement as a student and STEM faculty professional identity?
2. To what extent is the Professional Identity Questionnaire reliable and valid for measuring STEM faculty professional identity in United States higher education institutions?

4.1. Relationship Between Encouragement and STEM Faculty Professional Identity

Most participants reported low levels of receiving encouragement as students but high levels for all four dimensions within their professional identities. The statistically significant association between the correlated pairs of the two scales (see Table 4) had a linear correlation with a negative association, indicating the scale variables' movement in opposite directions. For example, if a participant reported a low value for an item in the encouragement scale, the associated item in the professional identity scale had a high value. To illustrate, consider the following items from each scale. A participant that provides a high score to the student-related professional identity item ST3 ("I establish a trusting and caring relationship with my students"), and a low score to the challenge-based encouragement item CH1 ("As a student, a professor encouraged me to believe in myself when I doubted my academic abilities"), demonstrates that faculty perceive receiving less encouragement as a student (score decreases) while exhibiting greater engagement in providing a caring relationship with their own students as part of their professional identity (score increases).

The weak/moderate correlation between encouragement received as a student and STEM faculty professional identity may have resulted from misclassification. Participants might have inaccurately rated the encouragement received if they did not understand how to define encouragement. This aligns with findings from Wong et al. (2019), who developed an academic encouragement scale and observed that encouragement was often confused with other forms of social support, including neutral persuasion without affirmations, praise lacking a motivational component, and difficulty distinguishing between the two types of encouragement, challenge-based and potential-based (Wong et al., 2019). Additionally, this low score could have resulted from recall bias related to the time elapsed since participants were students, as they may have recalled their interactions with faculty who taught them either more favorably or unfavorably. However, the participants had higher professional identity scores for the student-related and self-related dimensions than for the encouragement received. The results suggest that many STEM faculty may perceive the importance of their role with students and that encouragement aligns with two dimensions of their professional identity. This study did not measure current encouragement practices of STEM faculty, but indicates an association between encouragement and teaching practice.

Academic encouragement is an interaction between faculty and students and an "expression of affirmation through language or other symbolic representation to instill courage, perseverance, comfort, inspiration, or hope in a person within the context of addressing a challenging situation or realizing a potential" (Wong, 2015, p. 182). Based on this explanation, encouragement aligns with student-related and self-related faculty professional identities, defined in the study's conceptual framework as expressions indicating faculty consider their students and their students' successes important.

The results of this alignment could indicate a few challenges. First, faculty who did not receive encouragement as students may lack an understanding of how encouragement impacts persistence and retention. An adage in higher education is, "We teach the way we

were taught.” Consequently, faculty who base their teaching on prior experiences may find it difficult to use encouragement as an intentional strategy to promote student retention. The results also indicate that faculty value relationships with students. However, it remains unclear whether these relationships are primarily fostered within academic settings or through other forms of interaction, such as mentoring, academic advising, or involvement in student organizations. Providing professional development on evidence-based teaching practices that enhance student outcomes could offer meaningful learning opportunities for faculty and reflect the importance they place on supporting students.

Second, many STEM faculty have not received formal teaching training. Teaching is a significant faculty responsibility. However, most Ph.D. students receive little training or experience in pedagogy and lack preparedness to execute a key part of academic duties (Connolly et al., 2018; Feldon et al., 2023; Frey et al., 2020). A lack of teaching training could affect faculty members’ abilities to achieve the full potential of student retention in STEM.

The data in this study had high values for the self-related and student-related dimensions of faculty professional identity. The participants reported a high passion for teaching and dedication to their students. Although results positively reflected a high value for faculty’s engagement with students and teaching, the study did not measure faculty teaching practices. This omission highlights an important gap. While research demonstrates that students’ self-efficacy increases from encouragement (Hsu et al., 2021; Wong et al., 2019), it remains unclear how, or to what extent, faculty implement encouragement within their instructional approaches. Understanding this gap is critical, as limited faculty encouragement practices could hinder student persistence and retention in STEM programs, particularly among underrepresented and marginalized students who struggle to persist in their STEM degrees (Jackson, 2013; Seymour & Hewitt, 1997; Seymour & Hunter, 2019; Xu, 2018; Zhang & Allen, 2015).

4.2. Performance of the Professional Identity Questionnaire Scale

The 24-item PIQ is based on measurement scales of teacher professional identity in the literature (Hanna et al., 2019). The four dimensions for faculty professional identity provided insights into how STEM faculty see their strengths and areas for development. To the authors’ knowledge, this study was the first to focus on STEM faculty professional identities at higher education institutions in the United States. The original research for the PIQ occurred in Jordan (Abu-Alruz & Khasawneh, 2013), and those results varied from this study’s findings.

The PIQ is a validated but not widely used tool. Therefore, the PIQ underwent further testing for reliability. Internal consistency testing found a few areas of potential improvement for the PIQ. The PIQ had strong internal consistency; however, separating the results by dimension of professional identity showed low reliability for the work-related items on the scale. This finding indicates the need to question the appropriateness of the work-related items. The results also suggest that higher education faculty in the United States may not perceive work-related items as part of their professional identities or responsibilities.

4.3. Latent Dimensions Underlying Self-Related Professional Identity

EFA of the scale found three latent dimensions in self-related professional identity. A three-factor structure was an unexpected finding due to the scale’s organization around how community members (e.g., self, colleagues, and students) impact self-related professional identity (see Table 5). This finding could indicate too much specificity in the self-related scale statements on community member perceptions. Rewording could be a way to achieve construct continuity.

4.4. Limitations

The participants represented a limited STEM faculty population at one institution. Thus, the study results might not be generalizable to other contexts or disciplines. A larger and more diverse sample could yield different results, including variation in the levels of encouragement received or stronger predictive relationships between encouragement as a student and faculty professional identity. Expanding the sample size would also allow for more robust statistical analysis, such as assessing the predictive effects of encouragement and identifying additional correlations among study variables.

Another limitation concerns potential recall bias in participants' reports of encouragement received as students. As [Bell et al. \(2019\)](#) noted, "Cognitively, reporting of past activities is potentially subject to a range of different recall errors" (p. 327). Such bias may have influenced the accuracy of participants' recollections, leading to over- or underestimation due to the time elapsed between those experiences and survey completion. This may have affected the measured associations between encouragement and professional identity dimensions.

Additionally, the meaning and expression of encouragement may differ across disciplines, educational levels, and cultural contexts, which could influence how faculty recall or interpret their experiences. Although the Academic Encouragement Scale (AES) demonstrated high internal consistency within this sample, further research is needed to evaluate the construct validity of its subscales for faculty populations. The study's cross-sectional and retrospective design also limits causal inference. Future longitudinal or mixed-method studies could provide a more comprehensive understanding of how encouragement experiences develop over time and across institutional settings.

Finally, the PIQ instrument did not include items addressing representation or diversity within the faculty profession. The PIQ was originally developed outside of the United States, and the item set may not fully capture the values or experiences of underrepresented faculty in United States higher education. This omission limits the ability to examine dimensional differences across demographic groups and may have influenced the observed results. It is also important to consider that faculty educated outside the United States may interpret professional identity formation differently based on the academic cultures of their prior institutions, which could further affect responses. Future adaptations of the PIQ should include items that reflect diversity, representation, and cross-cultural dimensions of faculty professional identity.

4.5. Future Research

The current study demonstrated the importance of examining how encouragement, an evidence-based teaching practice, relates to the different dimensions of faculty professional identity. The current study had a limited STEM faculty sample. Future researchers could examine various disciplines across multiple and diverse categories of higher education institutions. Scholars using a larger sample could conduct structural equation modeling to better understand various associations between the demographics and the scales. Beyond methodological expansion, future research should build on these findings through conceptual and hypothesis-driven approaches. For example, mediation or pathway models could provide a deeper understanding of how encouragement contributes to professional identity formation and educational outcomes. A mixed-methods exploration to include qualitative data may also provide insight into the connection between encouragement and professional identity formation. Additionally, exploring contextual moderators such as disciplinary culture, institutional support, or prior teaching experience could clarify when and for whom encouragement has the strongest impact.

Future scholars could use the PIQ to refine and expand the main dimensions and their subscales, including the self-related subscale items and the reliability of the work-related scale items. A longer scale may be a means of identifying additional latent dimensions not observed in this study but mentioned in the literature (e.g., diversity, underrepresentation, and institutional knowledge). Further scale development and validation should occur to formalize and validate a faculty professional identity framework, currently underdeveloped in the literature.

4.6. Implications and Recommendations

The faculty perspectives of professional identity dimensions could have implications for prioritizing support for faculty and graduate programs. The results showed an association between receiving encouragement as a student and faculty professional identity. However, the study did not indicate how to incorporate research-based practices like encouragement to improve student self-efficacy, student retention, and degree attainment. The following are potential recommendations for applying the study's findings.

4.7. Professional Expectations in Higher Education

The STEM faculty in this sample valued specific dimensions within their profession. The lower scores for some areas may have resulted from a limited understanding of the various dimensions of their faculty roles. It is possible that the lower score may indicate that faculty may not prioritize responsibilities to the institution, such as service responsibilities (work-related). At a public institution, while faculty's roles within their institutional decision-making process are especially important due to their frequent interactions with students, incentives for these responsibilities may be low within their institutional contexts. For example, service commitments and mentorship are often not prioritized in promotion and tenure packages or annual evaluations (Squires & Hamilton, 2024). Promotion and tenure procedures often push a narrative that research productivity is most important, which is reflected in pre-tenure faculty's priorities (Helton & Pathman, 2023). It may be useful for institution leaders to conduct a similar study as ours on their faculty to understand the specific dimensions they value within their profession and whether it aligns with their institutional strategic plan. In cases of misalignment, additional support such as mentoring between experienced and early-career faculty, changes to faculty evaluations and promotion procedures, and other professional development may be needed.

4.8. Access to Encouragement Research

The low scores of faculty receiving encouragement are concerning, as they reflect a lack of exposure to encouragement as a pedagogical practice; without access to such models, faculty may be unaware of alternative ways of fostering student persistence and belonging. Providing professional development opportunities may enable faculty to define and provide encouragement for best practices, utilizing their impact on student retention, especially for URM students (Benabentos et al., 2022; Doherty & Wenderoth, 2022). These opportunities may include workshops, seminars, professional learning communities, and access to education research publications and conferences. In addition, training earlier in the academic pipeline to graduate students and postdoctoral researchers would allow future faculty to develop an understanding of evidence-based pedagogy, such as encouragement, before assuming teaching responsibilities.

5. Conclusions

The purpose of the current study was to assess STEM faculty perceptions of receiving encouragement as students and its relationship to the dimensions of their professional identity. Participants reported low levels of encouragement as students but high levels

of all four professional identity dimensions. Notably, the student-related and self-related professional identity dimensions scored higher than the encouragement received. Although these results reflect a strong value for faculty engagement with students and teaching, the study did not assess actual faculty teaching practices. These findings contribute to the literature on encouragement and underscore the need for faculty to receive institutional support and professional development aimed at bridging the gap between research and teaching practice.

To the authors' knowledge, this study is the first to examine STEM faculty professional identity in the United States using the PIQ. Scale factor analysis revealed three latent dimensions within the self-related professional identity subscale, suggesting that some items may require rewording to improve construct continuity. Additionally, the low internal consistency of the work-related dimension indicates a need to evaluate the appropriateness of the items for STEM faculty in the United States. Based on these findings, the PIQ instrument should be adapted to reflect how the faculty profession is defined in the United States and to incorporate items that capture the values of underrepresented faculty. This study provides external validation of the PIQ and contributes to the development of a framework for understanding faculty professional identity.

Overall, these findings highlight opportunities to enhance faculty development and institutional practices. Faculty professional identity influences how educators prioritize teaching, research, and service, and misalignments between institutional expectations and faculty values may limit their impact on student retention in STEM. Institutions could use similar assessments to identify gaps and implement mentoring, evaluation, and promotion systems that more effectively recognize teaching and service contributions. The limited exposure to encouragement among faculty underscores the need for professional development and early training in evidence-based pedagogy. Introducing concepts like encouragement during graduate and postdoctoral preparation, and reinforcing them through ongoing faculty development, may foster more inclusive, supportive, and effective learning environments in STEM.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/educsci15111563/s1>, Supplemental S1: Academic Encouragement Scale, Supplemental S2: Correlations.

Author Contributions: Conceptualization, R.Z. and Y.L.; Methodology, R.Z. and Y.L.; Validation, R.Z.; Formal analysis, R.Z.; Investigation, R.Z.; Resources, Y.L.; Data curation, R.Z.; Writing—original draft, R.Z.; Writing—review and editing, Y.L.; Visualization, R.Z.; Supervision, Y.L.; Project administration, Y.L.; Funding acquisition, Y.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was reviewed by the Institutional Review Board (IRB) at University of Massachusetts Lowell and it was determined that the study was not Human Subjects Research (NHRSR), as defined by 28 CFR 46 regulations.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are openly available in FigShare at <https://doi.org/10.6084/m9.figshare.29925017.v1>.

Conflicts of Interest: The authors declare no conflicts of interest.

References

- Abu-Alruz, J., & Khasawneh, S. (2013). Professional identity of faculty members at higher education institutions: A criterion for workplace success. *Research in Post-Compulsory Education*, 18(4), 431–442. [\[CrossRef\]](#)
- Alarcón, I. V., Castro, L. M. C., Mendoza-Garcia, J. A., Latorre-Navarro, E., Alvarado, D., & Virguez, L. (2023, June 25–28). *Nuestro impacto: An insider look into the connections between our past experiences and current teaching and mentoring practices* [Conference presentation]. 2023 ASEE Annual Conference & Exposition, Boston, MA, USA.
- Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, 37(2), 122–147. [\[CrossRef\]](#)
- Barbarà-i-Molinero, A., Cascón-Pereira, R., & Hernández-Lara, A. B. (2017). Professional identity development in higher education: Influencing factors. *International Journal of Educational Management*, 31(2), 189–203. [\[CrossRef\]](#)
- Bell, A., Ward, P., Tamal, M. E. H., & Killilea, M. (2019). Assessing recall bias and measurement error in high-frequency social data collection for human-environment research. *Population and Environment*, 40(3), 325–346. [\[CrossRef\]](#) [\[PubMed\]](#)
- Benabentos, R., Brewe, E., Potvin, G., Edward, J., & Kramer, L. (2022). Institutionalizing evidence-based STEM reform through faculty professional development and support structures. *International Journal of STEM Education*, 9, 36. [\[CrossRef\]](#)
- Boyer, E. L. (1990). *Scholarship reconsidered: Priorities of the professoriate*. The Carnegie Foundation for the Advancement of Teaching.
- Briggs, A. R. (2007). Exploring professional identities: Middle leadership in further education colleges. *School Leadership and Management*, 27(5), 471–485. [\[CrossRef\]](#)
- Brownell, S. E., & Tanner, K. (2017). Barriers to faculty pedagogical change: Lack of training, time, incentives, and... tensions with professional identity? *CBE Life Sciences Education*, 11, 339–346. [\[CrossRef\]](#)
- Byars-Winston, A., Diestelmann, J., Savoy, J. N., & Hoyt, W. T. (2017). Unique effects and moderators of effects of sources on self-efficacy: A model-based meta-analysis. *Journal of Counseling Psychology*, 64(6), 645–658. [\[CrossRef\]](#)
- Connolly, M. R., Lee, Y. G., & Savoy, J. N. (2018). The effects of doctoral teaching development on early-career STEM scholars' college teaching self-efficacy. *CBE—Life Sciences Education*, 17(1), r14. [\[CrossRef\]](#)
- Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research and Evaluation*, 10(7), 1–9. [\[CrossRef\]](#)
- Davey, R. (2013). *The professional identity of teacher educators: Career on the cusp?* Routledge.
- Doherty, J. H., & Wenderoth, M. P. (2022). Which evidence-based teaching practices change over time? Results from a university-wide STEM faculty development program. *International Journal of STEM Education*, 9, 22. [\[CrossRef\]](#)
- Erikson, E. H. (1968). *Identity: Youth in crisis*. W.W. Norton.
- Feldon, D. F., Wofford, A. M., & Blaney, J. M. (2023). Ph. D. Pathways to the professoriate: Affordances and constraints of institutional structures, individual agency, and social systems. In *Higher education: Handbook of theory and research: Volume 38* (pp. 325–414). Springer International Publishing. [\[CrossRef\]](#)
- Frey, R., Mutambuki, J., & Leonard, D. (2020). Features of an effective future-faculty teaching development program. *Journal of College Science Teaching*, 49(4), 58–65. [\[CrossRef\]](#)
- Gopaul, B. (2011). Distinction in doctoral education: Using Bourdieu's tools to assess the socialization of doctoral students. *Equity & Excellence in Education*, 44(1), 10–21. [\[CrossRef\]](#)
- Gopaul, B. (2015). Inequality and doctoral education: Exploring the "rules" of doctoral study through Bourdieu's notion of field. *Higher Education*, 70, 73–88. [\[CrossRef\]](#)
- Gopaul, B. (2016). Applying cultural capital and field to doctoral student socialization. *International Journal for Researcher Development*, 7(1), 46–62. [\[CrossRef\]](#)
- Han, J., Perron, B. E., Yin, H., & Liu, Y. (2021). Faculty stressors and their relations to teacher efficacy, engagement and teaching satisfaction. *Higher Education Research & Development*, 40(2), 247–262. [\[CrossRef\]](#)
- Hanna, F., Oostdam, R., Severiens, S. E., & Zijlstra, B. J. (2019). Domains of teacher identity: A review of quantitative measurement instruments. *Educational Research Review*, 27, 15–27. [\[CrossRef\]](#)
- Helton, M. R., & Pathman, D. E. (2023). Scholarship criteria for promotion in the age of diverse faculty roles and digital media. *Family Medicine*, 55(8), 544–546. [\[CrossRef\]](#)
- Henkel, M. (2012). Exploring new academic identities in turbulent times. In *Managing reform in universities: The dynamics of culture, identity and organizational change* (pp. 156–176). Palgrave Macmillan UK. [\[CrossRef\]](#)
- Hsu, H.-Y., Li, Y., Dugger, S., & Jones, J. (2021). Exploring the relationship between student-perceived faculty encouragement, self-efficacy, and intent to persist in engineering programs. *European Journal of Engineering Education*, 46(5), 718–734. [\[CrossRef\]](#)
- Jackson, D. L. (2013). Making the connection: The impact of support systems on female transfer students in science, technology, engineering, and mathematics (STEM). *Community College Enterprise*, 19(1), 19–33.
- Lent, R. W., & Brown, S. D. (2019). Social cognitive career theory at 25: Empirical status of the interest, choice, and performance models. *Journal of Vocational Behavior*, 115, 103–316. [\[CrossRef\]](#)
- Mead, G. H. (1934). *Mind, self, and society* (Vol. 111). University of Chicago Press.

- Portnoi, L. M., Chlopecki, A. L. A., & Peregrina-Kretz, D. (2015). Expanding the doctoral student socialization framework: The central role of student agency. *The Journal of Faculty Development*, 29(3), 5–16.
- Ramírez, T. (2022). Faculty teaching and research relationship: An old debate. *Odontos-International Journal of Dental Sciences*, 24(2), 8–9. [\[CrossRef\]](#)
- Samuel, M., & Stephens, D. (2000). Critical dialogues with self: Developing teacher identities and roles—A case study of South African student teachers. *International Journal of Educational Research*, 33(5), 475–491. [\[CrossRef\]](#)
- Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving* (Vol. 34). Westview Press.
- Seymour, E., & Hunter, A. B. (2019). *Talking about leaving revisited: Persistence, relocation, and loss in undergraduate STEM education*. Springer.
- Sheu, H. B., Lent, R. W., Brown, S. D., Miller, M. J., Hennessy, K. D., & Duffy, R. D. (2010). Testing the choice model of social cognitive career theory across Holland themes: A meta-analytic path analysis. *Journal of Vocational Behavior*, 76(2), 252–264. [\[CrossRef\]](#)
- Squires, V., & Hamilton, M. J. (2024). Staying engaged and achieving promotion: The role of collegial support and career reflection and assessment for mid-career faculty. *Trends in Higher Education*, 3(2), 297–307. [\[CrossRef\]](#)
- Starr, S., Haley, H. L., Mazor, K. M., Ferguson, W., Philbin, M., & Quirk, M. (2006). Initial testing of an instrument to measure teacher identity in physicians. *Teaching and Learning in Medicine*, 18(2), 117–125. [\[CrossRef\]](#)
- Thiry, H., Laursen, S. L., & Hunter, A. B. (2011). What experiences help students become scientists? A comparative study of research and other sources of personal and professional gains for STEM undergraduates. *The Journal of Higher Education*, 82(4), 357–388. [\[CrossRef\]](#)
- Trede, F., Macklin, R., & Bridges, D. (2012). Professional identity development: A review of the higher education literature. *Studies in Higher Education*, 37(3), 365–384. [\[CrossRef\]](#)
- Vergara, C. E., Urban-Lurain, M., Campa, H., Cheruvilil, K. S., Ebert-May, D., Fata-Hartley, C., & Johnston, K. (2014). FAST-Future Academic Scholars in Teaching: A high-engagement development program for future STEM faculty. *Innovative Higher Education*, 39, 93–107. [\[CrossRef\]](#)
- Wofford, A. M. (2021). Modeling the pathways to self-confidence for graduate school in computing. *Research in Higher Education*, 62(3), 359–391. [\[CrossRef\]](#)
- Won, S., Lee, S. Y., & Bong, M. (2017). Social persuasions by teachers as a source of student self-efficacy: The moderating role of perceived teacher credibility. *Psychology in the Schools*, 54(5), 532–547. [\[CrossRef\]](#)
- Wong, Y. J. (2015). The psychology of encouragement: Theory, research, and applications. *The Counseling Psychologist*, 43(2), 178–216. [\[CrossRef\]](#)
- Wong, Y. J., Cheng, H.-L., McDermott, R. C., Deng, K., & McCullough, K. M. (2019). I believe in you! Measuring the experience of encouragement using the academic encouragement scale. *The Journal of Positive Psychology*, 14(6), 820–828. [\[CrossRef\]](#)
- Xu, Y. J. (2018). The experience and persistence of college students in STEM majors. *Journal of College Student Retention: Research, Theory & Practice*, 19(4), 413–432. [\[CrossRef\]](#)
- Zhang, Y. L., & Allen, T. O. (2015). Challenges and support: Transfer experiences of community college engineering students. *Journal of Applied Research in the Community College*, 22(1), 43–51.

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.