



## Nascent Professional Identity Development in Freshman Architecture, Engineering, and Construction Women

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## Nascent Professional Identity Development in Freshman Architecture, Engineering, and Construction (AEC) Women

Increasing the persistence of talented women into male-dominated architecture, engineering, and construction (AEC) professions could reduce prevailing workforce shortages and improve gender diversity in AEC industry. Identity theorists advocate that professional identity development (PID) improves students' persistence to become professionals. However, little empirical research exists to inform and guide AEC educators and professionals on AEC-PID in undergraduate AEC women. As the preliminary part of a larger nationwide and longitudinal research study investigating PID processes in undergraduate AEC women, the objective of this research is to examine the characteristics and nascent AEC-PID in 69 women enrolled in freshman AEC courses in five U.S. institutions. A purposive sampling approach ensures participants have a wide range of demographic characteristics. Data from a recruitment survey is analyzed using the NVivo qualitative data analysis software. Content and relational inductive open coding are conducted vertically for each participant and horizontally across different participants.

Results indicate passion/interest, inherent abilities, significant others, benefits from industry, and desire to contribute to industry influence decisions to pursue AEC careers. With 52% of participants having science, technology, engineering, art, and math (STEAM) subject preferences, an *in vivo* code, *Perfect Middle Ground*, demonstrated the quest to combine STEM and visual art preferences in AEC career decisions. A participant noted that 'this major (civil engineering) is the *perfect middle ground* because I can be creative, but still use my strong gift which happens to be math'. Girls with STEAM strengths and passion, particularly in math and fine art, are most likely to develop nascent AEC-PID. Beyond STEM pre-college programs, AEC educators should consider recruiting from sports, as well as visual and performing arts events for pre-college students. Participants' positive views focus on the importance and significant societal impact of the AEC industry; while, negative views focus on the lack of gender and racial diversity. A combination of participants' AEC professional experiences and views reveal four increasing levels of nascent AEC-PID which are categorized as the 4Ps: *Plain, Passive, Progressive, and Proactive*. As a guide to AEC education and professional communities, recommendations are made to increase the AEC-PID of women in each category. With the highest nascent AEC-PID, women in the *Proactive* category should serve as leaders in AEC classrooms and student organizations. Considering their AEC professional experience and enthusiasm, they should serve as peer mentors to other students, particularly AEC women. Furthermore, they should be given the opportunity to step into more complex roles during internships and encouraged to pursue co-op opportunities.

Insights can guide more targeted recruitment, mentoring, preparation, and retention interventions that strengthen the persistence of the next generation of AEC women professionals. In the long term, this could reduce AEC workforce shortages, improve gender diversity, and foster the innovation and development of more gender friendly AEC products and services.

### Introduction

An 11% construction employment growth from 2016 to 2026, making the severe workforce shortages of the construction industry a nationwide crisis (Building Design and Construction,

2016; U.S. Department of Labor, 2018; McGraw Hill Construction, 2012; Choi, Shrestha, Lim, & Shrestha, 2018). Although women talents could contribute to resolving this national crisis, according to United Nations Educational, Scientific and Cultural Organization (2017), women continue to remain the most untapped population for the next generation of STEM professionals. In fact, the National Association for Women in Construction (NAWIC, 2018) reported that women make up 9% of the construction workforce, and women professionals are only 2.8% of this workforce. Considering that over 50% of the world's population is made up of women, the stronger persistence of women into the AEC profession could reduce workforce shortages, improve gender diversity, and enhance the innovation and development of more gender friendly AEC products and services. Women underrepresentation in engineering and technology professions is not due to their lack of cognitive ability, but as a result of the socialization and learning processes which influence their identities and career choices (Ofori-Boadu, 2018a; Ofori-Boadu, 2018b; Porter & Ofori-Boadu, 2018). Cultural stereotyping and negative imagery such as dirty hands, old boys' network, and negative female images discourage younger girls from making career choices that lead into male-dominated STEM professions (Phipps, 2001). While wide gender gaps in STEM fields such as biology no longer exist, women are still underrepresented in AEC professions. Interventions that improved women's participation in some STEM professions may not have been as effective with AEC professions, because they are not robust enough to overcome the unique characteristics of the AEC profession.

Undergraduate AEC programs to include architectural engineering, civil engineering, and construction management prepare students to work in the innovation, development, and management of buildings and structures. In addition to AEC curriculum, extracurricular programs strengthen pre-college and college interests and persistence into AEC careers (Ofori-Boadu *et al.*, 2019a; Ofori-Boadu *et al.*, 2019b; Ofori-Boadu *et al.*, 2019c; Ofori-Boadu *et al.*, 2017). Effective and targeted transformations in AEC educational and professional environments could improve female PID and persistence into AEC professions (Ofori-Boadu *et al.*, 2019a; Ofori-Boadu *et al.*, 2019b). However, very little is known about PID in undergraduate AEC women who are in the process of becoming AEC professionals. There is minimal empirical knowledge to guide decision makers in targeted strategies that will strengthen AEC-PID in undergraduate women. The current theory-practice gap which exists in many male-dominated undergraduate programs can be bridged with PID research on the process of internalization whereby undergraduate women students come to think, act, and feel like professionals.

## Theoretical Framework

The theoretical framework for this research has its foundation in psychology and sociology literature (Burke & Stets, 2009). Identity theorists advocate that an understanding of PID processes lead to targeted policies and programs that improve students' persistence into various professions. PID is the process by which students come to think, act, and feel like professionals (Cruess *et al.*, 2015). It is the successful integration of personal attributes and professional training in the context of a professional community. It is an ongoing process of interpretation and re-interpretation of experiences which allow the strengthening and maturing of an individual through a series of processes of professional education and experiences (Beijaard, 2004; Kerby, 1991; Kogan, 2000). Multiple factors within and outside the educational and professional

environment impact the evolution and progression of an individual's professional identity (Cruess *et al.*, 2015).

Researchers have examined how students view themselves as participants in various STEM programs and how various constructs interact to contribute to students' PID (Capobianco, 2006; Ofori-Boadu, 2018b). The professional identities of students enrolled in specific STEM programs is constantly evolving as a result of students' multiple self-identities that interact with academic and professional environments (Capobianco, 2006). Gee (2001) highlights the four perspectives of identity to include: (1) nature identity; (2) institution identity; (3) discourse identity; and (4) affinity-identity. Gee's model guides investigations on how students' multiple identities interact with academic and professional programs and institutional contexts as students mature and transition to think, feel, and become professionals. Helm (1998) emphasizes that the beliefs, values, wants, and views of individuals regarding what they want to become influences how they interact with those structures and contexts. Identity development is also influenced by cultural and social environments as individuals are shaped by the structures, forms, activities and events that occur within these environments (Holland *et al.*, 1998). Conceptually, PID is congruent with the processes that affect the personal identity development of individuals as they progress through life and continuously organize their experiences into a meaningful whole that incorporates personal, private, public and professional identities (Cruess *et al.*, 2015; Piaget & Inhelder, 1969; Kohlberg, 1984; & Kegan, 1982). The complex identity formed as individuals progress from infancy into adulthood is represented by individual, relational, and collective domains (Vignoles, Schwartz, & Luyckx, 2011). The individual domain focuses on personal characteristics and beliefs, the relational refers to influence from significant individuals like family and friends, and the collective domain reflects on the impact of social groups to which an individual belongs (Cruess *et al.*, 2015).

Drawing from these theoretical foundations, it can be inferred that some undergraduate AEC women may begin their nascent AEC-PID process even before they enroll in an undergraduate AEC program. While this AEC-PID may be weak, it is the source of inspiration that influences AEC program enrollment. Nascent AEC-PID may be influenced by pre-college STEM and AEC knowledge, strengths, experiences, views, and values. Following enrollment, AEC women begin to interact with new academic, professional, and institutional AEC environment. Interactions evolve among multiple identities during the formative years and progresses over time until a more mature AEC professional identity is developed (Ofori-Boadu *et al.*, 2019a). Students who do not have an effective PID progression usually will exit the AEC environment for other options. The PID process is complicated by negative environmental factors which influence the progression and participation of women in male-dominated AEC disciplines. Women often have to employ various strategies and tactics to construct their professional identity and cope in male dominated cultures (Hatmaker, 2013). Negative imagery and cultural stereotyping have a negative impact on the decisions made by young girls and women and limits their career choices into male dominated professions (Phipps, 2002). While research on the interactions between gender and STEM identities have contributed to improvements in women representation in STEM, women are still underrepresented in the AEC profession (Brickhouse, Lowery, & Schultz, 2000; Brickhouse, 2001; Chinn, 2001, Capobianco, 2006; NAWIC, 2018). The AEC educational and professional community is seeking for strategies to increase women participation. However, there is little empirical knowledge of the characteristics and nascent

AEC professional identities of undergraduate AEC women. Insights could shed light on how academic and professional environments can be transformed to strengthen AEC-PID and persistence of undergraduate women into male-dominated AEC professions.

### Objectives

As the preliminary part of a larger nationwide and longitudinal research study investigating PID processes in undergraduate AEC women, the objective of this paper is to examine the characteristics and nascent AEC-PID in 69 women enrolled in freshman AEC courses in five U.S. institutions. Nascent is defined as ‘just coming into existence and beginning to display signs of future potential, especially of a process or organization’ (Lexico, 2020). By enrolling in undergraduate AEC programs, all RPs demonstrated nascent AEC professional identities of thinking, acting, and becoming AEC professionals. It is assumed that RPs with pre-college AEC professional experience and views would demonstrate the highest level of nascent AEC-PID. Therefore, a combination of AEC views and professional experiences could be used to categorize nascent AEC-PID in undergraduate AEC women.

### Method

The research in this present paper reports on preliminary findings from a larger research study investigating AEC-PID processes in undergraduate AEC women. The overall goal of this four-year Institutional Review Board (IRB) approved longitudinal research study is to construct grounded theories that explain AEC-PID processes in undergraduate AEC women. Research participants (RPs) are undergraduate AEC women enrolled in freshman AEC programs in five U.S. institutions which are diverse in location, predominantly white institution (PWI)/historically black college/university (HBCU) status, accreditations, and AEC programs. Purposive maximum variation sampling is used to obtain a broad range of undergraduate AEC women. Data sources are primarily interviews and surveys.

The Grounded Theory (GT) method is selected over ethnography and phenomenology qualitative methodologies because it is cheaper and allows the use of iterative, inductive and interactional processes of data collection with simultaneous analysis and emergent interpretation for constructing theories from empirical data when a theory is not available to explain the process that occurs with time (Charmaz, 2006; Charmaz, 2014). GT surveys, interviews, and document reviews provide detailed descriptions of situations, events, people, interactions, and behaviors. Drawing from the sensitizing concepts, and the relativist ontology, constructivist worldview, and interpretivist epistemology, the constructivist GT methodology was preferred to the alternative positivist classic Glaser and Strauss GT method (Charmaz, 2014; Glaser & Strauss, 1967; Groen, 2017; Groen *et al.*, 2018; Groen *et al.*, 2017; Grounded Theory Online, 2018).

In this paper, 69 RPs completed recruitment surveys which requested demographic information to include age, GPA, race, annual household income, household size; favorite subjects; leadership and student organization experiences; AEC industrial experiences; country of birth; current extracurricular activities; AEC views; and rationale for AEC enrolment. Data from multiple-choice and open-ended questions are analyzed using the NVivo qualitative software and Microsoft Excel software. Content and relational inductive coding are conducted within each

participant and across different participants. Although very limited, RPs with missing data for specific survey items are excluded during the analysis of that particular survey item.

## Results and Discussions

### *Characteristics of undergraduate AEC women enrolled in freshman AEC courses*

Most of the RPs (98.55%) are between 18 and 25 years old. This suggests that compared to older women, younger women who are directly from high school or recent transfers from college or university programs, are more likely to enroll in AEC programs. African Americans and Whites are 50.72% and 36.23% of RPs respectively. Asians and American Indians/Native Alaskans are 8.70% and 4.35% respectively. Most (95.65%) of the RPs were born and have lived mostly in the United States. The racial diversity in the research population reflects racial distribution in the U.S. population. Table 1 shows that various financial backgrounds are represented in this study with the highest percentage (29.23%) from households with annual income exceeding \$101,000.

Table 1. Annual Household Income

Annual Household Income (\$)	≤\$25K	\$26K-\$50K	\$51K-\$75K	\$76K-\$100K	\$101K≤
Percentage of RPs (%)	18.46	12.31	23.08	16.92	29.23

With almost 70% of RPs being from households with income being greater than \$50,000, there is a strong indication that women from middle and high income households are likely to enroll in AEC programs. This is in agreement with the Association of American Colleges and Universities (AACU, 2018) that emphasizes that family income impacts educational enrollment and attainment. Nevertheless, the spread across various household income ranges is reassuring and demonstrates that financial resources are available for women from lower income households. Most RPs are from three to four person households (Table 2). This is slightly different from the 2019 U.S. household distribution which had only 27% of U.S. households being three to four persons, with one to two person households making up 62% of U.S. households Statista (2020). In contrast with Statista (2020) which had 8% of U.S. households being five to six person households, 34.85% of RPs were from five to six person households.

Table 2. Household Size

Number of household members	≤ 2	3 - 4	5-6	7-8	9 ≤
Percentage of RPs (%)	13.64	50.00	34.85	1.52	0.00

Most (75.81%) of the RPs had GPAs ranging from 3.5 to 4.0. This is expected because most AEC programs require high GPA for undergraduate AEC enrollment. Majority (72.46%) of the RPs did not indicate any political affiliation. It is unclear whether they are truly not politically affiliated or just declined to share that information. The rest of the RPs are Democrats (15.94%), Republicans (5.80%), Liberals (4.35%), and Conservatives (1.45%).

AEC Programs: Figure 1 shows that 27.54% of the RPs are enrolled in civil engineering programs, and closely followed by 23.19% in architecture. Also, 44.93% are enrolled in architecture related programs and 57% in engineering programs. Women are better represented

in architecture and engineering programs, but underrepresented in construction management. Approximately 14.49% of the RPs are enrolled in dual degrees indicating high intellectual capacity as most institutions have higher requirements for enrollment in dual degree programs.

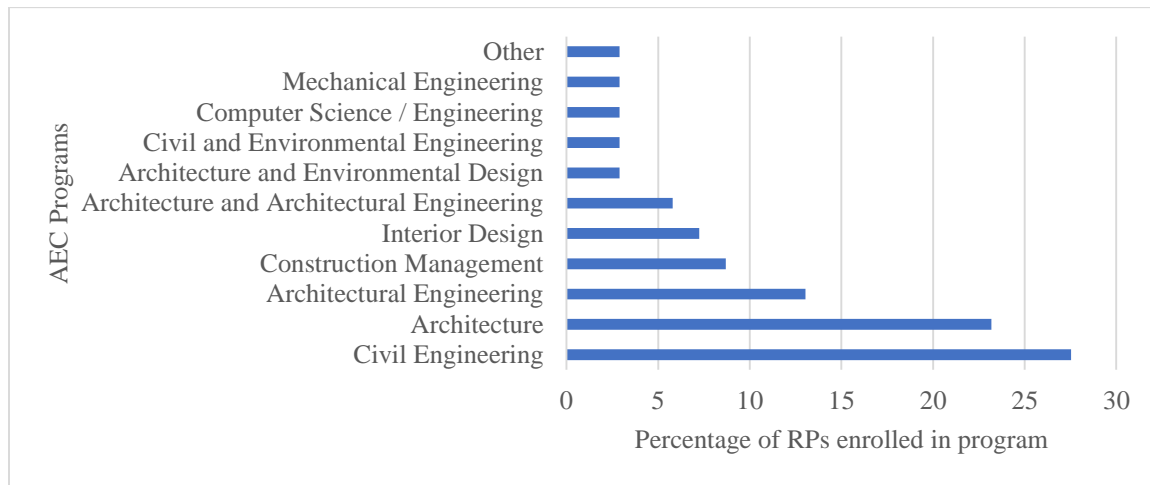


Fig. 1. AEC Programs

**Favorite subjects:** Math emerged as the most favorite subject as shown in figure 2, with 69.57% of the RPs and 94.44% of RPs in engineering programs selecting math as their favorite subject. Although math is a requirement for all AEC majors, 30.43% of the RPs did not consider math as a favorite subject. While a few of the RPs with lower preference for math are enrolled in civil engineering programs, most of them are in interior design, architecture, and construction management programs which have lower math requirements. This does not necessarily mean that these RPs did not excel in math; it just means math is not their favorite subject.

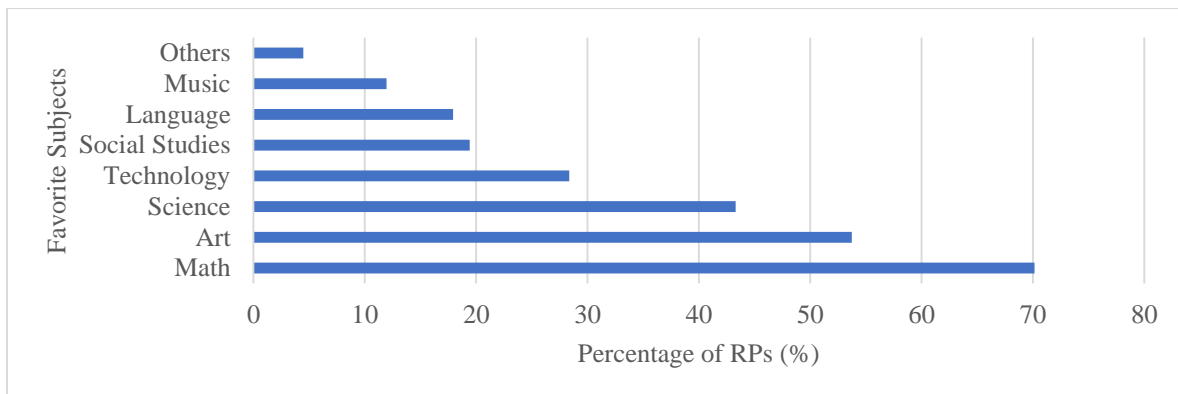


Fig. 2. Favorite Subjects

Art emerged as the second most favorite subject with 53.62% of the RPs indicating that art is their favorite subject. Most of these RPs are enrolled in architecture, interior design, and civil engineering programs. The design requirements of these programs are high and so it is reasonable that women with preference for art are enrolled in these programs. Surprisingly, 25.81% of RPs enrolled in architecture related programs and 20% enrolled in interior design programs did not select art as a favorite subject. Considering that art and design are key components of these programs, follow up studies will assess their experiences in these programs.

Only 43.48% of the RPs consider science as a favorite subject. Majority of RPs with science as a favorite subject are in civil engineering, architectural engineering, and architecture programs. Surprisingly, only 55.56% of RPs in engineering programs consider science as a favorite subject. Whereas low favorite status does not mean that RPs did not excel in science, it can be agreed that higher favorite status could improve performance. Research in STEM teaching innovations can strengthen science and mathematics subject preferences in pre-college and college women.

Religious Affiliation: Figure 3 shows that majority (60.87%) of RPs identify with Christianity, with majority being Catholics and Baptists. Religious diversity in this population contribute to the diverse perspectives that inform the findings from this research study.

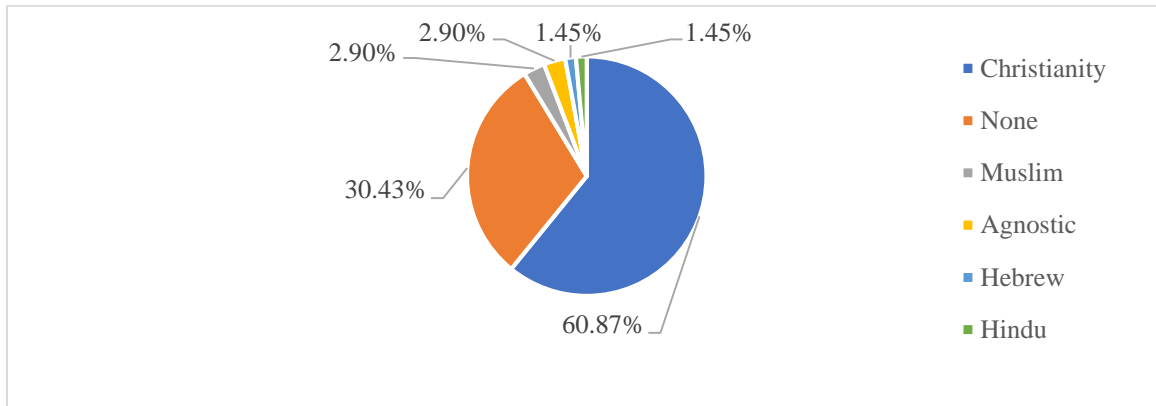


Fig. 3. Religion

Extracurricular Activities: Some RPs are members of student organizations (49.23%), serve as student leaders (51.56%), and have some AEC experiences (29.85%). Figure 4 shows that 69% of RPs are currently engaged in a variety of extracurricular activities with the average RP having 1.57 extracurricular activities and one RP having as many as seven commitments. Extracurricular commitments were mostly initiated through family networks, student organizations, and community engagements. Notably, 27.54% are engaged in AEC related activities to include Habitat for Humanity, Society of Women Engineers (SWE), American Society for Civil Engineers (ASCE), International Design Interior Association (IDIA), National Association of Women in Construction (NAWIC) and the National Association of Home Builders (NAHB). Civil engineering women are the most involved in extracurricular activities.

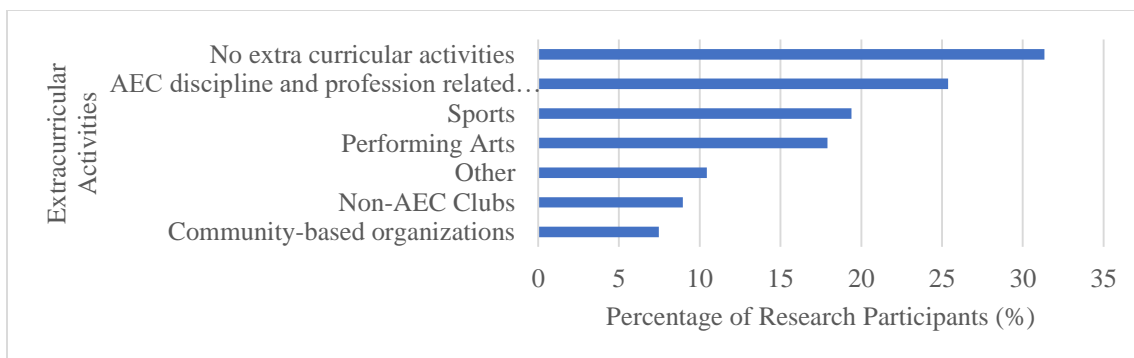


Fig. 4. Extracurricular Activities



RPs (18.84%) are involved in sports to include basketball, soccer, and tennis. Also, 17.39% are engaged in performing arts activities to include choir, poetry and dance. Notably, 10.45% of the RPs are involved in dance activities to include Ballet and Zumba. In addition to recruiting from pre-college STEM related programs and schools, AEC educators and administrators should seriously consider recruiting students from sports and performing arts events and organizations, as AEC students enjoy physical, outdoor, hands on, fun, and creative activities.

Decision to enroll in undergraduate AEC program: Five themes emerged from RPs responses to rationale guiding their decisions to enroll in undergraduate AEC programs as shown in figure 5. RPs expressed strong passion and interests in AEC professions. Their interests emerged from prior exposure to the AEC industry through sources such as HGTV television programs.

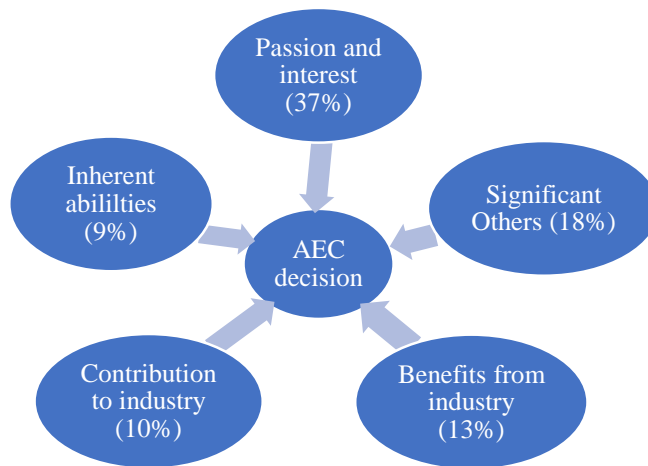


Fig. 5. Decision to enroll in undergraduate AEC programs

Significant others with some associations with the AEC industry influenced some RPs' decisions, while others were motivated by the desire to benefit from the industry through professional development and compensation. The desire to contribute to the industry by building structures, controlling environmental impacts, helping others, and improving gender diversity motivated some RPs to pursue AEC degrees. Also, some RPs pursued AEC degrees as a result of their inherent abilities to include problems solving, creativity, and hands on skills.

Views about AEC industry: While 22.39% of RPs expressed no views about the industry, many RPs expressed both positive (50.75%) and negative views (49.25%) about the AEC industry. Positive comments noted that it is a great and growing industry (31.34%), has a high impact on everyday lives, tasks, and global societies (10.45%), and presents lots of opportunities (8.96%). An RP stated that 'I think the AEC industry is essential to the way we all live our lives and do everyday tasks.' Several RPs are excited about the creative, innovative, and collaborative aspects of the AEC industry and the potential for their generation to contribute to this industry. An RP noted that 'I believe that the AEC industry will improve over the years because of my generation having more technology and techniques to understand the materials and how we can change things.' Similar comments demonstrated RPs' high levels of self-efficacy and strong nascent AEC professional identities with the zeal to obtain an education that will ensure positive transformations in the AEC industry. RPs also liked the fact that AEC professionals enjoy and see the fruit of their labor. Negative comments are associated with the lack of racial (7.46%) and

gender (41.79%) diversity. An RP from an HBCU noted that the AEC industry is ‘an amazing and constantly growing industry, but there is a lack of diversity with race and gender.’ Interestingly, a few RPs indicated that they were unaware of the low gender participation until they started taking undergraduate AEC courses. Nevertheless, the RPs expressed the hope that the number of women in the AEC profession will increase as they will continue to work hard to increase women representation.

Nascent AEC-PID Categories (4Ps): As shown in figure 6, the combination of RPs’ AEC professional experiences and views of the AEC industry is used to develop four increasing levels of nascent AEC-PID categories captioned as the 4Ps: (1) Plain; (2) Passive; (3) Progressive; and (4) Proactive. As a guide to AEC education and professional communities, recommendations are made to increase the AEC-PID of women in each category.

The **PLAIN** category comprises of 20.90% of RPs. These women have no AEC experience nor any clearly stated AEC views and so have the lowest nascent AEC-PID. They have enrolled in AEC programs and envisage themselves as having sufficient pre-requisite knowledge, skills, and abilities to successfully progress and graduate to become AEC professionals. AEC women who fall in this category will need additional resources and support from AEC educational institutions to nurture their initial interest and knowledge of the AEC industry to increase their AEC-PID. For example, AEC educators can encourage them to explore AEC publications, videos, websites, and projects to increase their AEC knowledge. Field trips, laboratory, internship, and hands on projects can increase their AEC experience. Also, they should be given opportunities to participate in AEC extracurricular activities and student organizations as these could increase their AEC knowledge and views through their exposure to other AEC students and professionals.

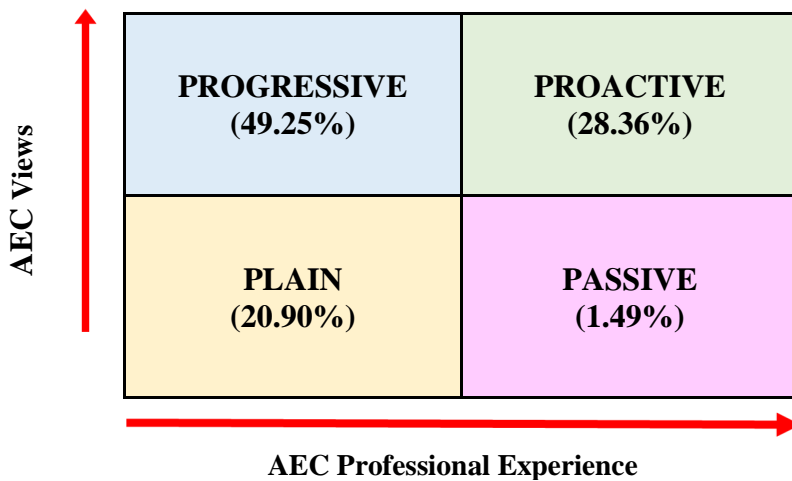


Fig. 6. Nascent AEC-PID Categories

The **PASSIVE** category has the lowest RP representation (1.49%) for women with some AEC experiences, but no AEC views. They are considered passive because it is expected that typically a student with AEC experiences should be capable and willing to share their AEC views. Consequently, they have the second lowest nascent AEC-PID. It is not clear why they appear unenthusiastic about sharing their AEC views. Future research should focus on why they have

AEC experiences, but are unwilling to share AEC views. This will provide insights that could help strengthen their AEC-PID. These women will need additional mentoring and encouragement from AEC educators and professional organizations to strengthen their enthusiasm about the AEC profession. They should be assigned female AEC student, faculty, and professional mentors. Lastly, they should be encouraged to join AEC women student and professional organizations such as the National Association of Women in Construction (NAWIC) to increase their interactions with other AEC women communities.

The **PROGRESSIVE** category represents majority of the RPs (49.25%). They did not have any AEC experiences, but shared some meaningful views about the AEC industry. They demonstrated the second highest level of nascent AEC-PID. Majority of RPs fell into this category and they are described as progressive because their lack of AEC experience does not hinder them from sharing their AEC views. Their limited AEC views are drawn from knowledge and understanding gained from the classroom, professors, peers, observations, books, student organizations, media, and the internet. Consequently, their comments are general statements about the growth, opportunities, collaboration, technology usage, and environmental aspects of the AEC industry; as well as regarding the lack of gender and racial diversity. One RP stated that ‘I think that it (AEC industry) can get political especially dealing with environmental issues.’ Another RP responded to the survey item after conducting an internet search on the AEC industry. This is commendable because she knew she did not have any AEC views, and went an extra mile to conduct some research on the AEC industry. In her own words, she stated that ‘after doing some research on what the AEC industry was and what they offered, I was interested in the collaborative spirit within each of the groups to carry out and achieve a project larger than themselves separately.’ RPs in this category expressed great enthusiasm about becoming AEC professionals and are excited about the changes that they would contribute to the AEC industry and profession. These women are ready to learn and progress in the profession. AEC professors and administrators should encourage these women to pursue internships in order to gain AEC experiences. They should also be encouraged to join AEC student clubs and organizations so that they can increase their knowledge and understanding of the AEC industry through interactions with other AEC students and professionals.

The **PROACTIVE** category represents RPs (28.36%) with AEC views and AEC professional experiences. They demonstrated the highest nascent AEC-PID. They mostly gained access to industrial experience opportunities through teacher and family networks. As result of these experiences, some of these RPs shared specific personal experiences and observations of the AEC industry. An RP stated that ‘I already know from an internship I did in my senior year of high school, I enjoy smaller offices because it is more personal and your ideas carry through.’ Her comment provided her perspective of one critical decision students have to make when trying to select the best internship among several opportunities. Do I intern with smaller or larger organizations? Her statement is not a general statement as observed with RPs in the Progressive category. It is very specific and related to her learning experience during her internship. This prior AEC experience had shaped her views and strengthened her AEC-PID as indicated by her expressing that she did enjoy small offices and that her ideas are more likely to be implemented in that environment. This category provides the strongest nascent AEC-PID as the RPs identified strongly enough with the AEC profession to obtain professional experiences prior to even beginning their AEC undergraduate education. Furthermore, these RPs are not discouraged by

the male-dominated environment that they experienced while working in the AEC industry, but have persisted to enroll in undergraduate AEC programs to become AEC professionals. With the highest nascent AEC-PID, women in the *Proactive* category should be given opportunities to serve as leaders in AEC classrooms and student organizations. Considering their AEC professional experience and enthusiasm, they should be encouraged to serve as peer mentors to other students, particularly AEC women. Lastly, they should be given the opportunity to step into more complex roles during internships and encouraged to pursue co-op opportunities.

*Perfect Middle Ground*: An in vivo code, *Perfect Middle Ground*, emerged as a key theme associated with several RPs committed to the quest to pursue a profession that required both STEM and Arts (STEAM) strengths. This is one of the distinct uniqueness of the AEC profession as it draws heavily from scientific and art disciplines as applied in the innovative and effective design and construction of buildings and infrastructure. One RP captured this theme beautifully in her statement that ‘this major is the *perfect middle ground* because I can be creative, but still use my strong gift which happens to be math’. Approximately 11% of the RPs made similar direct statements regarding their preference for careers that will require them to utilize both their STEM (logic and facts) and Arts (creativity) strengths. A further examination of the favorite subjects confirmed that several RPs had multiple favorite subjects, with majority (52%) falling into the STEAM category. They showed a strong preference for at least one STEM subject and fine Art, with 31.88% indicating that both math and art are their favorite subjects. They also enjoy sports, visual and performing arts activities (Figure 4). AEC communities should target girls who have strengths and preferences for STEAM subjects, particularly math and art. These girls are likely to have the strengths and passion needed to get enrolled in an undergraduate AEC program and successfully transition into the AEC profession. Beyond STEM pre-college programs, AEC educators should consider recruiting from sports, as well as visual and performing arts organizations for pre-college students (Figure 4).

## Conclusion

As part of a longitudinal research project investigating AEC-PID processes in undergraduate AEC women in five participating U.S. institutions, this paper summarizes findings from the analysis of surveys completed by 69 AEC women. The key findings are as follows:

- Compared to construction management, AEC women are better represented in architecture and engineering programs;
- The characteristics of AEC women include preference for STEM and Art subjects, high GPAs, middle and high household income, medium-sized households, and some religious and political affiliations. They participate in extracurricular activities which are mostly physical, creative, hands on, and outdoor to include sports, dance, and AEC student organization activities;
- The in vivo code, *Perfect Middle Ground*, demonstrated the quest to combine math and fine art subject preferences in AEC career decisions;
- The four increasing levels of nascent AEC-PID categories (4Ps) are Plain, Passive, Progressive, and Proactive with majority of AEC women falling in the Progressive category and the Proactive category having women with the highest nascent AEC PID. Well-designed interventions can be effective in increasing the AEC-PID of women in each category;

- Girls with STEAM strengths and passion, particularly in math and art are likely to develop AEC-PID. Beyond STEM programs, AEC educators should consider recruiting from sports, as well as visual and performing arts events for pre-college students;
- Undergraduate AEC women are aware of the importance of the AEC industry and its impact on the society, culture, and environment. However, they are concerned about the lack of gender and racial diversity.

Insights can guide AEC educators and administrators towards more targeted recruitment, mentoring, preparation, and retention interventions that strengthen AEC-PID and the persistence of the next generation of AEC women professionals. Specifically, findings can assist current and future AEC educators and administrators develop and modify academic programs, curricular, teaching methods, institutional environments, and best practices. Findings contribute to identity development and diversity theories that can guide AEC educational program and policy development and improve women representation in AEC professions. Future work involves investigating PID of these women as they transition from the freshman year into senior year, and then in to the AEC industry. In the long term, improved PID processes in AEC women students could improve their persistence; and, this would in turn reduce AEC workforce shortages, improve diversity in the AEC profession, and foster the innovation of gender friendly AEC products and services.

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