

Identity in Practice: Reflections from Malaysian Women who are Practicing Engineers

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Abstract. *Female representation in the Malaysian engineering workforce ranges from 46% (public sector) and 51% (private sector) and stands in marked contrast to the systematically low proportions of women working as engineers in the United States. This paper explores how female Malaysian practicing engineers view their identities as practicing engineers and how their descriptions differ from the engineering identities described by women in the U.S. Initial analyses suggest that Malaysian women engineers do not perform the same type of professional identity negotiation as their counterparts in the U.S. Our initial findings also suggest that while engineering as a field in Malaysia is gender typed as masculine, female engineers wield their professional identities to address gendered workplace challenges differently than women in the U.S. Findings presented here are part of a larger study that seeks to understand why women pursue and persist in engineering as a curricular and career choice.*

Introduction and motivation

Interestingly, Malaysian practicing engineers boast approximately 46% women in the public sector and 51% women in the private engineering manufacturing, and construction work sector (MWFCD & UNDP, 2014). While there have been a handful of studies attempting to explain the high number of women in computing in Malaysia (e.g., Lagesen, 2008), there are very few studies describing women in engineering in Malaysia, and fewer still provide insights about engineering identity. On the other hand, the U.S. context and other western industrialized economies all have similarly low proportions of women working in engineering (Charles & Bradley, 2009). Despite decades of research and millions of dollars in investment, women in the United States continue to be significantly under-represented in engineering at both the undergraduate, graduate, and workforce levels. Although women graduate with approximately 20% of engineering degrees, in the U.S. many drop out of engineering practice in particular, citing factors like feeling marginalized in the engineering workplace (e.g., Seron, Silbey, Cech, & Rubineau, 2016) and a mismatch between their identities and the acceptable engineering identities in the workplace (Faulkner, 2000; Hatmaker, 2013; Atiq, Morton, Ater Kranov, Kmec, & DeBoer, 2018) contexts would benefit from study of women's engineering identity in a space where they are well-represented.

Recognizing the salience of identity, we ask the following research questions: *(1) How do Malaysian women practicing engineers describe their engineering identity?* We report four themes that have emerged from our analysis that illustrate women's identity as practicing engineers. In our discussion of each of these four themes, we provide context to respond to the question, *(2) Further, how do the themes that characterize women's engineering practice identity(ies) differ from identities described in the United States and other high income North American and Western European contexts, where much of the work on engineering identity has been focused?*

Literature Review and Conceptual Framework

We contribute to the existing literature, which has thus far largely come from the perspective of the U.S. and the high-income western high-income countries, that discusses gendered identities in engineering by querying identities in engineering work for women in Malaysia. In addition to contributing to a richer, more cross-nationally and cross-culturally representative theoretical base, practical implications of this study can inform novel supports for women in engineering in numerous contexts. Our project's high-level research aim is to understand the macro- and micro-facilitating conditions that enable the high level of participation in engineering by women in Tunisia, Jordan, and Malaysia. By understanding the conditions that make such high participation of women across engineering fields and sectors (academia and industry) possible, both interventions to support women's participation and research into gender in engineering can be more appropriately complexified. In Malaysia, women represent a high share of engineers, including both engineers in academic institutions and industry – approximately 45% overall (UNESCO Institute for Statistics - *Global Education Digest*, 2008). Of related interest in the case of Malaysian women's representation in STEM are the gender ratios in the computer science and IT sectors of Malaysian industry. According to Seymour & Hewitt (1997), women represented 65% of the students at the School of Computer Science at Universiti Sains Malaysia (USM) and 66% of the students in Computer Science and Information Technology at the University of Malaya during the academic year 2001-2002. Studies of these proportions argue that they relate to a favourable socio-political environment that supports the rearrangement of social, political, gender and ethnic identities at play in the country (Goh, 2002; Gomes & University, 1994; Kahn, 1992).

Lagesen (2005) further asserts that one possible explanation for the case of Malay women's high representation in computer science is the historical existence of race-based policies, specifically a quota system of policies initiated in the 1970s. This quota system originated in what was controversially termed the *bumiputera* policy, a policy written into the constitution

that defined a special position for “Malay” or indigenous peoples. The policies include practices by which Malaysians of Chinese and Indian descent are disfavored on the grounds of race while the *bumipeteras* (“sons of the soil”) are constitutionally afforded special rights and privileges. What is more, these race-based politics specifically discriminated against Chinese and Indian women (Luke (2002), Lagesen (2005), Ng (1999) and Ng and Shanti (1997)). . As summarized by Mellström (2009): “race becomes a more pertinent and pervasive social category than gender, and it possibly and somewhat paradoxically operates more effectively to include women than many other inclusion strategies that have tried thus far” (p.893). This statement is echoed by the work of a number of scholars of Malaysian history and culture who assert that gender politics in Malaysia has always been superseded by race (Ng & Shanti, 1997). Some of these policies continue to be debated, and changes have been made in some educational practices, yet the historical legacy of race-based politics remains influential in Malaysian culture where the ethnic label determines many social and political rights (Nagata, 1996; Liu, Lawrence, Ward, & Abraham, 2002) In such a diverse ethnoscape, one should be cautious when using Eurocentric or Western feminist lenses with regards to Malaysian women and girls. In fact, Joseph (2000) argues that most often, such analyses fail to recognize the complexity of Malaysian society.

Other scholars attribute the gender balance in technical fields in Malaysia to an occupational or sector-based gender segregation. Occupational gender segregation in Malaysia distinguishes between a political bureaucracy that is heavily male-dominated and a nationalism that reflects a more global and western corporate masculinity (Cornell, 2001). These two macro-identities stand in contrast, and Mellström (2009) concludes that the traditional relational notion of masculinity and its realization in political and social hierarchies opens space for women’s participation in the sphere of newly industrializing nation such as Malaysia.

In our study, we specifically build on work on engineering identity and two potentially competing dualities. On the one hand, (Ng, 1999) shows that professional and gender identities stand in contrast and conflict with each other. In particular, female engineer’s professional identities are not gender-neutral—they are women first, engineers second (Faulkner, 2009; Hatmaker, 2013). Specifically, Hatmaker (2013) finds that workplace interactions marginalize women’s professional identities and highlight their gender identities, a process that leads to women’s self-management of the professional impression they make on others and one that takes a substantial professional and personal toll on women impressions of them. IN this study, we investigate whether professional and gender identities for Malaysian women (hereafter professional engineers or PEs) are similarly disjoint. In addition, we query Faulkner (2007)’s competing concepts of engineering identity as “technicist” vs. “heterogenous” or “technical/social dualism”. We investigate whether we see one, both, or neither in respondents’ descriptions of their engineering identities.

Faulkner (2009) provides a helpful overview of engineering identity research, and multiple aspects of her systematic review help us situate this study. First, she notes that it is important that we specify our definition of “engineering identity” to contextualize the type of work we do. Our work bridges the gap between professional and collective perspectives on engineering identity (responding to one of Morelock’s recommendations for engineering education research). We focus on the collective definition that, according to Morelock’s review and paralleling Tonso’s (2014) categorization, delimits engineering identity in the context of broader groups of people (e.g., whole nations, cultures). Our focus group interviews and inductive analysis are used to elicit both collective definitions of who engineers are and what they do as well as illuminating variation in these collective identities. In addition, we incorporate study of the concept of professional identity, or what Tonso describes as negotiation between the professional role or field and the individual person. Morelock puts all engineering identity research that uses “frameworks” into this category, and we specifically build on two of these individual conceptions. Faulkner (2007) and Hatmaker

(2013) illustrate what Morelock categorizes as two distinct sub-definitions of professional identity, respectively: the notion that engineering identity involves an individual's perceptions of the field, their relation to it, and others' perception of them, and the idea that engineering identity is the result of an individual's actions, including their acceptance or rejection of the profession and configuration of their role in it (Morelock, 2017). We investigate these individual actions and perceptions in the context of a collective national/sociocultural case, a specific gender context, and in the context of engineers working "in practice".

Methodology

These findings are part of a larger study of the micro- and macro-factors that shape women's participation in engineering in three predominately Muslim countries. We have conducted focus groups with a total of 168 women who either study, teach, or practice engineering in Tunisia, Jordan, and Malaysia. Data for this particular study draw on focus groups with 16 practicing engineers (PEs) across different sectors of work in Malaysia. Focus group interviews were transcribed, coded, and analysed using the Constant Comparative Method (CCM). Themes and sub-themes were organized and further analysed in the context of professional engineering identity. Here, we report on themes that describe engineering identity for the Embedded Unit of Analysis for Malaysian practicing engineers.

Data collection

In total, 16 practicing engineers participated in data collection, in 4 focus group discussions and 5 individual interviews (because of individual preference and/or scheduling demands). Practicing Engineers (PEs) were given a semi-structured protocol of questions, most of which paralleled the protocol of questions administered to undergraduate student and faculty focus groups. These included questions about their pathway into engineering, such as *"Have you ever wanted a career in something other than engineering? If so, what? What made you decide to stay in engineering?"* and questions about environment and experiences, e.g., *"Is your perception of engineering different now compared to when you started your career? If yes, how is it different?"*. The few questions that were added specifically for PEs probed their work and their decisions to go into industry, e.g., *"How did you choose a career in industry over academia/other jobs?"*. Interviews were conducted in English by members of the combined US- and Malaysia-based research team. A small number of clarifications were made in Malay by the local members of the research team and these were translated prior to transcription.

Analytic methods

Our larger study employs two methods to analyse our information and address our research questions: (1) a case study (Yin, 2014), more specifically a multi-site case study, with three embedded units of analysis (EUA) across three higher education institutions (HEIs) in three countries; and (2) constant comparison analysis methods (CCM) in order to ensure an inductive approach and to facilitate the emergence of themes out of the data. In this paper, we focus on our CCM analysis within one particular embedded unit of analysis.

We use CCM analysis as elaborated by (Lincoln & Guba, 1985) and as specifically described by (Grove, 1988). Broadly speaking, the CCM process can be broken into four stage: (1) code units of information from the raw data (in our case, translated and transcribed interviews); (2) categorize units into meaningful groups; (3) identify patterns within and between categories; and (4) conduct member checking. At the time of writing, the first three stages have been completed for the Malaysian PE embedded unit of analysis. Member checking will be done prior to REES, with the subsequent addition of the member checkers as authors. We will continue to revise and refine themes and sub-themes, and we plan to have completed the themes, thematic map, and a first round of member checking in advance of presentation at the REES conference.

The coding, categorizing, and synthesis stages of CCM were completed by multiple researchers on our team. For each stage, the research team conducted a training led by the primary investigators (PIs). Then, two research assistants served as the primary analysts on the same sets of data, meeting frequently and reviewing codes, categories, and thematic maps to assure confirmability and dependability. In the middle and at the end of each stage, the research assistants conferred with a PI to check on the analysis. As a result of Stage 3 (prior to member checking), a thematic map was constructed. In the context of professional identity research, we identified the most salient themes.

Current results

Initial findings for this work-in-progress point towards the formation of an identity that recognizes a gendered conception of engineering in practice, including challenges associated with women in the engineering workplace. However, themes also indicate a desire for “taking on a challenge” on the part of Malaysian women in engineering industries. This desire for challenge extends to an excitement about the newness and pace of engineering work in industry. Further, we identify two themes that point towards a lack of conflict in women’s personal and professional identities as engineers. For each of the four relevant themes, we provide example quotes, and we situate the theme within relevant literature on engineering identity.

Perseverance and the need to prove themselves

The first emergent theme (including sub-themes or “clusters” as well as specific categories) related to Malaysian PEs’ engineering identity was one of *perseverance*. A number of categories referred to women’s double burden of needing to work harder than men to be accepted in the field of engineering or to be perceived as competent and capable. Practicing engineers described a need to be tough and persist through difficulty, including an initial period in her engineering work where she had to prove herself to colleagues, supervisors, and even technicians whom she supervised.

As one engineer described, she felt the need to assert her capability and strength each time she encounters a new colleague:

Respondent 1: “...Even though it’s like they’re making you in their group but then it’s like what’s wrong in a girl being strong? Isn’t it? It’s so annoying. But for now the new comers will assume me so but after I showed them that I just can do anything then they’ll be Okay fine, I don’t want to have any problem with this girl anymore..”

Despite the prevalence of women in engineering in Malaysia, gendered perceptions of the field were clearly felt by women in industry. Interestingly, the dominant response to being questioned or discriminated against was not a desire to quit engineering, but instead an eagerness to prove themselves. This dualism (managing others’ impressions of them to gain confidence and embracing this challenge) mirrors studies of engineering identity in North America. Dryburgh (1999) describes both engineering culture and engineering identity as one of a “work hard, play hard” dynamic. She finds that women’s identity navigation evolves to manage male impressions of female engineers. This management of impressions is in service to a whole identity of the profession to which women have to show their membership. However, in the U.S. this professional identity negotiation is neither described as an “initiation” phase nor as a welcome challenge, as the identity ascribed by the Malaysian PEs exhibited. Instead, in the U.S. women’s professional engineering identity negotiation is a near constant struggle.

Multiple sources of identity confirmation

The second clear theme as related to the development of Malaysian women’s identities as professional engineers was a broad and diverse array of support factors. In other words,

instead of one clear “macro- or micro-facilitating condition” that helped to develop women’s professional identities in engineering, Malaysian professional engineers describe a variety of dimensions that reinforced and confirmed their identities as working engineers. For example, PEs report clear support and positive influence from their families, sponsorship/scholarship for pursuit of engineering studies, and resonance between their strong math and science abilities and interests and their work as engineers. These multiple sources of professional identity formation and support form a robust sense of themselves as “engineers” as a professional identity (BLINDED).

Respondent 2: “Okay me, why I chose engineering because of my father. Previously my father is a worker. They do the construction area. Every time I see my father so I say, okay I want to become like him because everything he do by himself. They repair all everything, love everything so need to ask somebody, okay you do it so you can do it by yourself. So why I need to pay another person [Inaudible] if I can do it by myself. That’s why I choose engineering.”

We see, in particular, that women’s educational experience includes multiple sources of confirmatory identity formation, including scholarships, strong academic performance, friends, and teachers. The resonance of strong academic performance with women’s representation in engineering has been made in prior work on Malaysian women in STEM more broadly, as Mellström (2009) explained the overrepresentation of Malaysian women in STEM field and many other academic fields by a long standing concern that Malay women outperform men in Malaysian academia, as well as in other areas of the society. Furthermore, having a positive interaction with faculty and advisors has been found to be strongly associated with students’ choice and persistence in science and engineering and information technology related majors across national contexts (Sax, 1994). In fact, Turner, Bernt, and Pecora (2002) found that secondary school teachers in the U.S seem to have a particular influence on girls’ choice of majors in STEM related fields, which is important in contexts where course taking plays a gateway role for university coursework and in contexts like Malaysia where STEM matriculation is predicated on following a technical track in secondary school. Rayman and Brett (1995) found that women in the U.S. who received support from both teachers and advisors are more likely to persist in science after graduation than those who receive support from a single source. For Malaysian PEs, multiple sources of support seemed to reinforce a robust sense of professional identity.

Gendered identity *within* professional spaces

As Malaysian engineers described their experiences, a picture of two distinct spaces for working identities were circumscribed: the office vs. the worksite (or “on-site”). Respondents described these two spaces as distinct, with one (office) being welcoming and a “fit” for women engineers and the other (worksite) being challenging, difficult, and at odds with the notion of women professional engineers. The worksite could include spaces such as offshore oil rigs, a construction site, or a factory floor. These sites were seen as in conflict with the identity of women engineers, so much so that they would require “special accommodations” when women chose to enter these spaces. On the contrary, office engineering work was seen as better a better “fit” for women.

Respondent 3: I have friends, she’s a civil engineer so yeah people around her talk, “Why are you onsite, you are a woman that is men’s work. ”

Interviewer: Yeah. They tell her that.

Respondent 3: Yes, but she say, “We’re engineer also.”

This distinction between the office and the worksite defines two very different spaces in which women engineers in Malaysia work. Rather than delineating the field or occupation in terms of gendered identity (which work in the US shows delineates gendered choices (Cech, 2013)), women describe gender-segregation in the types of work sites themselves within the field of engineering. Interestingly, though, this does not seem to relate to their choice of

working in an office or at a worksite. What this does, in a sense, is create an “acceptable” space within engineering for women and reinforces the idea that in terms of identity, “women” and “engineering” can go together.

Professional identity fits with specific notions of femininity/masculinity

Finally, we also see that respondents’ gendered identities fit with some (not all) gendered notions of the field of engineering. That is to say, their personal gender identity and professional identities are not in conflict. For example, one cluster of categories describes a sense of balance and equal treatment in engineering workspaces for men and women. Another cluster described the “normalcy” of women in the profession of engineering. Again, there was still an interesting juxtaposition with gender essentialist notions in engineering work – e.g., women in engineering not being able to perform certain tasks. This is also reflected in the distinct office and worksite identities described above. In addition, though, we see that women’s gendered identities fit with concepts of feminine and masculine identity for Malaysian PEs. Respondents reported a passion for engineering and, as noted in a few specific sub-themes, a sense that women were a *better* fit for engineering.

Respondent 4: “Actually, I like to accept challenge also. When I've been in working with construction always site work. When they assign me site work, okay no problem. I think that I'm also having fun of it dealing with the subcon, dealing with the client and so with the congress especially because in construction everyday you really face problems, everyday different problems that how you need that, they need an immediate solution. You need to check if you can decide if not you check with your supervisors or your managers, that's it. Actually, I also tried some work more in office work because I said, why that I've been here in this construction site work especially site inspection but I tried also some of the office work and I see it's boring. I said, okay I can do this because I'm also trying if I can do the work. I can do this but it seems that I'm not really for this line of work. I prefer more challenge. I cannot just sit down for eight hours or 10 hours in the office then go home maybe it's not my line.”

This sense that women’s professional engineering identities and personal identities correlate may reflect labor market history in Malaysia. One account finds that the symbolic association of the electronics industry with femininity in the Malaysia society originated with the mass recruitment of a largely female, largely rural, labor force coinciding with the opening of the Malaysian economy to the global market in the 1970s (Mellström, 2009). This influx opened up a representational space for women as reflected by one of the students interviewed in (Mellström, 2009) whose mothers or female relatives had worked in the electronics industry.

Discussion

Malaysian PE identity and implications for Malaysia

Professional engineering identity for respondents in this study was robust, and included both notions of gender as part of the professional identity as well as expectations of resilience. Women described an identity that recognized and also relished obstacles to engineering work despite their gender identities. They described identities that fit with engineering work as a field as a whole, but they also articulated identity conflicts in specific engineering workspaces (e.g., offices versus worksite). Their identities drew on and were reinforced by multiple sources of support, including educational experiences as well as family, peers, and mentors. This resilience on the part of Malaysian female engineers could also reflect early emergence of significant engineering/technical field – the emergence of the IT economy, and, with it, the recruitment of a women-dominated labour force, in contrast to non-technical fields (Mellström, 2009). Where researchers have described engineering workplace identity in North American contexts as a hyper-masculine workspace espousing “frontier masculinity” (Baharuddin, 2001), the Malaysian PE identity described by women engineers is or can be feminine. This may reflect

occupational gender segregation and perceptions/expectations of women's high performance Mellström (2009). Or, as noted from other prior work, it could be because gender as a dimension of identity is not as salient as, for example, race. Nonetheless, race/ethnicity was not discussed by our respondents in the context of engineering identity, so we do not see evidence in support of Lagesen (2005). Either way, we do not see evidence of the complete separation of "technical/social dualism" (Faulkner, 2007).

Implications for US and elsewhere

In addition to the existing comparisons and contrasts we draw in situating each of our themes, we also describe overall implications for other contexts. We see a stark contrast in the level to which Malaysian women PEs have to perform identity negotiation in their professional space. This lack of conflict in personal and workplace identities stands in contrast to what (Faulkner, 2009) describes as "doing gender", or balancing gender authenticity and inauthenticity to navigate workplace identities that do not fit with gender identities. While the pervasive gender norms that Faulkner describes can be related to the initial requirement for women to prove themselves as "real engineers", the identity described by our respondents seems to recognize and embrace this and describe it as a welcome, initial, transitory challenge. Instead of "gender-troubled" identities (Faulkner, 2007, 2009), we see an identity that is robust, stable, and incorporates femininity, and one that does not seem to distinguish between professional and personal identities (Hatmaker, 2013).

Future work may further investigate the theme of "leadership", which is emergent in the Malaysia PE sample. Prior work on engineering leadership identity in engineering practice points to a hybrid model of leadership identity specific to the field of engineering (Rottmann, Sacks, & Reeve, 2015). In addition, we will move on to case study analysis to further investigate the similarities and differences in engineering identity between women undergraduates, faculty, and practicing engineers, and across cases (Malaysia, Tunisia, and Jordan).

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