Exploring the Relationship Between Participation in a Living-Learning Community and Professional and Engineering Identities

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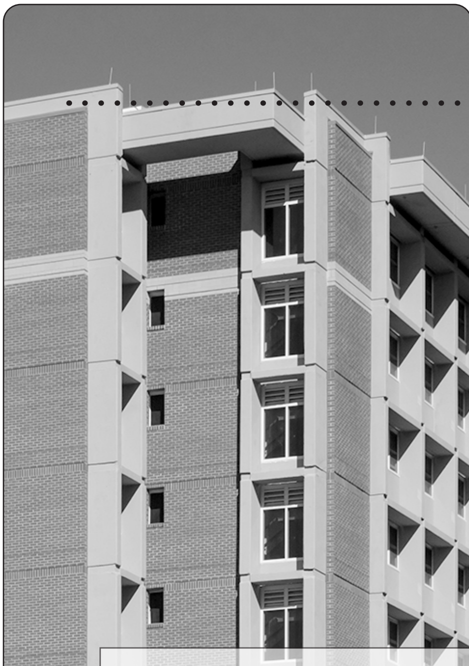

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PROFESSIONAL IDENTITY is a concept that has been explored over the years in a number of disciplines, but with little attention paid to engineers. A more specific component of professional identity is engineering identity, which warrants further investigation due to positive impacts on retention. The purpose of this study was to investigate how participation in an engineering-based living-learning community affects students' professional and engineering identities and to describe these identities within a college of engineering. Results revealed that some subscales of professional identity and engineering identity indicated statistically significant differences by participation in a living-learning community. Implications for future research and practice are discussed.

Living-learning communities (LLCs) were created to help bolster faculty-student interaction as well as active and collaborative learning. In many cases, LLCs can be used to create an intersection between a student's academic life and their residential life (Shushok & Sriram, 2010), making them high-impact educational experiences (Kilgo et al., 2015; Kuh, 2008). In a study of living-learning programs, Inkelas (2008) developed a thematic typology of LLCs consisting of 17 primary categories, including programs that focus on "grouping students of a particular major or disciplinary interest" (p. III-3). LLCs have been adopted by higher education institutions across the nation as a means to greatly enhance curricular coherence and deepen student learning (Shushok & Sriram, 2010).

A person's affinity for their profession has been linked to professional success and persistence in their respective field–and engineering is no different.

A student's development inside and outside the classroom is an incredibly important attribute to consider when developing professional and personal identity (Inkelas, 2008; Inkelas et al., 2018). Inkelas et al. (2018), for example, noted that studies of LLCs have shown "the power in helping students discern future career options" (p. 75). This is especially true when looking at engineering students and their confidence in the subject matter of their coursework; students in engineering LLCs are reported to have among the highest levels of confidence in succeeding in engineering courses (Inkelas, 2008). It can be hypothesized, then, that this higher self-confidence contributes to the development of identity, especially professional identity.

Professional identity is one of many factors contributing to the development and shaping of professionals across a multitude of industries. A person's affinity for their profession has been linked to professional success and persistence in their respective field—and engineering is no different. Recent studies have shown that a lack of identification with the engineering profession and one's view of oneself as an engineer often motivate students to migrate out of engineering into other majors (Patrick & Borrego, 2016; Tonso, 2014). Since the failure to have a strong identification with the field can affect retention, it is important to determine how engineering identity can be used to augment the recruitment and retention of engineering students, particularly in groups that traditionally have been underrepresented (Patrick & Borrego, 2016). For this reason, higher education administrators and engineering educators have turned to a myriad of interventions to help strengthen the professional identity of engineering students.

As noted by the National Center for Education Statistics (2018), of the approximately 1.9 million bachelor's degrees reported in the 2015-16 school year, 18% represented science, technology, engineering, and math (STEM) fields. However, nearly half of undergraduate students enrolled in STEM majors do not continue in this field; they change majors or simply leave the institution (Chen, 2013). Furthermore, if a student does not enter college as a STEM major, it is improbable that they will later switch their major to a STEM field (Ohland et al., 2008). Researchers have begun to focus on ways to bolster retention in STEM fields (Hall et al., 2015), and studies have found that LLCs can be particularly useful for improving the learning experience for engineers and for aiding their retention (Daempfle, 2003; Light, 2005; Wankat & Oreovicz, 2005). By more deeply connecting with faculty through the immersive experience of an LLC, students develop a greater sense of identity with their major (Ghosal et al., 2019), and this experience can increase their affinity with professional and engineering identities and consequently improve retention within the field.

PERSONAL, RELATIONAL, AND COLLECTIVE IDENTITY

Individuals have varying levels of self-identification, and three commonly understood levels include personal, relational, and collective identity (Brewer & Gardner, 1996; Schwartz et al., 2011). Personal identity is "the differentiated, individuated self-concept most characteristic of studies of the self" and reflects the individual level (Brewer & Gardner, 1996, p. 84). Components of personal identity include traits such as charisma, intellect, and athletic ability (Schwartz et al., 2011). Relational identity "is the self-concept derived from connections and role relationships with significant others" and reflects the interpersonal level (Brewer & Gardner, 1996, p. 84). Examples of this level include roles served by individuals such as sibling, colleague, and boyfriend/girlfriend. Collective identity "corresponds to the concept of social identity as represented in social identity theory and self-categorization theory" and reflects the group level of identity (Brewer &

Gardner, 1996, p. 84). Components of collective identity include race, gender, and occupation/profession. Within this collective view, professional identities are self-assigned based on social constructions and interactions with others (LaPointe, 2010). With the determination that professional identity is a construct of collective identity, professional identity and engineering identity can be explored in relation to student development and success in the form of retention.

Definitions of identity in its broadest terms are somewhat similar across the fields of engineering education, student development, and higher education, though the definition of professional identity varies among these fields. Gecas and Burke (1995) described professional identity as a form of personal identity, defined as "the various meanings attached to oneself by self and others" (p. 42). Similarly, identity can be defined as knowledge, emotions, abilities, and experiences that are organized around a social role (Giddens, 1991), with professional identity following a similar principle but organized around a professional role rather than a social one. Eliot and Turns (2011) defined professional identity as "a negotiation between the social expectations related to a specific professional role and the needs, wants, and aptitude of the individual engaging in that role" (p. 47). Brubaker and Cooper (2000) stated that identity can be understood as a core aspect of individual or collective association; it is "something *deep, basic, abiding, or foundational,*" as opposed to being "superficial, accidental, fleeting, or contingent" and thus is "understood as something to be valued, cultivated, supported, recognized, and preserved" (p. 7).

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Further discussions regarding professional identity have elucidated that it is "a negotiation between the social expectations related to a specific professional role and the needs, wants, and aptitude of the individual engaging in that role" (Eliot & Turns, 2011, p. 47). Although identity has a variety of uses, when thinking collectively it is used to focus on self-understanding rather than self-interest and to highlight the "*processual, interactive* development of the kind of collective self-understanding, solidarity, or 'groupness' that can make collective action possible" (Brubaker & Cooper, 2000, p. 7).

Although identity has been widely explored in the literature, the application of identity theories to engineering education is still relatively narrow and underdeveloped (Patrick & Borrego, 2016). Though discussions of identity theories within engineering began almost two decades ago (Stevens et al., 2005) and engineering identity has become a contemporary topic for engineering educators, its connection and epistemological roots within professional identity literature are still not fully understood.

As reported by Meyers et al. (2012), first-year students are 1.5 times less likely to identify as engineers than are sophomores, juniors, and seniors collectively. This finding provides insight regarding opportunities such as internships and co-ops that are more readily available to students with more experience in their area of study. With this in mind, studies can focus on investigating the engineering identities of advanced undergraduates (Patrick & Borrego, 2016). Though there is no single definition of what constitutes an engineering identity, some researchers have posited that it involves a complex equation with factors such as "problem solving, teamwork, learning, and personal contributions" (Anderson et al., 2010, p. 170). By understanding the concept of engineering identity and the factors associated with it, various theoretical frameworks used to model identity can be applied to discern what engineering identity really is and how it may connect to persistence and retention.

THEORETICAL AND CONCEPTUAL FRAMEWORKS

Given all the external and internal forces that influence an individual's sense of identity, Identity Stage Theory (IST) appears to be the most applicable to understand conceptualizations of professional and engineering identities. Originally introduced by Erikson (1963, 1993), this theory is a psychosocial perspective on how identity can be viewed as stages based on both individual and social identification. IST focuses on the premise that "identity develops in stages as a function of reconciling the inner individual and outer forces" (Patrick & Borrego, 2016, p. 9). Therefore, both professional identities in general and engineering identities in particular involve individual- and social-level identification and can be conceptualized as stages that build upon each other as identification increases for an individual.

Professional identity explores facets of the individual and collective self. Specifically, professional identity is "the self that has been developed with the commitment to perform competently and legitimately in the context of the profession" (Tan et al., 2016, p. 2). Professional identity develops through interactions with colleagues and external regulations, shaping the way an individual carries out the duties of their role (Holland et al., 2001; Monrouxe, 2010). As a result, this development is shared among other professionals in the same role and continually guides individuals throughout their careers. An individual with a high level of professional identity has a strong connection to their role and the values within their chosen career and therefore find their work meaningful (Tan et al., 2016). Additionally, professional identity tends to be fluid and varies according to different contexts (Evans et al., 2009), contributing to an individual's lifelong career development (Holland et al., 2001). Because individuals seek out higher education as a form of career preparation, education can be considered a stage within their identity formation. For this reason, IST again provides a solid theoretical basis for understanding the professional identity of students.

Engineering identity can be viewed from a developmental psychology perspective that "theorize[s] identity as a set of variables or factors" that contribute to success in engineering (Tonso, 2014, p. 273). Researchers have focused on whether students see themselves as an engineer, as well as on the qualities cited by students as being needed in the profession (Godwin, 2016). In addition to this individual focus, some studies have centered on the discourse used by students to develop and identify as engineers in practice or in a societal sense (Dannels, 2000; Godwin, 2016; Johnston et al., 1996). As stated by Tonso (2014), global economic demands, nationality or citizenship, and social and professional institutions all contribute to the development of engineering identity. This discourse within the body of knowledge is part of the internal and external dialogue used by students to form their identities as engineers (Godwin, 2016). Often these studies have asserted that higher scores on psychosocial scales suggest a higher association with engineering identity (Godwin, 2016; Patrick & Borrego, 2016), giving credence to its connection with IST.

PROBLEM STATEMENT AND RESEARCH OBJECTIVES

Because of their connection to retention, both professional and engineering identity warrant continued investigation by higher education administrators and engineering educators. Professional identity and its connection to retention requires more attention within the field, while engineering identity in particular needs to be investigated further in different engineering education contexts (i.e., large public university or private university, community college). Neither professional nor engineering identity, to our knowledge, has ever been investigated in connection to LLCs and their possible influence on identity development. Thus, the following research objectives were established for this study:

1. Describe professional and engineering identities of on-campus students within a college of engineering.
2. Determine if participation in an engineering-based LLC affects professional and engineering identity.
3. Explore the following differences found among student groups: ethnicity, first-generation college student status, gender, and entry term.

METHODS

We employed a postpositivist, quantitative, survey research method to examine our research questions (Creswell & Guetterman, 2017; Phillips & Burbules, 2000).

Participants

A population of 3,993 undergraduate and graduate students who reside in campus housing and are enrolled in the college of engineering at a large public research university in the southern United States during the spring 2019 semester were invited via email to participate in this study. An online web-based survey was conducted via Qualtrics. Using the Dillman et al. (2009) Tailored Design Method, a web-based survey recruitment approach, participants were contacted multiple times over a 6-week period. Specifically, they received an initial email with an invitation to participate and were sent five reminders over 6 weeks. The communications were personalized with the student's name and major and the name of their engineering LLC (if applicable). Personalization of recruitment emails to this extent aids in yielding a larger response rate (Dillman et al., 2009). A total of 735 responses were collected, resulting in an 18.41% response rate. Of these responses, 65 (8.97%) did not consent to participate in the study, and 167 (22.72%) did not complete the survey; therefore, a sample of 503 was used for analysis. Only respondents who completed the survey instrument were included in analysis.

Table 1 presents the demographics of the population, the sample, and the college of engineering for comparison. Undergraduate students comprised the majority of the sample (*n* = 470), representing 63.95% of the total respons-

Table 1

Demographics of the Accessible Population, Sample, and College

	Population		Sample		College	
	n	%	*n*	%	*n*	%
Gender						
Male	3,138	78.59%	379	75.35%	12,710	77.40%
Female	855	21.41%	124	24.65%	3,712	22.60%
First-generation						
Yes	739	18.51%	79	15.71%	2,746	16.72%
No	2,928	73.33%	384	76.34%	10,676	65.01%
Unknown	326	8.16%	40	7.95%	3,000	18.27%
Race						
White	1,990	49.84%	264	52.49%	7,815	47.59%
International	283	7.09%	41	8.15%	2,741	16.69%
Hispanic/Latino	903	22.61%	113	22.47%	3,070	18.69%
Black only/2+ or more	117	2.93%	12	2.39%	384	2.34%
Asian	547	13.70%	55	10.93%	1,854	11.29%
American Indian	8	0.20%	1	0.20%	29	0.18%
Two or more/excluding Black	137	3.43%	17	3.38%	430	2.62%
Native Hawaiian only	3	0.08%	0	0.00%	15	0.09%
Unknown	5	0.13%	0	0.00%	84	0.51%
Years at institution						
First-year	2,625	65.74%	360	71.57%	3,381	20.59%
Second-year	561	14.05%	51	10.14%	3,513	21.39%
Third-year	294	7.36%	34	6.76%	2,980	18.15%
Fourth-year	301	7.19%	25	4.97%	2,989	18.20%
Graduate	226	5.66%	33	6.56%	3,559	21.67%
LLC involvement						
Participant	968	24.24%	152	30.22%	-	-
Nonparticipant	3,025	75.76%	351	69.78%	-	-

Professional identity develops through interactions with colleagues and external regulations, shaping the way an individual carries out the duties of their role. As a result, this development is shared among other professionals in the same role and continually guides individuals throughout their careers.

es, while 6.56% were graduate students ($n = 33$). Using a student's entry term into the institution, a number was determined to represent years at the institution for each undergraduate respondent. The sample included undergraduate students with the following years at the institution: 71.57% in their first year ($n = 360$), 10.14% in their second year ($n = 51$), 6.76% in their third year ($n = 34$), and 4.97% in their fourth year or more ($n = 25$). The number of years at the institution was not considered for graduate students, as this information was considered less relevant for this population. The respondents consisted of 75.35% men ($n = 379$) with a mean age of 19.32. In terms of race and ethnicity, more than half of the respondents were White (52.49%, $n = 264$), a disparity seen within the engineering population at the institution. Overall, the demographics of the sample were representative of the institution and college (Texas A&M University, 2019).

Measures

We utilized a 38-item researcher-developed instrument that explored the professional and engineering identities of college students. The instrument was approved by the Institutional Review Board and contained three components: (a) demographic information, (b) professional identity, and (c) engineering identity.

Demographic information. Demographic information was connected to institutional records using the respondents' student identification numbers. Once connected, the unique identifier was removed. Demographic variables included in the study were age, race, gender, first-generation college student status, LLC participation, and enrollment term.

Professional identity. We used an established scale—the 25-item Professional Identity Five-Factor Scale (PIFFS) developed by Tan et al. (2016)—in order to increase reliability (Creswell & Guetterman, 2017). PIFFS examines five factors associated with professional identity: knowledge about professional practices, experience with the profession, having a professional as a role model, professional self-efficacy, and preference for a particular profession (Tan et al., 2016).

As applied in this study, knowledge of professional practices consisted of six items, such as "I have a good idea about the rules and regulations in the industry" and "I know the nature of the work I will do in my future work environment." Experience with the profession also contained six items and included statements such as "I follow developments in my future industry in newspapers and on television." Having a professional as a role model included six items, such as "When working on problems in class, I imagine myself to be in the shoes of a professional in my future work environment" and "I admire most of the teachers who are professionals in the area that I would like to enter." Seven items made up professional self-efficacy, such as "I have no doubt that I will master all the skills necessary to succeed in my future work." Preference for a particular profession, the fifth and final factor, consisted of items like "Do you already know what kind of work or profession you prefer?" All the items except one were placed on a 5-point Likert scale of 1 (*never true*), 2 (*not really true*), 3 (*neutral*), 4 (*somewhat true*), and 5 (*definitely true*). The exception was "Do you already know what kind of work or profession you prefer?" which required a response of *yes* or *no*. Construct reliability was achieved using the coefficient *H* test (Hancock & Mueller, 2001), with results greater than 0.7 for each factor, which indicated good reliability (Tan et al., 2016).

PIFFS was chosen for this study because of its intended use as a means "to analyze the professional development of students in the course of their education" and to measure "the success of curriculum in bringing about these changes, and in determining the stages of the curriculum at which significant changes occur" (Tan, 2014, p. 58). Because LLCs are considered pedagogical and/or curricular approaches (Kingston et al., 2014; Zeller, 2008), they may provide a meaningful avenue for comparing professional identity development in LLC participants to that of non-LLC participants. Thus, the scale was appropriate to use for this population and for the overall purpose of the study. Additionally, in the original study, the sample was divided into two subgroups: the high professional identity group, with scores from 3.27 to 4.53 ($n=625$), and the low professional identity group, with scores from 1.67 to 3.23 ($n=670$). The average of the scores was 3.23, $SD=0.44$ (Tan et al., 2016). The two groups (high and low professional identities) were compared using the independent sample *t*-test if there were indeed expected and distinct differences across all five factors that were important in contributing to professional identity development (Tan et al., 2016).

Engineering identity. Godwin (2016) developed an 11-item measure of the engineering identity of postsecondary students with three constructs: "students' feeling of recognition by others; students' interest in the subject; and students' beliefs about their performance/competence in the subject area" (p. 5). These self-reported items were measured by asking students to what extent they agreed or disagreed with particular statements about their professional identity on an anchored scale with ratings of 0 (*strongly disagree*), 1 (*disagree*), 2 (*somewhat disagree*), 3 (*neither disagree nor agree*), 4 (*somewhat agree*), 5 (*agree*), and 6 (*strongly agree*). Additionally, using Godwin's anchored scale rather than a Likert scale allowed for "a more interpretable distance between each numeric response and made the assumption of continuous scales associated with maximum likelihood factor analysis more valid" (p. 5).

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Cronbach's alpha was used to evaluate construct reliability for the engineering identity scale. Each construct validity was presented to better estimate overall reliability while taking into account standard errors and individual reliabilities—resulting in 0.77 for recognition, 0.89 for interest, and 0.88 for performance/competence (Godwin, 2016). Cronbach's alpha indicated strong internal consistency, suggesting that items measured as a single factor grouped strongly together (Creswell & Guetterman, 2017).

Procedure

Data were extracted from Qualtrics and were analyzed using the IBM SPSS® statistical software for social sciences (Version 25). A screener question was used immediately after obtaining electronic consent to ensure that all students were pursuing a degree within the college of engineering. This screener was added in case students changed their major or degree program to one outside the college after the recruitment panel was obtained, thereby making their professional and engineering identities irrelevant for inclusion given the study's purpose. One respondent indicated that they were no longer pursuing a degree within the college, so their responses were excluded from analysis. Next, if respondents did not respond to a particular item, the missing value was replaced with the mean for that item during data analysis (George & Mallery, 2001). There were nine instances within the engineering identity scale and 43 within the professional identity scale where the missing data accounted for less than 15% of the scale and missing values were replaced with the item mean. If a participant's responses were missing on more than 15% of the scale, then their responses were removed from both the analysis of that particular scale and the analysis of the total score for the instrument (George & Mallery, 2001).

Specifically, the first research objective was obtained by reporting descriptive statistics for each of the professional identity scale and engineering identity scale constructs and the scale total of residential students within the college of engineering. To address the second research objective, which sought to determine if participation in an engineering-based LLC affects professional and/or engineering identities, scale results were presented by LLC participants and non-LLC participants who identified as first-year students as of fall 2018. Independent sample *t*-tests were applied to compare constructs between LLC participants and non-LLC participants. A Bonferroni correction was used to adjust the *p*-value to ensure that tests of significance were not caused by a type I error (Napierala, 2012).

LIMITATIONS

While we believe the study to be sound, we note four limitations. First, we utilized a quantitative instrument to understand identity. As shared previously, identity is dynamic, so quantitative research might flatten the data by preventing students from explaining the rich context of their identity formation as an engineer. Therefore, future studies may choose to add a qualitative component to catalogue the development of engineering and professional identities. Qualitative research in this area would be powerful and informative.

The second limitation stems from the fact that this study utilized self-reported commitment to the college, commitment to the major, and anticipated retention to the fall semester. This self-reported data may not be accurate for determining such commitments and retention as compared to utilizing institutional data. Third, while our sample size is sufficient, we note a limitation related to the sample size yielding adequate representation for some statistical analysis. For instance, as we later report, we were unable to conduct statistical analysis on various racial and ethnic groups.

Finally, the data may also be subject to a volunteer bias, as students within the engineering LLC applied for and sought out a specific experience for engineers. This potential for volunteer bias may mean that they already had high professional and engineering identity scores before their participation. Previous studies on LLCs have cited such volunteer bias (Slotta & Acosta, 2017); therefore, it is suggested that future researchers invoke a process of pre- and post-testing to understand the changes in professional and engineering identities for students who participate in LLCs or other forms of pedagogical and curricular experiences.

RESULTS

The first research objective sought to describe the professional and engineering identities of on-campus students within a college of engineering. Table 2 and Table 3 use descriptive statistics to explore professional and engineering identities, respectively. Tests for statistical significance between professional or engineering identity and student group (i.e., ethnicity, first-generation college student status, gender, and years at the institution) were conducted. Each table presents only statistically significant differences by student group.

. . . engineering curricula should focus on bolstering female engineering identity by emphasizing both their recognition and their performance and competence in the field.

Professional Identity Results

The sample (N = 503) reported a total professional identity mean score of 3.28 (SD = 0.45). In terms of professional identity subscales, self-efficacy was the highest subscale, with a mean of 3.83 (SD = 0.43). The lowest subscale mean was preference for a particular profession, with a mean score of 2.28 (SD = 0.65), likely caused by the different scales used to complete this particular mean score. The professional identity instrument was a 5-point Likert scale (Tan et al., 2016), while the engineering identity instrument was a 7-point anchored scale (Godwin, 2016). As a reminder, assessment of preference for a particular profession featured a question requiring a response of *yes* or *no* (Tan et al., 2016). Thus, this construct used a different scale.

Independent sample *t*-tests were conducted to determine any differences in the professional identity subscales between males and females. Levene's test for homogeneity was applied to ensure that each test met the assumption of $p < 0.05$. The findings of these tests indicated no statistically significant differences.

Independent sample *t*-tests were performed on first-generation college student status to determine any differences in profes-

Table 2

Professional Identity Results by Subscale

	Knowledge			Experience			Role Model			Self-efficacy			Preference			Total		
	M	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*
Gender																		
Male	3.64	0.70	0.51	2.92	0.85	0.42	3.74	0.67	0.48	3.84	0.44	0.55	2.28	0.65	0.79	3.28	0.47	0.79
Female	3.59	0.64		2.85	0.77		3.79	0.58		3.81	0.40		2.30	0.63		3.27	0.40	
First-generation																		
Yes	3.66	0.68	0.43	2.74	0.94	0.23	3.78	0.73	0.43	3.84	0.49	0.86	2.33	0.63	0.39	3.27	0.49	0.81
No	3.59	0.68		2.88	0.78		3.72	0.62		3.83	0.41		2.26	0.65		3.26	0.44	
Unknown	3.88	0.62		3.42	0.87		4.02	0.64		3.77	0.46		2.34	0.62		3.49	0.50	
Race																		
White	3.59	0.68	0.05	2.89	0.83	0.00	3.73	0.65	0.10	3.85	0.39	0.61	2.30	0.66	0.76	3.27	0.45	0.03
International	3.95	0.63		3.47	0.88		4.04	0.64		3.81	0.49		2.30	0.63		3.52	0.51	
Hispanic/Latino	3.66	0.74		2.78	0.81		3.75	0.72		3.80	0.47		2.29	0.64		3.26	0.49	
Black only/ +2 or more	3.41	0.74		2.73	0.80		3.50	0.55		4.04	0.43		2.09	0.63		3.15	0.37	
Asian	3.57	0.56		2.90	0.69		3.72	0.51		3.78	0.46		2.23	0.61		3.24	0.35	
American Indian	3.67			3.00			4.00			3.83			1.50			3.20		
Two or more / excluding Black	3.46	0.50		2.58	0.62		3.81	0.46		3.77	0.39		2.19	0.70		3.16	0.33	
Years at institution																		
First-year	3.58	0.68	0.32	2.84	0.81	0.54	3.75	0.64	0.19	3.87	0.40	0.00	2.26	0.65	0.44	3.26	0.44	0.92
Second-year	3.76	0.79		3.16	0.96		3.90	0.71		3.79	0.47		2.29	0.69		3.38	0.57	
Third-year	3.73	0.54		2.87	0.66		3.53	0.56		3.71	0.49		2.23	0.60		3.22	0.38	
Fourth-year	3.65	0.60		2.94	0.71		3.72	0.61		3.60	0.41		2.42	0.66		3.26	0.41	
Graduate																		
Total	3.63	0.68		2.90	0.83		3.76	0.65		3.83	0.43		2.28	0.65		3.28	0.45	

Table 3

Engineering Identity Results by Subscale

	Recognition			Interest			Perf./Competence			Total		
	M	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*
Gender												
Male	4.79	0.99	0.02	5.16	1.08	0.88	4.60	1.03	0.02	4.85	0.88	0.04
Female	4.54	1.05		5.17	0.90		4.26	1.12		4.66	0.81	
First-generation												
Yes	4.78	0.79	0.41	5.27	1.05	0.33	4.39	0.99	0.34	4.81	0.73	0.78
No	4.70	1.04		5.15	1.02		4.51	1.06		4.78	0.87	
Unknown	4.86	1.18		5.11	1.19		4.80	1.23		4.92	1.14	
Race												
White	4.74	1.02	0.58	5.14	1.03	0.70	4.57	1.04	0.33	4.82	0.85	0.68
International	4.85	1.17		5.11	1.19		4.78	1.22		4.92	1.12	
Hispanic/Latino	4.80	0.89		5.29	0.93		4.40	1.05		4.83	0.79	
Black only/+2 or more	4.63	0.93		5.25	0.89		4.53	1.07		4.80	0.81	
Asian	4.52	1.17		4.98	1.26		4.31	1.07		4.60	1.01	
American Indian	4.00			5.00			4.40			4.47		
Two or more / excluding Black	4.51	0.82		5.25	0.67		4.40	1.08		4.72	0.56	
Years at institution												
First-year	4.73	0.98	0.05	5.19	1.02	0.05	4.52	1.05	0.19	4.81	0.83	0.12
Second-year	4.62	1.38		4.94	1.42		4.33	1.36		4.63	1.28	
Third-year	4.95	0.66		5.18	0.79		4.64	0.80		4.92	0.59	
Fourth-year	4.48	0.92		5.03	0.82		4.25	0.99		4.59	0.71	
Graduate												
Total	4.72	1.01		5.16	1.04		4.51	1.07		4.80	0.87	

sional identity subscales. Levene's test for homogeneity was only violated for the subscale of experience ($p = 0.014$). Findings indicated no statistically significant results for any of the professional identity subscales or total. The alpha was corrected using the Bonferroni adjustment, resulting in an alpha value of 0.049.

A one-way ANOVA was conducted on the various racial identities included in the study to find any differences in the means among the professional identity subscales. Homogeneity of variances existed in each subscale, as assessed by Levene's test for equality of variances. Participants were classified into seven groups based on institutional data: White ($n = 264$), international ($n = 41$), Hispanic/Latino ($n = 113$), Black only/2+ or more ($n = 12$), Asian ($n = 55$), American Indian ($n = 1$), and two or more/excluding Black ($n = 17$). Table 2 presents the mean scores of professional identity subscale by race. Race was found to be statistically significant for subscales of knowledge, $F(6, 484) = 2.162$, $p = 0.045$; experience $F(6, 485) = 4.330$, $p = 0.001$; and the total, $F(6, 484) = 2.347$, $p = 0.030$). A Tukey post-hoc test was attempted to explore the source of the statistically significant difference between the participants of different races, but it could not be completed because one group had fewer than two cases. The one-way ANOVA was re-run without the American Indian participants. Race was found to be statistically significant for subscales of knowledge, $F(5, 484) = 2.593$, $p = 0.025$; experience, $F(5, 485) = 5.193$, $p = 0.000$; and the total, $F(5, 484) = 2.81$, $p = 0.016$. A post-hoc Tukey test showed that, for the knowledge subscale, the White and international groups differed significantly at $p < 0.05$; the remaining groups were not significantly different from the others. For the experience subscale, the White and international, international and Hispanic/Latino, international and Asian, international and two or more/excluding Black groups differed significantly at $p < 0.05$. For the total, the White and international, international and Hispanic/Latino, and international and Asian groups differed significantly at $p < 0.05$.

A one-way ANOVA was conducted to explore the differences in the means between years at the institution and professional identity subscales. The assumption of homogeneity of variances was violated for knowledge ($p = 0.033$) and the total ($p = 0.000$), as assessed by Levene's test for equality of variances. The professional identity subscales of knowledge, $F(3, 61.512) = 1.206$, $p = 0.315$, and the total, $F(3, 50.401) = 0.166$, $p = 0.919$), showed no statistical significance by years at the institution. The efficacy subscale exhibited a statistical significance difference by years at the institution, $F(3, 454) = 5.15$, $p = 0.002$. Tukey post-hoc analysis revealed that the mean increase was statistically significant ($p = 0.01$) between students in their first and fourth years (0.27, 95% confidence interval [CI] [3.42, 3.79]) at the institution, but no other group differences were statistically significant.

Engineering Identity Results

In regards to engineering identity, the total mean score was reported as 4.80 ($SD = 0.87$) across the 503 participants in the sample. The highest subscale was interest, with a mean of 5.16 ($SD = 1.04$). The lowest engineering identity subscale was performance and competence, with a mean score of 4.51 ($SD = 1.07$).

Independent sample t-tests were run to determine any differences in engineering identity subscales between males and females. Levene's test for homogeneity was consulted, and each test met the assumption ($p < 0.05$). The alpha value was adjusted to 0.049 using a Bonferroni adjustment. The recognition subscale revealed higher scores for male (4.79 ± 0.05) than female engineering students (4.54 ± 0.09), a statistically significant difference of 0.25 ([95% CI, 0.04, 0.45], $t[497] = 2.358$, $p = 0.019$). The performance and competence subscale indicated male engineering students having higher scores (4.60 ± 0.05) than their female peers (4.26 ± 0.10), a statistically significant difference of 0.34 ([95% CI, 0.13, 0.56], $t[496] = 3.138$, $p = 0.002$). The emotional intelligence total subscale demonstrated higher male scores (4.85 ± 0.05) than female scores

(4.66 ± 0.07), a significant statistical difference of 0.19 ([95% CI, 0.01, 0.37], $t[496] = 2.119$, $p = 0.035$).

Independent sample *t*-tests were performed on first-generation college student status to determine any differences seen in engineering subscales. Findings indicated no statistically significant results.

A one-way ANOVA was conducted on the various racial identities included in the study to deduce if there were any differences in the means among engineering identity subscales. Upon reviewing Levene's test for homogeneity, there were no violations in the assumption across the subscales. There were no statistically significant differences among the means of the engineering identity subscales by race.

A one-way ANOVA was conducted to determine any differences in the means between years at the institution and engineering identity subscales. Levene's test for homogeneity was reviewed. The assumption of homogeneity of variances was violated for the recognition subscale ($p = 0.008$). The engineering identity subscale of recognition was found to approach statistical significance ($p = 0.05$) by years at the institution, Welch's $F(3, 63.664) = 2.751$, $p < 0.05$. No statistically significant difference was shown to exist in the means of the subscales interest, $F(3, 462) = 1.928$, $p = 0.05$, or performance and competence, $F(3, 461) = 1.709$, $p = 0.189$, by years at the institution. The means were lower in fourth-year students than first-year students.

Living-Learning Community Results

The second research objective sought to determine if participation in an engineering-based LLC affects professional and/or engineering identity. Table 4 and Table 5 present descriptive statistics for the professional and engineering identities of undergraduate respondents in their first year at the institution ($n = 360$) by engineering LLC participation. Tests for statistical significance were conducted between professional and engineering identities and student group (i.e., ethnicity, first-generation college student status, gender, and years at the institution). Each table presents only statistically significant differences by student group. Some student groups did not achieve 30 respondents, so their significance results should be used with caution.

Table 4 presents the professional identity subscales by LLC participation. The highest subscale was self-efficacy, with a mean of 3.88 ($SD = 0.40$). The lowest subscale was preference for a particular profession, with a mean of 2.26 ($SD = 0.65$). When considering LLC participation, the highest subscale was self-efficacy for LLC participants ($M = 3.86$, $SD = 0.40$) and for non-LLC participants ($M = 3.82$, $SD = 0.44$). Independent sample *t*-tests were run to determine any differences in the professional identity subscales between LLC participants and non-LLC participants. Levene's test for homogeneity was consulted and indicated that the assumption was never violated ($p < 0.05$). The findings showed no statistically significant results.

Table 5 presents engineering identity means by LLC participation. The highest scoring subscale was interest ($M = 5.19$, $SD = 1.02$), with the lowest being performance and competence ($M = 4.53$, $SD = 1.05$). The greatest difference in the means of 0.18 between LLC participants and non-LLC participants was in the recognition subscale. Independent sample

Table 4

Professional Identity Subscales by LLC Involvement

	Knowledge			Experience			Role Model			Self-efficacy			Preference			Total		
	M	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*
LLC involvement																		
Participant	3.57	0.65	0.78	2.77	0.81	0.15	3.74	0.64	0.91	3.86	0.40	0.64	2.26	0.66	0.75	3.24	0.43	0.61
Nonparticipant	3.65	0.69		2.96	0.83		3.76	0.65		3.82	0.44		2.29	0.64		3.30	0.46	
Total	3.58	0.68		2.84	0.81		3.75	0.64		3.88	0.40		2.26	0.65		3.26	0.44	

Table 5

Engineering Identity Subscales by LLC Involvement

	Recognition			Interest			Perf./Competence			Total		
	M	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*	*M*	*SD*	*p*
LLC involvement												
Partcipant	4.60	1.10	0.11	5.17	1.02	0.72	4.52	1.11	0.66	4.76	0.92	0.78
Nonparticipant	4.78	0.97		5.16	1.04		4.51	1.05		4.82	0.85	
Total	4.73	0.98		5.19	1.02		4.53	1.05		4.82	0.82	

t-tests were run to determine any differences in the engineering identity subscales means by LLC participation. Much like the professional identity subscales, the findings indicated no statistically significant results.

DISCUSSION AND IMPLICATIONS

Results from this study have a number of implications for practice and future research related to engineering education and LLC administration. First, implications are presented from analysis of the sample, population, and college representation of student groups. Next, insights and actions are recommended based on results of the professional and engineering identity scales. Finally, LLC-specific recommendations are made for practice and research.

Sample Analysis

In most cases, the sample representation was similar to the representation of the on-campus population and college-number frequencies of student groups (i.e., gender, race) (Table 1). Some distinguishable differences were observed in gender, first-generation status, racial group, and LLC participation. For gender, the female representation within the sample (24.65%) was greater than that for the population (21.41%). The overall college representation of females was 22.60%. Therefore, the male representation in the sample was less than that in the population, leading to a slight overrepresentation of females. A similar phenomenon was seen when looking at first-generation status. A majority of participants (76.34%) were legacy students (not first-generation college students), meaning they were slightly overrepresented in the sample by 2.80%. When exploring representation by race, discrepancies were observed between the counts of White and Asian respondents, with a roughly 3% difference between the population and sample. The various numbers for years at the institution illustrated discrepancies as large as 6% in first-year respondents and as small as less than 1% in third-year respondents. However, the largest overrepresentation occurred when looking at LLC participants, with 6% more participants in the sample frequency than in the population. This means that non-LLC participants were underrepresented in the sample.

These insights are important to keep in mind when interpreting the results of the study. Additionally, this comparison of the study population to the college population could be a useful activity for aiding college administrators, faculty, and LLC program administrators in understanding their student body and knowing which students participate in their engineering-based LLCs. Of course, there may be lurking variables not included in the study, such as socioeconomic status or required live-on policies, that may affect students who decide to live on campus or participate in an LLC.

Professional Identity Analysis

When exploring the results of the professional identity scale in regard to gender, no statistical difference was seen in the means across the various constructs. The largest difference in the observed means was 0.07, while the smallest difference was 0.01. Because of the similar mean scores within professional identity subscales, it is reasonable to assume that men and women are relatively consistent in their professional identity development.

Similar to gender revealing no statistical or practical significance difference on the professional identity constructs, no difference was shown related to the variable of first-generation status. This result may indicate that being a first-generation college student does not impact a student's semblance of professional identity negatively. For housing professionals who desire to develop their students' professional identity, this finding suggests that there may be no need to differentiate students by first-generation status or by gender. For instance, an engineering LLC may offer professional identity development programs for all of their students rather than implementing demographic-specific programming.

These insights may also have an effect on future engineering education research. When designing future studies, researchers may work to confirm the result that first-generation college student status does not affect professional identity in a pronounced way and may consider adding variables such as those related to socioeconomic status. Using this as a pivot point can identify groups that are underrepresented within engineering programs.

In terms of the means of the professional identity constructs by racial group, international students scored the highest mean in all of the subscales, except in self-efficacy, where White students scored the highest (M = 3.85), and in preference for a particular profession, where they tied with White students (M = 2.30). Additionally, differences existed in the means for the professional identity constructs across the different racial groups. A possible explanation for higher scores by international students is that students attending a school abroad will often choose the school of a particular major (i.e., engineering) and are making a substantial commitment to attend in a foreign country.

We acknowledge that institutional data combining the race and ethnicity of international and domestic racial groups into one question causes concern for analysis. An additional limitation of this study came from the small sample size, which prevented us from conducting some statistical tests of significance. Future research should be conducted where sample sizes enable researchers to analyze the differences in professional identity among various racial groups, as suggested by Chang (2002).

Final recommendations related to professional identity come from the statistically significant differences based on years at the institution. First- and fourth-year students at the institution scored statistically significant differences on one of the five subscales (self-efficacy). These results are the opposite of our expectations. Fourth-year students scored lower (M = 3.60) than did first-year students (M = 3.87). This difference may be explained by the fact that as students progress in their degrees, they may become more aware of their own knowledge and skill gaps within the engineering curriculum and thus score themselves lower than do their more idealistic first-year student peers. To state it another way, the college experience has an inherent design to broaden a student's view of the world, giving them more and more information and options and mature perspective as they progress. First-year students have a narrower viewpoint, so it is easier for them to make a concrete statement. Housing professionals working with engineering LLCs might consider programs that incorporate upper-division students, who could serve as mentors, participate in panel discussions, and take part in other forms of interaction to develop first-year students' professional identity. Overall their presence and involvement with first-year students will aid first-year students in having more realistic understandings of their engineering knowledge and skills.

Engineering Identity Analysis

When exploring the engineering identity differences between males and females, males had higher means in recognition (M = +0.25, p = 0.02), performance and competence (M = +0.34, p = 0.02), and in the total mean score (M = +0.19, p = 0.04). These results indicate that females identify less as engineers than their male counterparts do. It is likely that this difference does not come from a lack of support in education, but from females being traditionally underrepresented in engineering (Hamrick, 2019; Wasilewski, 2015). As a result, engineering curricula should focus on bolstering female engineering identity by emphasizing both their recognition and their performance and competence in the field. This finding supports housing professionals' current practice of creating floors or wings for female engineers. This layering of engineering identity and gender may aid in bolstering female recognition, performance and competence, and their overall engineering identity.

Similar to first-generation status not producing noticeable differences within professional identity scores, there is also a negligible difference seen in engineering identity. This once again indicates that being a first-generation college student does not impact a student's semblance of engineering identity negatively.

Living-Learning Community Analysis

When exploring how LLC involvement affects engineering identity, the mean scores of interest and performance and competence were very similar between LLC participants and non-LLC participants. However, the means for the recognition subscale were more differentiated, indicating that respondents involved in LLCs do not recognize themselves as engineers to the same extent as their first-year peers. This surprised us, as one of the enumerated limitations of the study was volunteer bias—LLC participants naturally would seem to have higher scores because they identify more as engineers, as evidenced by their motivation to apply for the LLC in the first place. Perhaps the explanation for this result is that students involved in LLCs participate in the program to bolster their engineering and professional identities. Conversely, perhaps the reason for non-LLC participants having a higher recognition stems from the idea that they do not perceive a benefit from LLC involvement because they already know their desired plans within engineering. Another explanation may have to do with pressure to declare a major. At the institution where this research was conducted, there is an entry-to-a-major process where students have to apply for their upper-division major within the college of engineering and are only a general engineering major when they begin college. It seems to make sense that students who are actively working to declare their major may identify with it more as opposed to a transfer student. This idea is supported by non-LLC participants scoring higher on most of the professional identity subscales as well.

These findings would provide LLC administrators with the necessary information to develop programs that more deeply integrate students with the discipline and faculty. Related to recognition, for instance, engineering administrators could pioneer a marketing campaign that utilizes program swag as a way to bolster engineering identity recognition. To illustrate, similar to the "I'm First" Campaign originally developed by the Center for Student Opportunity, program administrators could create t-shirts that assert "I'm an engineer." Finally, future research for engineering-based LLC involvement should be longitudinal, using pre- and post-testing to explore how LLC participants and non-LLC participants develop professional and engineering identities over time.

REFERENCES

Anderson, K. J., Courter, S. S., McGlamery, T., Nathans-Kelly, T. M., & Nicometo, C. G. (2010). Understanding engineering work and identity: A cross-case analysis of engineers within six firms. *Engineering Studies, 2*(3), 153–174. https.//doi.org/10.1080/19378629.2010.519772

Brewer, M. B., & Gardner, W. (1996). Who is this "we"? Levels of collective identity and self representations. *Journal of Personality and Social Psychology, 71*(1), 83–93. https.//doi.org/10.1037//0022-3514.71.1.83

Brubaker, R., & Cooper, F. (2000). Beyond "identity." *Theory and Society, 29*(1), 1–47. https.//doi.org/10.1023/a:1007068714468

Chang, J. C. (2002). *Women and minorities in the science, mathematics and engineering pipeline* (ED467855 2002-06-00). ERIC. https://files.

eric.ed.gov/fulltext/ED467855.pdf.

Chen, X. (2013). STEM attrition: College students' paths into and out of STEM fields: Statistical analysis report [Report NCES 2014-001]. National Center for Education Statistics.

Creswell, J. W., & Guetterman, T. C. (2017). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (6th ed.). Pearson.

Daempfle, P. A. (2003). An analysis of the high attrition rates among first year college science, math, and engineering majors. *Journal of College Student Retention: Research, Theory & Practice, 5*(1), 37–52. https.//doi.org/10.2190/dwqt-tya4-t20w-rcwh

Dannels, D. P. (2000). Learning to be professional: Technical classroom discourse, practice, and professional identity construction. *Journal of Business and Technical Communication, 14*(1), 5–37. https.//doi.org/10.1177/105065190001400101

Dillman, D. A., Phelps, G., Tortora, R., Swift, K., Kohrell, J., Berck, J., & Messer, B. L. (2009). Response rate and measurement differences in mixed-mode surveys using mail, telephone, interactive voice response (IVR) and the Internet. *Social Science Research, 38*(1), 1–18. https.//doi.org/10.1016/j.ssresearch.2008.03.007

Eliot, M., & Turns, J. (2011). Constructing professional portfolios: Sense-making and professional identity development for engineering undergraduates. *Journal of Engineering Education, 100*(4), 630–654. https.//doi.org/10.1002/j.2168-9830.2011.tb00030.x

Erikson, E. H. (1963). *Youth: Change and challenge*. Basic Books.

Erikson, E. H. (1993). *Young man Luther: A study in psychoanalysis and history*. W.W. Norton & Company.

Evans, N. J., Forney, D. S., Guido, F. M., Patton, L. D., & Renn, K. A. (2009). *Student development in college: Theory, research, and practice* (2nd ed.). Jossey-Bass.

Gecas, V., & Burke, P. J. (1995). Self and identity. In K. Cook, G. Fine, & J. House (Eds.), *Sociological perspectives on social psychology* (pp. 41–67). Allyn and Bacon.

George, D., & Mallery, P. (2001). *SPSS for Windows step by step: A simple guide and reference: 10.0 update* (3rd ed.). Allyn and Bacon.

Ghosal, L. N., Worsham, R., & Miller, C. (2019, March). *The Career Identity Program: Designing a values based career plan for first-year engineering students* [Paper presention]. Annual Conference of the American Society for Engineering Education Southeastern Section, Raleigh, NC, United States. Retrieved from http://www.asee-se.org/proceedings/ASEE2019/papers2019/77.pdf

Giddens, A. (1991). *Modernity and self-identity: Self and society in the late modern age*. Stanford University Press.

Godwin, A. (2016, June). *The development of a measure of engineering identity* [Paper presentation]. 123rd Annual Conference & Exposition of the American Society for Engineering Education, New Orleans, LA, United States. Retrieved from https://www.asee.org/public/conferences/64/papers/14814/view

Hall, C. W., Kauffmann, P. J., Wuensch, K. L., Swart, W. E., DeUrquidi, K. A., Griffin, O. H., & Duncan, C. S. (2015). Aptitude and personality traits in retention of engineering students. *Journal of Engineering Education, 104*(2), 167–188. https.//doi.org/10.1002/jee.20072

Hamrick, K. (2019). *Women, minorities, and persons with disabilities in science and engineering* (Special Report NSF 19-304). National Science Foundation, National Center for Science and Engineering Statistics. Retrieved from https://www.nsf.gov/statistics/wmpd

Hancock, G. R., & Mueller, R. O. (2001). Rethinking construct reliability within latent variable systems. In R. Cudeck, S. du Toit, & D. Sörbom (Eds.), *Structural equation modeling: Present and future* (pp. 195–216). Scientific Software International.

Holland, D., Lachiotte, W. S., Jr., Skinner, D., & Cain, C. (2001). *Identity and agency in cultural worlds*. Harvard University Press.

Inkelas, K. K. (2008). *The national study of living-learning programs: 2007 report of findings*. University of Maryland. Retrieved from https://drum.lib.umd.edu/bitstream/handle/1903/8392/2007%20NSLLP%20Final%20Report.pdf?sequence=1&isAllowed=y

Inkelas, K. K., Jessup-Anger, J. E., Benjamin, M., & Wawrzynski, M. R. (2018). *Living-learning communities that work: A research-based model for design, delivery, and assessment*. Stylus Publishing.

Johnston, S., Lee, A., & McGregor, H. (1996). Engineering as captive discourse. *Techné: Research in Philosophy and Technology, 1*(3-4), 128–136. https://doi.org/10.5840/techne199613/413

Kilgo, C. A., Sheets, J. K. E., & Pascarella, E. T. (2015). The link between high-impact practices and student learning: Some longitudinal evidence. *Higher Education, 69*(4), 509–525. https://doi.org/10.1007/s10734-014-9788-z

Kingston, L. N., MacCartney, D., & Miller, A. (2014). Facilitating student engagement: Social responsibility and freshmen learning communities. *Teaching & Learning Inquiry, 2*(1), 63–80. https://doi.org/10.2979/teachlearninqu.2.1.63

Kuh, G. (2008). *High-impact educational practices: What they are, who has access to them, and why they matter*. Association of American Colleges and Universities.

LaPointe, K. (2010). Narrating career, positioning identity: Career identity as a narrative practice. *Journal of Vocational Behavior, 77*(1), 1–9. https://doi.org/10.1016/j.jvb.2010.04.003

Light, J. (2005). *Developing and assessing a holistic living-learning community for engineering and science freshmen* [Doctoral dissertation abstract]. Washington State University.

Meyers, K. L., Ohland, M. W., Pawley, A. L., Silliman, S. E., & Smith, K. A. (2012). Factors relating to engineering identity. *Global Journal of Engineering Education, 14*(1), 119–131. Retrieved from http://www.wiete.com.au/journals/GJEE/Publish/vol14no1/16-Myers-K.pdf

Monrouxe, L. V. (2010). Identity, identification and medical education: Why should we care? *Medical Education, 44*(1), 40–49. https://doi.org/10.1111/j.1365-2923.2009.03440.x

Napierala, M. A. (2012). What is the Bonferroni correction? *AAOS Now, 6*(4), 40. Retrieved from https://www.aaos.org/AAOSNow/2012/Apr/research/research7/?ssopc=1

National Center for Education Statistics. (2018). *The condition of education 2018* (Report NCES 2018-144). Retrieved from https://nces.ed.gov/pubs2018/2018144.pdf

Ohland, M. W., Sheppard, S. D., Lichtenstein, G., Eris, O., Chachra, D., & Layton, R. A. (2008). Persistence, engagement, and migration in engineering programs. *Journal of Engineering Education, 97*(3), 259–278. https://doi.org/10.1002/j.2168-9830.2008.tb00978.x

Patrick, A. D., & Borrego, M. (2016, June). *A review of the literature relevant to engineering identity* [Paper presentation]. 123rd Annual Conference & Exposition of the American Society for Engineering Education, New Orleans, LA, United States. Retrieved from https://www.asee.org/public/conferences/64/papers/15028/view

Phillips, D. C., & Burbules, N. C. (2000). *Postpositivism and educational research*. Rowman & Littlefield Publishers.

Schwartz, S. J., Luyckx, K., & Vignoles, V. L. (Eds.). (2011). *Handbook of identity theory and research*. Springer Science+Business Media.

Shushok, F., Jr., & Sriram, R. (2010). Exploring the effect of a residential academic affairs-student affairs partnership: The first year of an engineering and computer science living-learning center. *The Journal of College and University Student Housing, 36*(2), 68–81. Retrieved from http://www.nxtbook.com/nxtbooks/acuho/journal_vol36no2/index.php#/0

Slotta, J. D., & Acosta, A. (2017, June). *Scripting and orchestrating learning communities: A role for learning analytics* [Paper presentation]. 12th International Conference on Computer Supported Collaborative Learning, Philadelphia, PA, United States. Retrieved from https://repository.isls.org/bitstream/1/250/1/47.pdf

Stevens, R., O'Connor, K., & Garrison, L. (2005, June). *Engineering student identities in the navigation of the undergraduate curriculum* [Paper presentation]. Annual Conference of the American Society for Engineering Education, Portland, OR, United States. Retrieved from https://peer.asee.org/engineering-student-identities-and-the-navigation-of-the-undergraduate-curriculum

Tan, C. P. (2014). *Educating for professional identity development* [Doctoral thesis]. Erasmus University Rotterdam.

Tan, C. P., Van der Molen, H. T., & Schmidt, H. G. (2016). To what extent does problem-based learning contribute to students' professional identity development? *Teaching and Teacher Education, 54,* 54–64. https.//doi.org/10.1016/j.tate.2015.11.009

Texas A&M University. (2019). *Accountability: Measuring the pursuit of excellence*. Retrieved from http://accountability.tamu.edu/

Tonso, K. L. (2014). Engineering identity. In A. Johri & B. Olds (Eds.), *Cambridge handbook of engineering education research* (pp. 267–282). Cambridge University Press.

Wankat, P., & Oreovicz, F. (2005). Making them want to stay. *ASEE Prism, 14*(7), 53. Retrieved from http://proxy.library.tamu.edu/login?url=https://search.proquest.com/docview/236149814?accountid=7082

Wasilewski, C. H. (2015). *Men and women in engineering: Professional identity and factors influencing workforce retention* [Doctoral dissertation]. Seattle Pacific University.

Zeller, W. J. (Ed.). (2008). *Residence life programs & the new student experience* (3rd ed.). University of South Carolina.

Discussion Questions

1. Explain how a first-year student's participation in an engineering-based LLC can limit or enhance their holistic college experience.
2. What might account for the racial differences in the professional identity results?
3. The scores for males were consistently higher than they were for females in regard to elements of engineering identity. What does this suggest for LLC implementation?
4. Results indicated no significant differences in professional and engineering identity between LLC participants and non-participants. In your opinion, should this engineering LLC be discontinued? Why or why not?
5. What ethical considerations are involved in implementing an LLC when there are disparities based on race, gender, or some other identity?
6. Based on this study's results, how might you shape an academically focused LLC to enhance participants' professional and disciplinary (e.g., engineering) identity?
7. The authors describe the literature supporting engineering identity. What professional identities exist for students on your campus, and how might you influence that development for residential students outside of LLCs?

Discussion questions developed by Denise Davidson, Associate Professor, and Jeri Fries and Nick Paseano, graduate students in the College Student Affairs program at Bloomsburg University of Pennsylvania.