Who am I as a Future Professional? Examining Professional Identity Status Across Demographics in STEMM Undergraduates

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Abstract

In 2015, Mancini et al. validated and published the Professional Identity Status Questionnaire (PISQ-5d). This survey uses five factors to measure how an individual identifies themselves within their chosen field of profession. In recent years, the survey has been modified and adopted for use in other fields such as nursing and social work, and among students in Science, Technology, Engineering, Mathematics, and Pre-Medical (STEMM) programs. For this study, the PISQ-5d survey was utilized to investigate how undergraduate students at a Hispanic-serving institution identify themselves as future professionals in their field. The results of this study aim to understand further how students of different backgrounds relate to being a future professional in their field by comparing the identity statuses of the students based on a multitude of demographic and academic data including gender identity, racial and ethnic identity, admission, STEM degree program including pre-medical students (STEMM), class standing, first-generation classification, and financial need. The results of this study show multiple statistically significant differences between students of various demographics. This study also shows how this survey can be used to identify STEMM individuals who may have deficits in professional or career development as they work towards becoming future professionals in their field.

Keywords: professional identity, identity status, PISQ-5d, underrepresented demographics

Professional identity is defined as a dynamic and cognitive process surrounding the perception of inclusion in a social group of individuals who share specific technical and work-related knowledge (Gondim, 2016). The formation of a professional identity is said to be a constant process of construction and revision. This process is heavily emphasized during undergraduate studies at secondary education institutions due to the variety of professional fields students are exposed to (Carvalho et al., 2021). STEM identity (Science, Technology, Engineering, Mathematics) is similar to professional identity but narrows the scope to include only STEM-based professions. Studies have been published on the formation of professional identity and the methods used to measure it across various professions, such as in social work (Carvalho et al., 2021) and nursing (Philippa et al., 2021). As research regarding professional identity has become more popular, there has been an increasing number of publications investigating the professional identities of individuals in the field of education, including teachers and students in a variety of disciplines such as medicine, engineering, and other STEM fields (Conn et al., 2015; Goldie, 2012; Head & Wilson, 2025; Karaolis & Philippou, 2019; Kelly et al., 2020). Multiple studies have highlighted the importance of the development of a strong engineering identity and its relationship with student persistence through an engineering degree track (Beam et al., 2009; Pierrakos et al., 2009; Verdín, 2021).

Attrition and Career Readiness in Underrepresented Demographics

In 2013, a report revealed high attrition rates of students pursuing STEM degrees. This report concluded that the attrition rate for students beginning a STEM bachelor's (four-year) degree was 48% and was even higher at 69% for a STEM associate (two-year) degree (Chen, 2013). Almost half of the students who pursued a STEM bachelor's degree did not complete that degree. The STEM attrition rate is stated to be higher for historically underrepresented groups, including but not limited to women, Black/African American, and Hispanic individuals (Chang et al., 2014; Hill et al., 2010; Hill et al., 1990). One publication found that the rate of African American and Hispanic students leaving the STEM degree program was higher than that of White students (Riegle-Crumb et al., 2019). This study also concluded that African American and Hispanic students were more likely to leave a degree program and pursue a degree in a different field than White students. Unfortunately, students leaving a degree program to pursue a separate profession that

better represents students who "look like them" is not uncommon (Astorne-Figari & Speer, 2019; Ganley et al., 2018). These findings highlight a lack of persistence in STEM majors at a time when it is needed the most. It is predicted that there will be 3.5 million jobs in various STEM fields by the year 2025; however, there are concerns that as many as two million of these jobs will be left without qualified STEM professionals to fill them (Coykendall, 2024). Collectively, these findings are a small part of a larger concern in science education regarding historically underrepresented groups in STEM and the effects this under-representation has on how these individuals see themselves as future professionals in STEM (Blickenstaff, 2005; McGee & Bentley, 2017).

There has been an increase in the belief that students currently enrolled in an undergraduate program need to develop a wide breadth of knowledge, skills, and resources to increase their chances of being successful in their future career (Hooker & Brand, 2010). Preparing for a career path can present a unique set of challenges for some students, particularly for historically underrepresented gender or racial demographic groups, students from low-income households, and first-generation college students (Hooker & Brand, 2010; Thomas, 2014). Universities have been increasingly viewed as playing a major role in hosting opportunities for all students to develop the skills necessary to market themselves as employable and career-ready (Daniels & Brooker, 2014; McDonald & Dominguez, 2015). However, multiple survey results from 2017-2018 reveal that less than half of college students feel their higher education has sufficiently prepared them for joining the workforce (Green et al., 2023). Studies have continuously utilized identity when investigating career readiness in practitioners who have been engaged in their professional roles due to the perceived link between identity, career readiness, and career performance, including professional identity (Kalbfleisch & Burwell, 2007; Mitin et al., 2018; Wang et al., 2017). If measures of professional identity can be used to identify individuals who are at risk of not feeling ready for their future careers, then a unique opportunity for higher education arises to target at-risk STEM individuals and increase their career readiness. This can potentially increase the number of future STEM professionals available and reduce the overwhelming number of vacancies in STEM careers that are currently predicted (Coykendall, 2024).

Theoretical Framework

For this study, identity is defined as the collective meaning assigned to individuals who belong to specific societal roles or social groups (Burke & Stets, 2022). Professional identity focuses on individuals who belong to specific professional groups. This research views identity through the identity status model (Crocetti et al., 2014; Marcia, 1966). This model states that identity is constructed through three main constructs. The first construct, commitment, describes the decision an individual makes about an identity domain before engaging in the identity space (Marcia, 1966). The second construct, called exploration, refers to the comprehensive search of information about the identity domain with respect to the values, beliefs, and goals an individual wishes to pursue (Mancini et al., 2015; Marcia, 1966). The last part of the model is the reconsideration of commitment, which is the degree to which an individual contemplates replacing their current commitment with an alternative one when the current commitment is no longer satisfactory to the identity of the person (Crocetti et al., 2014).

In 2015, Mancini et al. created, validated, and published the Professional Identity Status Questionnaire (PISQ-5d). The 20-question survey is used to measure how an individual identifies themselves using a five-factor model consisting of both measures of identity and measures of behavior, the latter being included due to the high correlations between identity and work-related behaviors (Mancini & Montali, 2009; Meyer et al., 2006). The five factors were derived from the three constructs in the published literature of Marcia and Crocetti. The definitions of the resulting five measures in the five-factor model and how they relate to the three constructs are below:

1. Commitment.
    - **affirmation**: The significance and sense of accomplishment a person assigns to their place as a member of a professional group (Mancini et al., 2015).
    - **identification with commitment**: The extent to which an individual identifies themselves with their commitment (Meeus et al., 2002).

2. Exploration.
    - **in-depth exploration**: How much an individual actively reflects and seeks out information regarding their current commitments (Meeus et al., 2002).
    - **practices**: Behavioral measurement of the extent to which an individual engages in actions directly relevant to their profession of choice (Mancini et al., 2015).

3. Reconsideration of Commitment.
    - **reconsideration of commitment:** The extent to which an individual contemplates revising current commitments if they are no longer satisfactory (Crocetti et al., 2008).

These five factors defined above are evaluated using the 20 Likert-scale questions in the PISQ-5d survey. Each factor is measured using four unique Likert-scale questions. The responses from each of those four questions are aggregated together, resulting in a single score for an individual factor. Students' average scores for each of the five factors are then collectively analyzed using statistical analyses and cluster analysis techniques to classify them as belonging to one of five distinct identity statuses. These identity statuses provide insight into how a student identifies as a future professional in their chosen career field. These five identity statuses have been published and discussed in the literature from the works of Erikson, Marcia, and Crocetti et al. (Crocetti et al., 2008; Erikson, 1956; Erikson, 1968; Marcia, 1966, 1980). Mancini first introduced the names of the five identity statuses with the original publication of the survey instrument, and these names have been used in various analyses of identity since their release (Head & Wilson, 2025; Kelly et al., 2020; Mancini et al., 2015; Türksoy, 2021). For this study, updated definitions from the literature will be used to define the identity statuses with slight modifications to better represent how the identity statuses explain how the individuals identify as future professionals in their field (Crocetti et al., 2013; Mancini et al., 2015; Meeus et al., 2002).

- **Achievement:** Students in this identity status have explored, experienced, and committed to their future profession. These individuals score highly in the commitment and exploration factors while scoring low in the factor of reconsideration of commitment.

- **Moratorium**: Students in this identity status are actively seeking out information regarding future professions in hopes of committing to a future profession but have not done so yet. Students with this identity status have high scores in the exploration factors and reconsideration factors and low scores in the commitment factors.

- **Searching Moratorium**: Students in this identity status have explored and committed to a future profession; however, the student now considers the future profession unsatisfactory. This identity status is stated to represent individuals who alternate between the moratorium and achievement identity statuses (Mancini et al., 2015). Students with this identity status score highly in all five measured factors.

- **Diffusion**: Students with this identity status have little experience thinking of themselves as future professionals and may not feel an active commitment to any future profession. These students are not actively looking for an alternative future profession to pursue. Individuals in the diffusion identity status score low in all five factors.

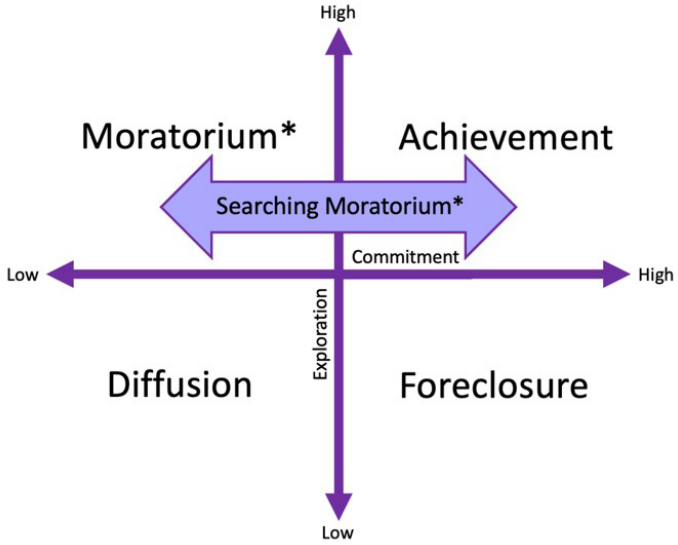
- **Foreclosure**: Students in this identity status have made an active commitment towards a future profession without having explored other options. Students in the foreclosure identity status score high in the commitment factors but low in the exploration and reconsideration factors.

Figure 1 differentiates the five identity statuses based on the three constructs of the identity status model. Searching moratorium is shown as an arrow between moratorium and achievement due to Mancini's

description that the searching moratorium identity status "characterizes individuals who vacillate between the moratorium and achievement identity statuses." (Mancini et al., 2015)

Figure 1

Graphic representing the Five Identity Statuses



Note. Graphic representing the five identity statuses based on the three-factor groups in the identity status model theory. Identity statuses marked with an asterisk represent high reconsideration of commitment, and those without an asterisk represent low reconsideration of commitment. For reference, individuals in the moratorium identity status exhibit low commitment, high exploration, and high reconsideration of commitment (Mancini et al., 2015).

Professional Identity in STEMM

This study views identity using the ideas and perspectives of Erikson (1968) and Marcia (1966, 1980), who discuss "adolescence" as a period where an individual's identity is explored and formed. From this perspective, it can be said that individuals pursuing secondary education to prepare for a future profession are also in a period of identity exploration and formation. Previous studies regarding the formation of an individual's identity in science-related industries, referred to as science identity, have found that a strong science identity can have a positive impact on an individual's decision to join a science occupation during formative developmental periods of an individual's life (Stets et al., 2017; Vincent-Ruz & Schunn, 2018). Therefore, it is essential to promote the formation of a strong professional identity during a student's college experience.

Professional identity has been investigated in postsecondary education students using the PISQ-5d survey; however, these studies limit the comparisons of demographics to male and female gender identity only (Gamliel et al., 2020; Kelly et al., 2020). There is a gap in the literature investigating other factors with the PISQ-5d that have been discussed as having an impact on professional identity. These factors include gender identity (including outside of the gender binary), racial identity, admission pathway, STEM discipline, students who are first in their family to attend a postsecondary institution (First Generation), and students considered to be in financial need (Araojo & Ayoobi, 2024; Costello, 2005; Hult et al., 2003; Maccubbin, 2023; Van De Mieroop & Clifton, 2012; Vieira et al., 2017; Waterman et al., 1974). Evaluating student professional identity is crucial for identifying gaps in the development of career readiness among undergraduate students. This career readiness development comes at a pivotal time when students are building the knowledge, skills, and attitudes for successful career entry and growth (Carvalho et al., 2021; Kondratyuk et al., 2024). Identifying gaps in professional identity development can lead to further research, potentially resulting in targeted support strategies that aid the individuals who need it the most. This knowledge can facilitate discussion on what can be done to better support STEMM students in the formation of their professional identity as they prepare themselves for their future careers to increase persistence in STEMM degree programs. This led to the two research questions guiding this study:

1. How do students at a public research-intensive institution of higher education identify as future professionals in their field?
2. What differences exist between students of various demographics as it pertains to their professional identity?

Methods

Survey

This study utilized a modified PISQ-5d questionnaire to collect information about STEMM (Science, Technology, Engineering, Math, and Pre-Medical) students' professional identity. In this study, "pre-medical" refers to students enrolled in a specific degree track aimed to prepare them for medical school (i.e., "pre-med" students). This questionnaire includes 20 Likert-scale questions with a response of 1 meaning "not at all" and a response of 5 meaning "very much." The PISQ-5d was originally designed to measure undergraduate psychology students' professional identity. For this study, the wording was modified by replacing the word "psychologist" with "professional in your field." The Likert scale survey and optional demographic questions can be found in Supplemental A. Demographic questions were included to gather more information about the participants' gender identity, racial identity, admission status, and declared degree program. The survey was distributed to six chemistry-based courses at a large Hispanic-Serving Research Institution. Those courses included General Chemistry I, Organic Chemistry I, Chemistry for Engineers, Introduction to Forensic Science, Forensic Crime Scene Investigation, and Geology. The survey was distributed to students online approximately two weeks after the semester began.

Participants

There were 351 complete responses to the survey. Several demographic questions included in the survey asked students to self-report their current gender and racial identities, admission pathway to the university, and their declared degree path. All demographic questions, including participant name and email address, were optional. For students who opted to give this information, the university's Institutional Knowledge Management (IKM) was utilized to confirm admission pathways and declared degree paths, as well as gather more information, such as class standing, first-generation status, and financial needs. When IKM could not gather the information for select participants, the students' self-reported responses were used. Participant sections for admission, class standing, first-generation status, and financial need can be found in Supplemental B.

Gender Identity

Of the 351 students who completed the survey, 190 identified themselves as cisgender female, 145 students identified themselves as cisgender male, and 14 students identified themselves as either transgender or gender non-conforming individual (TGNC). Of these 14 students, seven identified as non-binary and seven identified themselves as transgender male. Two students chose not to disclose their gender identity and, as such, were not included in the analysis for gender identity but were included in other group analyses.

Racial Identity

The 351 students who completed the survey were classified as one of five racial or ethnic identities: Black/African American, Asian/Asian American, Hispanic, White, or Mixed-Underrepresented. For students who identified as two or more races or ethnicities, priority was given to marginalized groups (Fink et al., 2023). There were 11 individuals who either did not disclose their racial or ethnic identity or were part of a racial identity in which the sample size was not large enough for analysis. Of the 351 students who answered the survey, 20 students were categorized as Black/African American, 43 students were categorized as Asian/Asian American, 90 students were categorized as Hispanic, 170 students were categorized as White, and 17 students were categorized as Mixed-Underrepresented.

Declared Degree Program

Students who completed this survey reported a wide variety of degree programs. To be able to include as many as possible for analysis, these degree programs were grouped based on their STEMM status. Of these groups, 147 students were studying in a science degree program, 99 were in an engineering degree program, and 87 were in a pre-medical degree program. Additionally, 13 students were studying degree programs not included in STEMM, and one student was studying a math degree program. However, these two groups were not included in the analyses of STEMM degree programs as the sample size of each degree program group was too small. Overall, 333 students were included in this part of the analysis.

Procedure

Cluster Analysis

Following the completion of the semester, the survey responses from all sampled courses were aggregated into one SPSS dataset. Data validation in the form of Confirmatory Factor Analysis (CFA) using the original model was performed before running the cluster analysis procedure, both of which are described by Mancini (Mancini et al., 2015). The results of the CFA analysis can be found in Supplemental G.

First, Hierarchical Cluster Analysis is used to produce a dendrogram, which, alongside other criteria such as the Calinski-Harabasz index, silhouette criterion, Akaike and Bayesian Information Criterion (AIC and BIC), was used to select the optimal number of clusters. Once the number was determined, K-means cluster analysis was conducted using the results from the Hierarchical cluster analysis as the initial cluster centers. This study followed the procedure of the original publication (Mancini et al., 2015). Once the K-means cluster analysis was complete, the data was analyzed quantitatively using Chi-Square analysis and Kruskal-Wallis H Test.

Chi-Square Analysis

Pearson chi-square analysis was conducted to compare the proportion of students of specific demographics who identify with a particular identity status. This analysis was realized using contingency tables. For contingency tables with groups of small sample sizes, Fischer's Exact test using a Monte Carlo simulation to approximate the p-value was utilized. For these simulations, a seed number was randomly generated and used for all simulations. This seed number is 110194448. This analysis aimed to determine if any specific demographic identified significantly more or less with one identity status over another. Since the contingency table was used to investigate multiple comparisons, the Bonferroni test correction was implemented to lower the probability of a Type I error (Armstrong, 2014). The effect size was calculated using Cramer's V measurement (Cramér, 1946) with Cohen's interpretation (Cohen, 1988). For the post-hoc analysis, multiple comparisons using a two-proportion z-test were conducted as needed.

Kruskal-Wallis H Test

A Kruskal-Wallis H Test was utilized to compare the students' aggregated and averaged scores with each other. This analysis aimed to determine if students of a specific type of demographic were reporting significantly higher scores in one or more of the five factors than other students in that demographic, as opposed to comparing students based on their identity status. Similar to the chi-square analysis, the Bonferroni test correction was utilized to reduce the probability of a Type I error (Armstrong, 2014). A Mann-Whitney U test is used as an alternative if there are only two groups within any demographic. Post-hoc analysis was completed as needed for Kruskal-Wallis H analyses using multiple pairwise Dunn tests to determine statistically significant pairings.

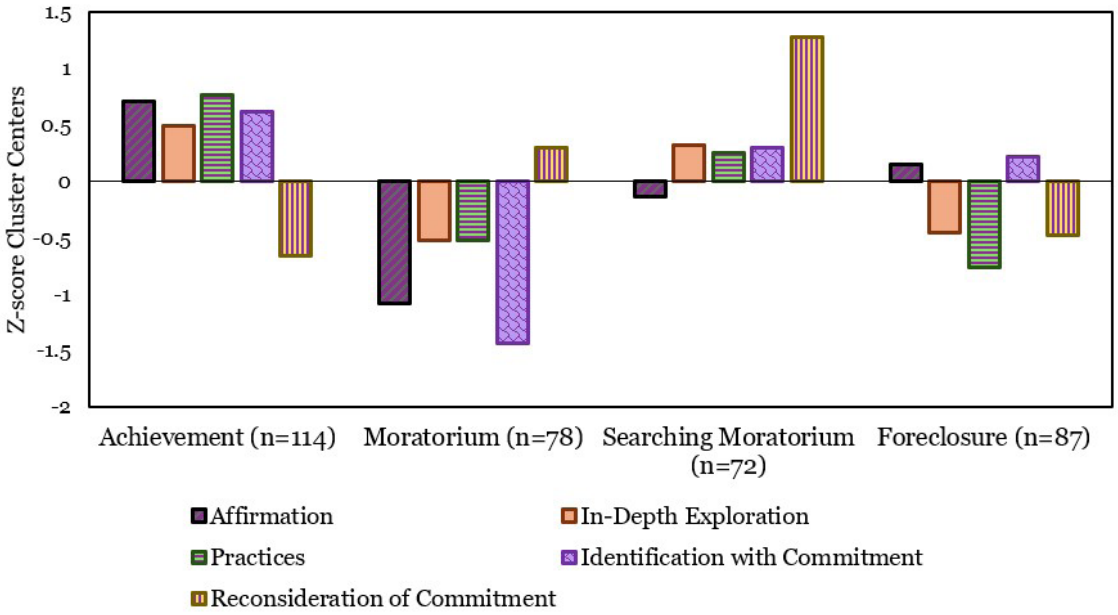
Results

Cluster Analysis

Using a dendrogram, Calinski-Harabasz index, silhouette criterion, AIC, and BIC, it was determined that the appropriate number of clusters for the dataset was a four-cluster solution. Therefore, K-means cluster analysis was run with the preselection of four clusters. Four of the established identity statuses could be recognized: Achievement, Moratorium, Searching Moratorium, and Foreclosure. When testing a five-cluster solution, the remaining fifth cluster was determined to mirror the Moratorium identity status. No cluster representing the Diffusion identity status emerged from the data after completing the cluster analysis procedure. The cluster centers of each factor regarding each of the four identity statuses are shown in Figure 2. These cluster centers are shown using standardized scores to more easily represent a "high" ($z > 0.2$), "medium" ($|z| \leq 0.2$), and "low" ($z < -0.2$) cluster center.

Figure 2

Cluster Centers for Each Factor in the Four Identity Statuses.



Note: Red (diagonal stripe) bars represent the cluster center score for the factor of affirmation in each of the four identity statuses. Orange (light grey) bars represent the cluster center score for the factor in-depth exploration. Green (horizontal stripe) bars represent the cluster center for the practice factor. Purple (dark grey) bars represent the cluster center for the identification with commitment factor. Yellow (vertical stripe) bars represent the cluster center for the factor reconsideration of commitment in each of the four identity statuses.

Achievement

The achievement identity status shows students with high scores in the categories of affirmation, practice, and identification with commitment, and in-depth exploration, and a low score in the category of reconsideration of commitment. This is consistent with the results of Mancini (Mancini et al., 2015) and Kelly (Kelly et al., 2020) on the achievement identity status. Out of the 351 students who took the PISQ-5d survey, 114 students identified with the achievement identity status.

Moratorium

The moratorium identity status represents students who score high in the factors of reconsideration of commitment and low in the factors of affirmation, in-depth exploration, practices, and identification with commitment. This is slightly different than Mancini's results, which show students with this identity status scoring medium in the in-depth exploration factor, but is consistent with Kelly's results (Kelly et al., 2020). Out of 351 students, 78 identify with the moratorium identity status.

Searching Moratorium

This identity status represents students who score high in the factors of in-depth exploration, practices, identification with commitment, and reconsideration of commitment, and score medium in the affirmation factor. This differs from Mancini's original cluster analysis results, which show students scoring low in both affirmation and identification with commitment (Mancini et al., 2015). It also differs from Kelly's cluster analysis results for this cluster (Kelly et al., 2020), which shows students scoring high on all five factors. Out of 351 students, 72 identify with the searching moratorium identity status.

Foreclosure

Students in this identity status scored high in the category of identification with commitment, low in the factors of in-depth exploration, practices, and reconsideration of commitment, and medium in the factor of affirmation. This differs from Mancini's results; the participants in the foreclosure identity status scored low in in-depth exploration and high in practice. These results are very similar to Kelly's results, with the exception that the students in Kelly's study scored high in affirmation instead of medium (Kelly et al., 2020). Out of 351 students, 87 identify with the foreclosure identity status.

Gender Identity

The distributions of identity statuses for the cisgender male, female, and TGNC students are shown in Table 1.

Table 1

Distribution of Student Identity Statuses Based on the Students' Gender Identity

Gender Identity	Achievement	Moratorium	Searching Moratorium	Foreclosure
Cisgender Female (n = 190)	38.4%	17.9%	17.4%	26.3%
Cisgender Male (n = 145)	26.9%	26.9%	22.1%	24.1%
TGNC (n = 14)	14.3%	28.6%	42.9%	14.3%

Fischer's Exact Test

Due to the low sample size of the TGNC student group, Fischer's exact test using a Monte Carlo simulation was used to determine whether how a student identifies as a future professional in their field is independent of gender identity. This contingency table shows statistical significance, with a p-value equal to 0.032. Potential contributions to the significance of this contingency table include the adjusted residual for the cells of female achievement students (2.5) and TGNC searching moratorium students (2.1). This gives evidence

that how students identify as future professionals in their field is not independent of gender identity. Cramer's V was calculated to be 0.139, indicating a small effect size associated with the test, which was also statistically significant at $p = 0.034$. Post-hoc analysis did not reveal any statistically significant pairwise differences.

Kruskal-Wallis H Test

The results of the Kruskal-Wallis H test show statistically significant differences in the categories of Affirmation ($H(2) = 11.082$, $p = 0.004$), Identification with Commitment ($H(2) = 8.565$, $p = 0.014$), and Reconsideration of Commitment ($H(2) = 9.513$, $p = 0.007$). Pairwise comparisons show significant differences between TGNC and cisgender female students in all three factors mentioned above (adj. $p = 0.003$, 0.028, and 0.020, respectively). These comparisons also show differences between TGNC and cisgender male students in the category of affirmation (adj. $p = 0.015$). More specifically, the TGNC students in this study are reporting lower scores overall regarding the factors of affirmation and lower scores than cisgender female students for identification with commitment. The TGNC students in this study are also reporting higher scores in the factor reconsideration of commitment compared to cisgender male and female students. No statistical differences were found between cisgender male and female students in any of the five factors.

Racial Identity

The distribution of students and how they identify as future professionals in their field based on their racial identity is shown in Table 2.

Table 2

Distribution Of Student Identity Statuses Based On The Students' Racial Identity

Racial Identity	Achievement	Moratorium	Searching Moratorium	Foreclosure
Black/African American (n = 20)	10.0%	25.0%	20.0%	45.0%
Asian/Asian American (n = 43)	25.6%	16.3%	44.2%	14.0%
Hispanic (n = 90)	42.2%	15.6%	20.0%	22.2%
White (n = 170)	30.0%	25.9%	15.3%	28.8%
Mixed-Underrepresented (n = 17)	47.1%	35.5%	11.8%	5.9%

Fischer's Exact Test

Due to the low sample size of the Mixed-Underrepresented racial group, Fischer's exact test using a Monte Carlo simulation was used to determine whether how a student identifies as a future professional in their field is independent of racial identity. The results of Fischer's Exact test via Monte Carlo simulation show that how students identify as future professionals in their field is not independent of their racial identity, with a p-value less than 0.001. Cramer's V was calculated to be 0.189. This indicates a medium effect size for a 5x5 contingency table, which is also statistically significant at $p < 0.001$.

Post-hoc analysis revealed statistically significant pairings comparing the proportion of students of a particular race who identify with each identity status. There is a higher proportion of searching moratorium students who identify as Asian/Asian American compared to the proportion of foreclosure students

(adj. p=0.041), moratorium students (adj. p = 0.005), and achievement students (adj. p = 0.002) who identify as Asian/Asian American.

Kruskal-Wallis H Test

The results of the Kruskal-Wallis H test show insignificant results for the factors of practice ($H(4)$= 6.777, p = 0.148) and in-depth exploration ($H(4)$ = 6.867, p = 0.143). All other factors show statistically significant differences between the different racial identities: affirmation ($H(4)$ = 10.080, p=0.039), identification with commitment ($H(4)$ = 12.742, p = 0.013), and reconsideration of commitment ($H(4)$= 20.891, p < 0.001).

Post-hoc analysis via Dunn tests shows that although the overall distributions between students of different racial identities are different for the factor of affirmation, there were no individual pairings that were statistically significantly different from each other after adjusting using the Bonferroni correction. When comparing groups based on their scores in the Identification with Commitment category, White and Hispanic students (adj. p = 0.005) were statistically significant. Hispanic students reported higher scores in the factor Identification with Commitment than White students. Lastly, for the factor of Reconsideration of Commitment, two pairs were found to differ from each other significantly: White students and Asian/Asian American students (adj. p < 0.001), and Hispanic students and Asian/Asian American students (adj. p=0.002). To a statistically significant degree, Asian/Asian American students report higher scores in the factor Reconsideration of Commitment than both Hispanic students and White students.

Gender and Racial Identity

Due to the statistically significant differences in how students identify as future professionals in their field between students of different gender identities and between students of different racial identities, it was determined that further investigation was necessary. A three-way contingency table was conducted to determine if there were any statistically significant differences in how students of different racial identity statuses identify as future professionals in their field while controlling for a third variable, gender identity. A Kruskal-Wallis H test was also conducted to compare the distribution of scores for each of the five factors between students of different racial identities, controlling for gender.

Due to the low sample size for TGNC students, only the analysis that controlled for cisgender male and cisgender female students of different racial identities could be interpreted. Monte Carlo simulation was also used due to the low cell counts. When controlling for gender, the cisgender female contingency table comparing students of different racial identity statuses based on how they identify as future professionals in their field revealed statistically significant results (p < 0.001). In contrast, the male contingency table of the same comparison revealed statistically insignificant results with a p-value of 0.527. Further investigation into the comparison of cisgender female students of different racial identity statuses and how they identify as future professionals revealed similar results to the overall comparison of how students of different racial identity statuses identify as future professionals in their field. Contributing the most to the statistically significant contingency table are the female Asian/Asian American students who identify with the searching moratorium identity status (adj. residual = 4.6). The results also show that the proportion of students in the searching moratorium identity status who identify as Asian/Asian American is significantly greater than the proportion of Asian/Asian American students in any other identity status.

The results of the Kruskal-Wallis analysis revealed no statistically significant differences when comparing the distributions of scores for each of the five factors for male students of different racial identities. Statistically significant differences between the factor scores of affirmation (p = 0.048) and reconsideration of commitment (p = 0.004) were found between female students of different racial identities. Post-hoc analysis did not reveal any statistically significant pairs between the distribution of affirmation scores, but did find two statistically significant pairwise comparisons between the distribution of reconsideration of commitment scores. It was found that Asian/Asian American students reported statistically significantly higher scores in

the factor of reconsideration of commitment compared to both White students (adj. p = 0.001) and Hispanic students (adj. p = 0.017).

STEMM Degree Program

The distribution of students and how they identify as future professionals in their field based on their declared type of degree program is shown in Table 3. The sample sizes for the declared groups of technology, mathematics, and non-STEMM degree programs were too small for analysis; therefore, only the degree program groups of Science, Engineering, and pre-Medical will be discussed and analyzed.

Table 3

Distribution Of Student Identity Statuses Based On Students Declared STEMM Track

STEMM Major	Achievement	Moratorium	Searching Moratorium	Foreclosure
Science (n = 147)	35.4%	23.1%	14.3%	27.2%
Engineer (n = 99)	25.3%	31.3%	19.2%	24.2%
Pre-Medical (n = 88)	37.9%	9.2%	31.0%	21.8%

Chi-Square Analysis

The results of Pearson's chi-square analysis show that how a student identifies as a professional in their field is not independent of their STEMM degree program ($c2(8, n = 333) = 20.569$, p = 0.001, V=0.180). Potentially contributing to this statistically significant finding are the adjusted residuals for science students that identify with the searching moratorium identity status (-2.4), engineering students that identify with the moratorium status (2.7), engineering students that identify with the achievement identity status (-2.0), pre-medical students that identify with the moratorium identity status (-3.3), and pre-medical students that identify with the searching moratorium identity status (3.0). Cramer's V shows a small effect for a 5x3 contingency table. The post-hoc analysis found that pre-medical students identified with the searching moratorium identity status much more than students enrolled in a science major (p = 0.002).

One hypothesis for this finding is that many students are starting to realize the intensity and difficulty of pursuing a medical profession and are reconsidering whether this is the path they truly desire to take (Freeman et al., 2016). Another hypothesis is that students in pre-medical degree programs have not decided on which specialty they wish to pursue as a medical professional and, therefore, may not be reconsidering becoming a medical professional overall, but only considering or reconsidering what field of medicine they will pursue (Reed et al., 2001). Additionally, it was found that students enrolled in a pre-medical major identify with the moratorium identity status significantly less compared to students enrolled in both science majors and engineering majors.

Kruskal-Wallis H Test

The results of the Kruskal-Wallis H test showed no statistically significant pairings overall for the factor of identification with commitment only ($H(2) = 4.802$, p = 0.091). There are significant results in the factors of affirmation ($H(2) = 7.091$, p = 0.029), in-depth exploration ($H(2) = 12.771$, p = 0.002), practices ($H(2)=6.123$, p = 0.047) and reconsideration of commitment ($H(2) = 9.700$, p = 0.008). Pairwise comparisons show that

students in a pre-medical degree program are reporting higher scores in the factors of affirmation, in-depth exploration, and practices than students in an engineering degree program (adj. p = 0.026, 0.002, and 0.045, respectively). This gives evidence that students on track to become future medical professionals believe they are exploring and practicing as future medical professionals to a greater extent than students on track to become future engineering professionals do. Also, students on track to become future medical professionals are feeling more affirmed in themselves as future medical professionals than students on track to become future engineering professionals.

Pairwise comparisons also show that students in a pre-medical degree program are reporting higher scores in the factor of in-depth exploration than students in science degree programs (adj. p = 0.021). This shows that pre-medical students are searching for information regarding their future professions more than students on track to become future science professionals believe they are. Lastly, it was found that students in an engineering degree program reported higher scores in the factor of reconsideration of commitment than students in a science degree program (adj. p = 0.007). This shows that students on track to become future engineering professionals are searching for other alternative professions more than students on track to become future science professionals are.

Statistically Insignificant Results

Supplemental C-F contains the results for comparisons and statistical analyses between students of different admission pathways, class standings, First-Generation status, and Pell-Grant eligibility, as well as the methods used to classify the participants as listed above. As these demographics have been discussed in the literature as having an impact on the formation of a professional identity, it was valuable to include them in the analysis and report the findings.

Discussion

Overall, the results show distinct differences in how students of different gender identities, racial identities, and STEMM degree programs identify as future professionals in their fields. There is evidence showing that cisgender male and female students identify differently as future professionals than TGNC students. Proportionally, TGNC students identify with the moratorium status significantly more than cisgender male and female students. The moratorium identity status, in theory, represents students who struggle to commit to a specific field of profession (Mancini et al., 2015). This is also supported by the Kruskal-Wallis comparison for gender, as it was found that TGNC students are also reporting statistically higher scores in the factor of reconsideration of commitment and statistically lower scores in the factors of affirmation and identification with commitment.

These two factors are both related to the commitment one feels towards becoming a future professional, supporting the idea that TGNC students may struggle with committing to becoming a future professional compared to their cisgender male and female peers. These results support previous observations regarding the intersection of gender identity and vocational identity, which discuss how TGNC individuals feel pressured to prioritize either their vocational identity or gender identity due to the anticipation of stigmatization caused by their gender transition, potentially limiting career aspirations and leading to TGNC students dismissing potential career opportunities (Budge et al., 2010; Corlett et al., 2024; Corrigan et al., 2009). This also may be evidence regarding a lack of sense of belonging that students of other gender identity statuses outside cisgender male and female students experience, a topic that has been discussed in previous publications centered around transgender individuals (Beemyn, 2003; McKinney, 2005). Although this study makes no broad claims regarding the professional identity of TGNC students in the TGNC community, the results of this study support the need for further inclusion and research into the STEMM identity of students outside of the gender binary.

There is also evidence showing that Asian/Asian American students proportionally identify more with the searching moratorium identity status compared to other racial identities. Further investigation showed that it was cisgender female Asian/Asian American students. This conclusion is also supported by the significant pairings from the Kruskal-Wallis H test, which showed Asian/Asian American students reporting statistically

higher scores in the factors of In-Depth Exploration and Reconsideration of Commitment. When controlling for gender, similar results were found between the female Asian/Asian American students, but no statistically significant differences were found between male Asian/Asian American students. These results indicate that further research into the professional identity of Asian/Asian American individuals may be needed to support career readiness within this demographic, in particular, female Asian/Asian American students.

For students of different STEMM degree programs, most differences were found regarding students in a pre-medical degree program and students in an engineering degree program. Students in a pre-medical degree program are identifying with the searching moratorium identity status to a statistically significant extent. This is supported by the Kruskal-Wallis H test, showing students in a pre-medical degree program are reporting significantly higher scores than students in science or engineering degree programs for all factors except Identification with Commitment. The current hypothesis for this result surrounds the many disciplines and sub-disciplines of medical-based professions. These students may not be reconsidering becoming a future medical professional outright, but rather reconsidering or are currently still deciding which medical specialty is right for them. Another hypothesis is that students pursuing a medical profession may be at a point in their academic career where they realize the expectations that must be met to be considered for medical school, such as a high GPA, difficult coursework, work-study, research study, etc. Many students may be realizing they cannot meet these high expectations and, as such, may be reconsidering pursuing a career in medicine altogether (Barr et al., 2008).

Conclusion

The purpose of this study centered around two research questions: how do students at this institution identify as future professionals in their field, and what are the differences between students of certain demographic groups? Using the PISQ-5d survey, students were classified as one of four identity statuses, giving insight into how they view themselves as future professionals in their field. Differences within the professional identity of students were found between students of different gender identities, racial identities, and STEMM majors. Demographics with statistically significant scores in the reconsideration of commitment factors, such as TGNC students and Asian/Asian American students, could be at risk of leaving their STEMM major and furthering the divide of underrepresented demographics in STEM careers.

Limitations

There are a few limitations regarding the statistical analyses of this study. The first limitation focuses on the results of the data validation, particularly the Cronbach's Alpha measures. There is a low value of internal consistency for the factors of in-depth exploration and practices. The original publication also recognized and discussed a low value of internal consistency regarding in-depth exploration when the PISQ-5d survey was originally published (Mancini et al., 2015); however, in the original publication, the internal consistency for the factor of practices was within acceptable boundaries as opposed to the internal consistency of practices in this publication. This could be due to the sample for this study, undergraduate students at a large, research-intensive university in the United States, as opposed to psychology students at an Italian university. Approximately half the students surveyed are considered freshman or sophomore students. As practices have been discussed to be more of a behavioral measure, these students may not have had many opportunities to behave professionally. It is hypothesized that these students may still be taking introductory-level courses and, as such, may not have had opportunities to develop or practice many skills relevant to their future profession, unlike junior or senior students who may have had the chance to do so during internships or upper-level laboratory courses.

The second limitation is in the sample size of certain demographic groups. Although this research was conducted at a Hispanic-serving institution, the authors acknowledge that the university serves a large proportion of white students. There is a low sample size for students who identify as a Mixed-Underrepresented racial group and Black/African American, as well as students who identify as transgender or gender non-conforming. This may affect the results of some statistical analyses, as there is a

risk when making inferences about larger populations based on a small sample of students (Faber & Fonseca, 2014).

The third limitation of this study regards how it classifies those who are in financial need. The results of this analysis are located in Supplemental F. Students were classified as being in financial need if they qualified for a Federal Pell Grant. However, whether a student qualifies for a Federal Pell Grant is largely dependent on the financial income of the student's family in the form of the "Expected Family Contribution." The authors of this study recognize that there are students who do not qualify for financial assistance through the Federal Pell Grant but are still in need of financial assistance.

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