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Professional Identity Formation in an ET Capstone Course

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Despite a growing trend in identity-related research in STEM and engineering education, there has been little focus on engineering technology. This study examined professional identity formation in an undergraduate engineering technology (ET) capstone course. The *Professional Identity Status Questionnaire - 5 Dimensions* (PISQ-5d) [1] instrument was adapted for ET students in a 4-year program and administered to all students in the capstone course at the beginning and end of the term. Then it was analyzed as a diagnostic tool to inform practice. Students provided self-reported ratings to indicators measuring five dimensions of professional identity formation: *Affirmation, In-depth exploration, Practices, Identification with commitment*, and *Reconsideration of commitment.* Based on these results, cluster analysis determined a professional identity status by grouping students into *Achievement, Foreclosure, Moratorium*, and *Diffusion* statuses. Comparisons were made between the pre- and post-course surveys and previous data that examined ET students across all levels within an undergraduate ET program at a mid-sized, midwestern institution in the United States. A discussion of the course's organization, the study's methodology, and the results are provided. The paper concludes with recommendations for future research and practice.

Introduction

Consideration of students' identity formation has been called a 21st-century education imperative [2]. While engineering education has seen an uptick in recent years following the trend of STEM disciplines in general [3-5], similar research in Engineering Technology (ET) has been scarce. Identity is complex, multi-faceted, and changes over time [3]. Individuals can embody multiple identities based on various personal and social factors [6]. Identity theories are a recognized lens of analysis in educational and social inquiry and educational research for examining perceptions, motivations, efficacy, attitudes, roles, and emotional commitment [7]. This study focused on professional identity development and status in an undergraduate ET capstone course. The *Professional Identity Status Questionnaire - 5 Dimensions* (PISQ-5d) [1] instrument was adapted for ET students in a 4-year program and administered to all students in the capstone course at the beginning and end of the term. Students provided self-reported ratings to indicators measuring five dimensions of professional identity formation. An overarching goal of this study was to begin to quantify students' professional identity status at multiple intervals to improve future practice.

Background

Professional identity is often thought of as an individual's strong association with and sense of unity within a particular profession [8]. A professional identity not only reflects the type of work one does but often signals the specialized training and skills that have been acquired [9]. This study draws on the work of Mancini et al. [1], who suggested that there are five interrelated dimensions significant to university students' formation of their professional identity status: 1) *Affirmation*, 2) *In-depth exploration*, 3) *Practices*, 4) *Identification with commitment*, and 5) *Reconsideration of commitment*. According to Mancini et al., *Affirmation* captures the importance and pride one feels within their professional community. *In-depth exploration* refers to the reflection on current commitments while seeking new information. *Practices* measure the

likelihood of engaging in actions relevant to a professional community. *Identification with commitment* involves choices made in central identity domains and the resulting self-confidence. *Reconsideration of commitment* involves comparing current commitments to alternatives due to dissatisfaction.

Marcia [10] suggested that professionals transition between four stages of professional identity status. According to Marcia, individuals with an *achieved* status are committed individuals with a coherent identity. Those in *moratorium* status are exploring various choices but have no clear commitments yet. *Foreclosure* status reflects those who are committed but have done so without exploration (i.e., their identity may be based on others' choices and values), and *diffusion* status, meaning there is no exploration or commitment. Building on the work of Marcia, identity researchers later proposed a fifth status, *searching moratorium*, which they described as being in the process of revising statuses [11-12]. This status was also found when investigating the professional identities of undergraduates [1]. Mancini et al., [1] concluded that the PISQ5-d could be a useful diagnostic tool for practitioners in undergraduate education, recommending its future use with additional groups and pre-post treatments.

Professional identity status development research in STEM students and professionals is limited thus far but may provide a new direction for engineering (technology) education-related identity research. Pastoor [13] studied STEM students' (including engineering and engineering technology majors) career behaviors and intentions. A pretest-posttest within-subjects design was utilized to measure changes in intentions toward career behaviors. The results revealed a significant increase in intentions toward learning about oneself, making choices, and committing to those choices. Kelly et al. [14] found that STEM professionals (including engineers and technologists) did not exhibit more established STEM identities than STEM undergraduates. Kelly et al. suggested that the shifting landscape of STEM education and the blurring of traditional subject boundaries present a challenge to forming a robust definition of achievement in professional identity status. This was supported by evidence of low levels of achieved identity, higher moratoriums, searching statuses, and the recognition that identity exploration is an ongoing process that spans a lifetime, not just early adulthood. In a previous study, the author studied a cross-section of 47 ET undergraduates, finding that year in school was significant with dimensions of professional identity status [15].

Methods

This non-experimental study took place within an ET capstone course at a mid-sized, midwestern R2 university. A slightly modified version of the *PISQ5-d* (rephrased for ET) was administered to students as an online survey pre-course and post-course. There were 14 participants. All students were seniors in their final semester of a four-year bachelor's degree program. The study sought to understand how professional identity status evolved over one semester while participating in targeted professional development activities related to manufacturing organization and management through a design-focused project. The undergraduate catalog lists the capstone course as "The study of industrial production systems, including product, manufacturing, and plant engineering through managing a production project." To achieve this goal, students were divided into teams with members with various technical competencies to develop and implement a lean production process. The activities of this course are expected to

assist the student in making the transition from the classroom to positions of responsibility within a corporate setting.

A descriptive univariate analysis of the *PISQ-5d* was conducted by item. The data was found to be normally distributed. Next, items were summarized and standardized by the corresponding dimensions of professional identity to identify clusters of participants (groups) that reflected the traits of a particular professional identity status using a K-Means cluster analysis with five preset clusters representing the professional identity statuses found with a similar population of ET undergraduates [15]. Clusters were graphed using standardized scores for enhanced clarity and readability. Additionally, a paired samples T-test was conducted to compare means of the dimensions of professional identity status over time, which provided insight into the overarching research question of whether the ET capstone course experiences were significant in their professional identity development formation (changing of identity statuses over time). However, a specific curricular intervention was not the focus of this study at this time, and the results were not found to be significant.

Results

Affirmation (Pre: M = 4.57, SD = .66; Post: M = 4.59, SD = .63) was rated the highest overall dimension, with a slight improvement over time in mean value (post - pre = .02) which was the least change among all dimensions surveyed over time. This likely indicates that students continued to feel positively towards the dimensions of Affirmation throughout the course. High levels of *Affirmation* were previously found to be a significant correlate to recognizing oneself to becoming an ET professional [15].

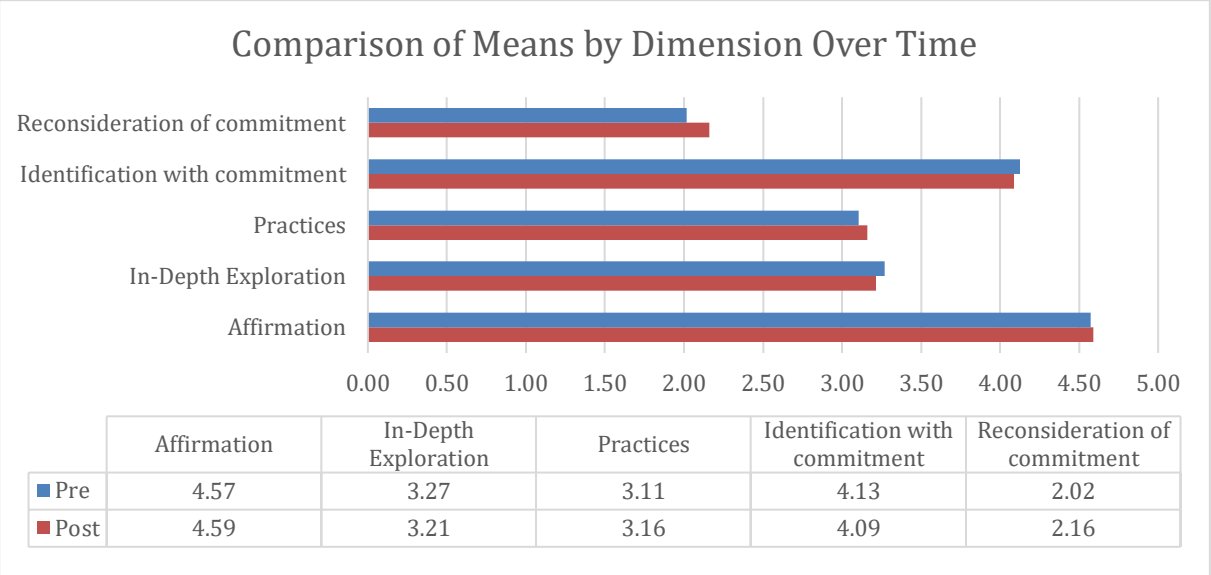
Identification with commitment was the second highest rated dimension, also found in both pre- and post-course surveys (Pre: M=4.13, SD=.81; Post: M=4.09, SD=.98). However, the net change was (-.04), meaning that students indicated they felt slightly less *Identification with commitment* than when they began the course. It is unclear from the study exactly why students overall reported less Identification with Commitment, but clues may be found in the lowest rated item (with the most variability in responses): *Thinking of myself as an engineering technology professional helps me understand who I am.* Students in *Diffusion* and *Foreclosure* status tended to indicate lower responses toward this dimension.

The next highest rated dimension was *In-depth exploration* (Pre: M=3.27; SD=1.5; Post: M=3.21, SD=1.46), with a net change of -.05 and had the most variability among students' responses. Indicators of *In-depth exploration* decreased over time. The lowest rated response was: *Do you ever wonder whether if a profession in engineering technology is the most suitable for you?* Students with lower responses tended to cluster into *Achieved* and *Moratorium* statuses, while those with high responses were in the *Foreclosure* and *Diffusion* groups, suggesting that those who felt more certain of the professional identity were less questioning of their choice.

Practices (Pre: M=3.11, SD=1.36; Post: M=3.16, SD = 1.32) increased by .05. This was likely because the capstone course has been intentionally designed to provide targeted ET professional development activities. Results from this dimension may provide some indirect assessment indicative of students' recognition of these efforts.

Reconsideration of commitment had the lowest overall rating (Pre: M=2.02, SD ; M=2.16, SD = 1.20) with a net change of .14. This was the largest change from the beginning to the end of the course and may be magnified by the low sample size of this study. Looking more closely into the data, the sole student who rated themselves high in this dimension was found to be in a Searching Moratorium status, meaning they are actively in the process of revising their professional identity, particularly as they also rated themselves high in other dimensions. Figure 1 illustrates how the dimensions of professional identity changed over time.

Figure 1. Comparison of Means by Dimension Over Time



	Affirmation	In-Depth Exploration	Practices	Identification with commitment	Reconsideration of commitment
Pre	4.57	3.27	3.11	4.13	2.02
Post	4.59	3.21	3.16	4.09	2.16

The survey instrument items are summarized pre- and post-course in Table 1.

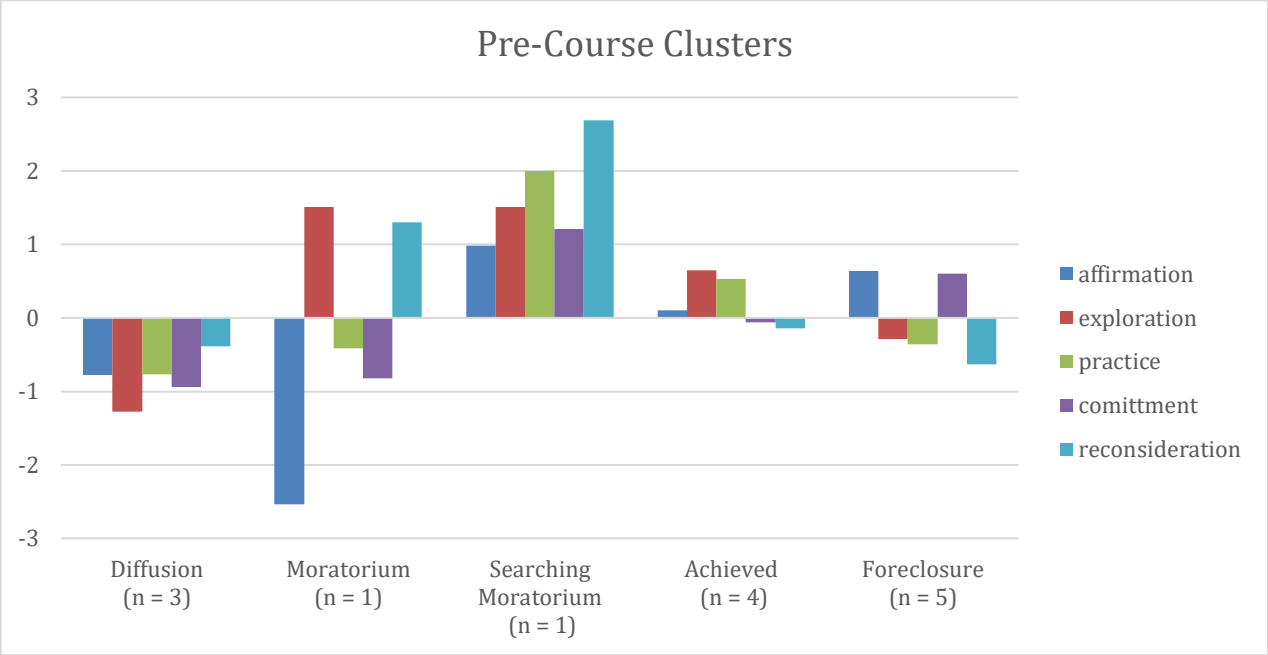
Table 1. *Pre-Post Survey Results of PIQ5-d*

Dimensions of Professional Identity	**PRE**		**POST**	
	M	SD	M	SD
Affirmation				
It is important is it for me to become an engineering technology professional.	4.79	0.58	4.79	0.43
I feel confident at this moment in time as a future engineering technology professional.	4.14	0.66	4.36	0.63
I am looking forward to becoming an engineering technology professional.	4.71	0.61	4.71	0.47
I am proud of becoming an engineering technology professional.	4.64	0.63	4.50	0.85
In-Depth Exploration				

Dimensions of Professional Identity	PRE		POST	
	M	SD	M	SD
Becoming an engineering technology professional is a concern for me.	3.64	1.69	3.64	1.55
Do you ever think about the advantages and disadvantages associated with becoming an engineering technology professional?	3.36	1.28	3.43	1.40
Do you pay attention to what other people think or say about engineering technology professionals?	3.21	1.53	3.14	1.23
Do you ever wonder whether if a profession in engineering technology is the most suitable for you?	2.86	1.56	2.64	1.60
Practices				
Do you ever watch videos or read books and/or articles written by engineering technology professionals?	3.14	1.10	3.50	1.16
Do you ever seek information about the different job options that a degree in engineering technology may offer?	3.79	1.12	3.79	1.12
Do you ever seek information about the trends, innovations, concerns of the engineering technology profession?	3.57	1.40	3.36	1.08
Do you ever participate in meetings and/or conferences where engineering technology professionals speak?	1.93	1.07	2.00	1.24
Identification with commitment				
Thinking of myself as an engineering technology professional helps me understand who I am.	3.86	1.10	4.00	1.04
Thinking of myself as an engineering technology professional makes me feel secure in my life.	4.14	0.66	4.14	1.10
Thinking of myself as an engineering technology professional makes me feel self-confident.	4.21	0.80	4.00	1.04
Thinking of myself as an engineering technology professional make me feel confident about the future.	4.29	0.61	4.21	0.80
Reconsideration of commitment				
If I could change my choice of becoming an engineering technology professional, I would.	2.43	1.45	2.57	1.34
Do you ever think that choosing a different profession would make your life more interesting?	1.79	1.31	1.86	1.10
Do you ever think that it would be better to prepare yourself for another profession?	2.00	1.24	2.21	1.25
I am considering the possibility of changing my university major to be able to practice another profession in the future.	1.86	1.23	2.00	1.11

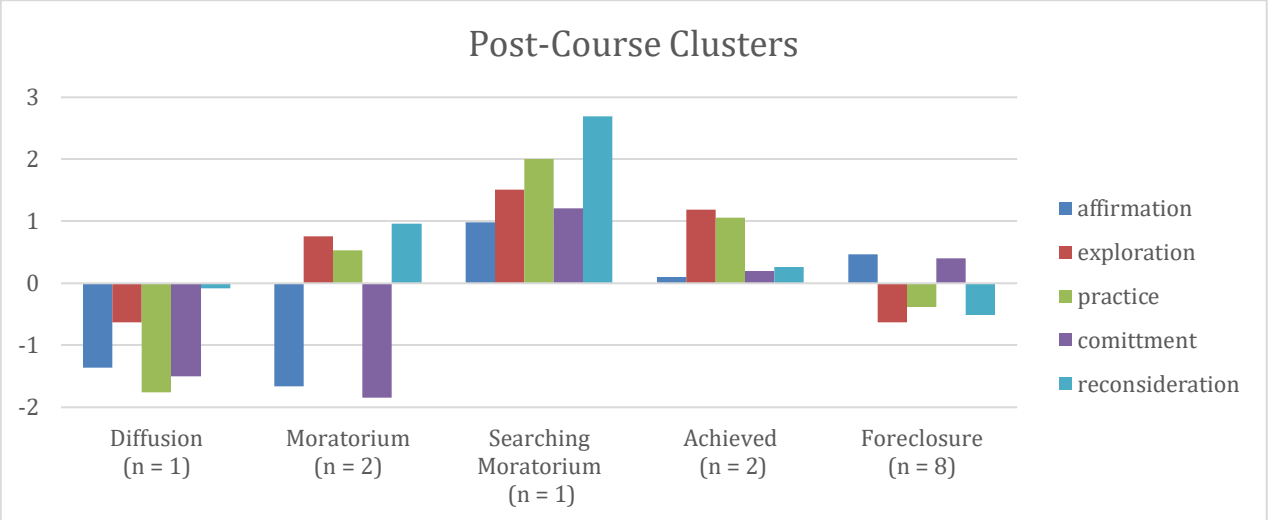
Based on the pre-course survey, five students were found to be in *Foreclosure* status, four students were in *Achieved*, three students were in *Diffusion*, one student was in *Moratorium*, and one student was in *Searching Moratorium* status as shown in Figure 2.

Figure 2. *Pre-course PIS Clusters*



As shown in Figure 3, post-course survey results indicated a net change of (+3) students in *Foreclosure* status, (-2) in the Achieved status, (-2) in Diffusion, (+1) Moratorium, and no change to total number of students in Searching Moratorium.

Figure 3. *Post-course PIS Clusters*



Recommendations

This study began by observing the results from a cross-sectional dataset, with plans for future longitudinal data collection. Next steps include continuing to collect data in subsequent semesters and courses, intending to make comparisons between different groups of ET students, courses, and interventions. The author intends to use these results to inform future practice and encourages others to do the same. The purpose of this study was to collect and analyze data that could begin to quantify a critical aspect of the goals of a particular course and the ET program itself: To ensure that students are adequately prepared to serve as professionals in engineering technology. Practitioners often scrutinize their curriculum and methodologies through self-reflection or rely heavily on qualitative feedback from students and other stakeholders to accomplish this. Also, results from diagnostics approaches like the one from this study may be helpful not only for course and instructor evaluation but also for program evaluation and accreditation. However, the author acknowledges that this study lacks deeper connections with the 'why'. Future work should seek to integrate more qualitative data to arrive at meaningful conclusions.

Additionally, future scholarship should explore relationships between curricular interventions, such as distinctive capstone projects, for example, and other elements of the curriculum and course structures to identify trends that will inform practice, especially given the finding from this study that ET capstone students believe: *It is important is it for me to become an engineering technology professional.* Finally, since a goal of identity-related research in ET education is to be able to make comparisons with conventional engineering or other STEM capstone experiences, the author recommends that future studies of this nature should consider this imperative.

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