



Preliminary Findings of a Phenomenological Study of Middle Eastern Women's Experiences Studying Engineering in Ireland

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This paper reports analysis of phenomenological interviews conducted with eight women studying engineering, all Arabic speakers and practicing Muslims, and all from the countries of Oman and Kuwait. Data were collected as part of a larger study of women's experiences learning engineering in institutions of higher education in Poland, Portugal, and Ireland. The eight women contributing data for the analysis for this paper were all enrolled on engineering degree programs in Dublin, Ireland, where they studied together.

The larger study involves conducting longitudinal data via interviews with 47 women around Europe to understand what their undergraduate experiences in STEM have been like. Analysis of the first round of interviews (n=47) collected from women in Poland (n=12), Portugal (n=11), and Ireland (n=24) indicated that women from the Middle East (n=8) were having a different experiences than the other women. The latter group included women born in the country where they enrolled for higher education (n=32) as well as international students who had experienced the secondary school system in the country where they later registered for higher education (n=6). Table 1 provides information about all participants. The eight participants whose interviews were analysed for this study are shown in boldface.

Table 1: Participants in overall sample (participants in this study designated in bold)				
Interview location	Studying in home country	International with schooling in host country	International without schooling in host country	Total Number
Ireland	10	6	8	24
Poland	12	0	0	12
Portugal	10	0	1	11
Total	32	6	9	47

For this paper, we explore experiences described by women from the Middle East. We collected their first interviews, reviewed them, and considered the content using interpretive phenomenological methods. Then we designed this study and conducted follow-up interviews with them during their third year of study. We use these interviews to report here. Alongside the activity of analysing and reporting findings of that subset of data, we continued collecting interviews with them during their (current) fourth year.

This work-in-progress aims to understand what this subset of students has experienced and how they have experienced it. We use phenomenological methodologies to investigate and interpret the experiences described by these eight women, all of whom started a four-year Bachelor of Engineering program together in 2014 at a large public institution of higher education in Ireland. The study involves the entire population of Middle Eastern women in

this cohort of engineering undergraduates. Of the eight, seven were still enrolled in 2018 and were in their fourth year of higher education. The interviews with the first seven were all conducted in their first year. The remaining student provided an interview in her second year, just before leaving the institution and exiting the engineering major. Data from those who leave are extremely valuable because such students rarely provide interviews. Table 2 details the interview sequence. Interviews included in this analysis are shown in boldface.

Table 2: Interviews with participants from the Middle East (this study in bold face)

Participant	First year	Second year	Third year	Fourth year	Total
F01	1	0	1	1	3
F02	1	0	1	1	3
F03	1	0	1	1	3
F04	1	0	0	1	2
F05	1	0	0	1	2
F06	1	0	1	1	3
F07	1	0	1	1	3
F08	0	1	0	0	1
Total	7	1	5	7	20

Background / context

As education researchers, we aim to understand the experiences the women have while studying engineering in Ireland. We consider: What aspects of the experience are shared across all Middle Eastern women in the course? What challenges, barriers, sources of inspiration and support do these women experience? Which behaviours of friends, teammates, and instructors help these students in learning, and which hinder them?

The authors started this line of research in 2014, aiming to understand students' experiences of collaborative and problem-based learning (PBL) environments. We began by interviewing a broad and diverse set of female engineering students. The lead author travelled to multiple locations across Europe—Ireland, Portugal, and Poland—to gather data from students in three geographically and culturally diverse corners of the European continent. It happened that one-third of the Irish cohort hailed from the Middle East. During the Academic Year 2012-13, we conducted our first set of semi-structured interviews with 46 of the participants. Interviews varied from 45 to 120 minutes in length and were conducted on-campus at Dublin Institute of Technology (DIT), Instituto Politécnico de Setúbal, and Warsaw University of Technology.

Literature

Within the emerging field of engineering education research (EER), phenomenological studies of individuals' engineering experiences are beginning to appear. The most pertinent set of findings appears in doctoral dissertations, most of which have not yet been reported in journals. We have located five dissertations that use phenomenology to generate findings. Most employ Tinto's (1987) theory of persistence as the theoretical framework. Three focus on the student experience (Ecklund, 2013; Kuzmak, 2010; Smith, 2012), and two others explore women's experience in engineering practice, emphasizing aspects of education (Charity-Leeke, 2012; Somerville-Midgette, 2015).

Smith (2012) interviewed women (n=17) in their first or third year studying engineering at one of four universities in Massachusetts, USA. Smith's research confirmed dominant themes in the literature regarding interest and persistence of women in engineering, namely: (1) the views of parents, family and friends heavily influence women's decisions to enter engineering and (2) a sense of self-efficacy in science and math also influences women's decisions to join and remain. Smith's primary discovery was that positive experiences in and feelings about high school physics led the participants to major in engineering. We had discovered the same theme in comparing the experiences described by Polish and Irish women, and reported it to Irish policy makers (Chance, Eddy, & Bowe, 2016).

Kuzmak (2010) used phenomenology to investigate persistence among (n=6) women studying engineering at a small rural university in the US, considering attributes that influenced their decision to enter engineering and the roles of both the academic system and the social system in their persistence to graduation. Important to entering engineering were having: success in math, positive self-esteem, and parents who "supported a gender-neutral environment" (p. 99). Within the institution, relationships with males affected persistence. The six participants had mastered the ability to ask for help; however, they did not interact socially with the males in their program outside the classroom itself.

Ecklund interviewed (n=12) male students in one private university in Texas, USA during their third or fourth year of engineering. Preparation before university was important to persistence, as were both having and/or building a strong network of support and "being grounded in academic skills and characteristics" (Ecklund, 2013, p. iii). Intrinsic and extrinsic motivation also affected persistence.

Charity-Leeke (2012) used phenomenology to investigate experiences of (n=9) women engineers in the USA, assessing gender roles within the socio-cultural context. This study used post-modern feminist theory (Creswell, 2007) along with social cognitive theory (Lent & Brown, 2008). Findings of this study were not presented succinctly, but do provide detailed understanding of the women's experiences.

More recently, Somerville-Midgette (2015) used Moustaks' (1994) method for phenomenological analysis to study persistence among (n=6) African-American women in who had practiced engineering for 4.5 years or longer. She found "that early academic experiences and achievement shaped participants' decision to enter the engineering field. Environmental factors, intrinsic motivation, support systems motivated participants to persist through postsecondary programs and to enter the engineering field" (Somerville-Midgette, 2015, p. 3).

Results of these five dissertations align. The sample sizes ranged from 6 to 17 with a median of 9, lending support to the size of our sub-group sample size, and underscoring the difficulty of managing longitudinal data from 47 different participants in the overall study. Small sample sizes are common for phenomenological studies in general, and also for phenomenological research in engineering education.

Aim and objectives / research questions

We seek understanding of the lived experience of female, Middle Eastern students because we believe this group faces unique barriers when studying STEM subjects in a Western country. We wanted to identify aspects that we and other educators might be overlooking and to help us all do a better job supporting this sub-set of students. We let the findings arise from the interview data provided by students, rather than starting with a pre-determined theory or framework. This is consistent with phenomenological methodologies—research questions take final form as the data are interpreted and better understood. During interviews, participants were encouraged to raise topics. We later examined the data to identify what questions could be answered, ultimately asking:

- Q1) What prior experiences led these women to study engineering? What has the phenomenon of learning engineering been for them?
- Q2) Regarding Problem-Based Learning pedagogies, what has been their experience with collaborative learning and learning in groups? To what degree have PBL pedagogies helped support our participants?
- Q3) Regarding the balance of challenge and support (Sanford & Adelson, 1962), what difficulties have these women experienced? What moments of enjoyment or satisfaction? To what degree have challenges and supports balanced effectively?
- Q4) What guidelines can be put forward for engineering educators as findings of this study?

Methodological approach

We conducted initial phenomenological interviews during students' first year (2014-2015), follow-up interviews with the sub-set of women from the Middle East (spring 2017), and final-year interviews with Irish-based participants (2017-2018). The Irish-based participants joined our DT066 common core Bachelor of Engineering program together, in September 2014.

We conducted initial analysis, using interpretive phenomenology, to summarize each participant's first interview and help shape the direction of the study and the plan for follow-up interviews. Starting in the third year, we used NVivo software to code all interviews collected. As per Table 2, this included first-year interviews (n=7), the second-year exit interview (n=1), and third-year interviews (n=5). In the process, we identified several pertinent themes and formulated recommendations to help educators communicate more effectively.

Initial interviews opened with the question, "How have you been getting on here in [this city] and at [this institution]?" Follow-up interviews began with the question, "When you think back over your past years here in [this city] and [at this institution], what stands out most in your mind?" The initial interview invitation indicated that we had interest in collaborative learning, but the interviews were conversational in nature to allow topics most important to the participant to rise to the forefront. We used an open-ended, semi-structured format and allowed the participant to determine the length of the interview based

on the flow of conversation. The interviewer raised topics from the interview schedule in instances where they had not arisen naturally in conversation.

In keeping with phenomenological methods, we did not start with an existing theory or conceptual framework as one would if using another methodology (such as critical race theory, which could also yield interesting insights). In this case, we seek to know what this group of students has experienced, without presupposing that their experience mirrors any existing theory, or even that it necessarily needs to be changed. We have, however, assumed that there are aspects of this group's experience that we have been overlooking and that we can better understand through careful, systematic analysis. We have used the transcendental phenomenological approach defined by Moustakas (1994) with the goal to produce a refined synthesis of meanings and essences of their experience.

We enhanced the accuracy of results and validity of findings by providing written transcripts of interviews to our participants and requesting feedback on a draft of this paper from them.

Results

We discuss results related to each of our research questions. To protect anonymity, we have not included individual participant codes in this report. Participant quotes have been italicized, but individual voices are not distinguished from one another. The year-level of the interviewee is indicated on occasion, to aid comprehension.

What prior experiences led these women to study engineering?

Themes that arose in discussions of schooling included: school context, determining career trajectory, determining to study abroad, choosing Ireland, experiencing foundation studies and preparation work, and choosing this institution.

All but one participant had come from gender-segregated schools in Oman and Kuwait. During childhood, participants did not study alongside or socialize with boys outside their immediate family. All participants had studied English in school, but only a couple had taken any academic subject in English. Although they studied maths and physics in school, they learned the terms of science in Arabic. Parents had important supporting roles—encouraging their independence and their pursuit of higher education.

Enjoyment of maths and of practical, hands-on learning encouraged participants to consider engineering. Selecting an appropriate sub-field of engineering was an important concern—during secondary school and even earlier. They perceived engineering was a good career for women and that engineering jobs in their country would be plentiful. Having good job opportunities was crucial to their decision-making. Participants saw their governments encouraging high school graduates to pursue engineering. With regard to future employment, they anticipated working in teams with men as well as women, and with people from many parts of the world. They envisioned their work would be conducted

in English and that they would need to communicate effectively in English in order to work as engineers, even in their home country.

Many had parents encouraging them to pursue subjects that would provide independence in the future, with both medicine and engineering considered good choices. Several selected engineering after attempting to enter medicine and either not enjoying it or not being admitted to study. Some experienced disappointment at not getting the scores to enter medicine. Others realized they preferred maths and engineering.

Participants valued and trusted the input from close family members regarding career choices and paths. Siblings and cousins with prior experience studying related topics, particularly in Ireland or the UK, were central to informing their decisions. Most participants envisioned themselves going back to their home country to work following their studies. They planned to work in manufacturing, oil and gas, or utility companies. Most anticipated balancing work, marriage, and motherhood in the future, and planned to live with their parents until marrying.

What has the phenomenon of learning engineering been like for these women?

All engineering students in this honours (four-year) Bachelor of Engineering program take the same first year classes. This common core provides a sample of the three major streams of engineering available for specialization: (1) civil and structural; (2) electrical and electronics; and (3) mechanical and manufacturing. At the end of the first year, after completing basic course work applicable to all streams as well as three hands-on team-based design projects representing each of the available streams, each student selects and enters one of the streams, often making a fine-grained selection of speciality after year two. Participants made reference to this process in their interviews, and some of them modified their selections in light of their experiences.

How this process was experienced is of interest to us. For this group of students, adapting to the style of teaching—and the way of learning promoted by the institute and the college—required some adjustment. They described their first year tutors as extremely helpful and supportive—as people they frequently visited with questions. All the women in the sample stayed beyond the first year. It wasn't until the end of the second year that one participant left engineering, saying, "*in my case I didn't use to understand in the classes (...). I was in classes that didn't make any sense to me.*" She had avoided the first-year interview since she felt unengaged and disinterested and said she'd have little to offer. (The content of her interview, she said, was common knowledge among her peers, and our use of quotes would be fine.) Although other students also had difficulty understanding, they found ways to connect with what was being said. For this student, however, engineering content was not interesting and she had to force herself to engage with it. All women in this sample found the presentation and delivery of material challenging. Their descriptions of class time focused on: how material was communicated; learning through observation; practicing new techniques in class/lab; asking the teacher for help; and resolving concerns about grades. Other themes relevant to the question "What has the phenomenon of engineering study been for these women?" had to do with making sense of

content presented, studying and practicing new material and skills, asking peers for help, experiencing the common core and choosing a sub-field, and considering an exit from engineering.

What has been their experience with collaborative learning and learning in groups?

In first year, based on the institute's practice for assigning students to modules, participants often found themselves separated from friends who were taking the same modules but at a different time or in a different sequence. They heard from friends about projects and assignments they would encounter later, and this built excitement and anticipation. In the category of team projects, themes had to do with (1) being able to develop ideas together and (2) dividing work. Other categories had to do with (3) ethnic diversity, (4) gender mixing and gender differences, and (5) teaching others. We had specifically queried the issues of gender and teaching others, among many others. For this group of students in particular, gender was a central concern of group learning.

In the first year, participants were expected to work on team projects with males and some of them encountered problems when they were placed alone as the sole women on the team. By third year, they had experienced many different group compositions, and had frequently been the only female group member. They described advantages of having other women on the team to back them up, bounce ideas off, and improve ideas before pitching ideas "to the boys" Their descriptions of early interactions with male students—particularly non-Arabic males—were highly descriptive, suggesting they were highly memorable due to their novelty. Overall, participants much preferred working with English-as-first-language students to working on teams composed strictly of Arab or international students, or teams of all women which they saw as lacking a full range of engineering skills and perspectives. They wanted opportunities to work with Irish students and other English-speaking students, and their circle of support tended to expand over the years with each of them finding their own branch of friends to complement their core group. The core group was composed of Middle Eastern women who entered their College in the same year, and Arab friends they had made while completing an English preparation year and a foundation studies year in this city, prior to entering third-level.

Participants described learning to work with males. A first-year student explained:

Actually a lot of times we study together... because she's a girl and I can connect with her. It's like, in our original land we can't connect with boy... it's like we a little bit shy from boy, because when we was child, we didn't play with boy. That's why and it's easy to connect with her. It's easy to study with her.

By third year, the same student said:

At the beginning, I mean in the first year, it was a little bit hard for me to accept this. But then, now, I understand—here, you have to be mixing. Even with Arabic guys, or Irish guys or whatever. You have to be mixing here, because also in engineering, you'll see, there's not too much women in engineering and there is much, much of boys. And we have like,

even like, one girl in groups of boys and that's like, it's fine now for me to work with the boys.

Even those with some exposure to boys in school had new communication styles to learn:

although back home I've been to a mixed high school, but I didn't use to interact with males. Like, it's just, I didn't used to. But here I ask a lot. I'm not afraid to ask for help, even if they were male.

A first year student noted advantages of making new friends:

when you [make new] friends here, and you know people here, you get really strong. Like, they give you strength.

As they moved into their specialty, the number of women in their classes grew smaller:

I only have like one Arab girl with me.... All the others are guys. But then, you have to start talking to the males because, when you need help and, like that—like if I and [the one other woman] got stuck—I'd ask others. And yeah, they'd be really willing to help. I've this classmate that is from Saudi. He is really, really, really kind. Like, he always, after every lab, he goes around each and every person and then he's like, "Do you need any help?" Or like, he's so, so kind. Honestly, he took a big burden off of my shoulder.

Making the adjustment to speaking with others wasn't always easy or comfortable, as a third-year student explained in a series of quotes:

now I'm, the fifth year for me in Ireland. So that's, it's a change now. Like I can connect with other people and it breaks down other things, yeah. When I go back to my country—like, for example, in my country we can't sit with boys like it should be like sitting with girls just. But here in college, it must be with girls and boys. So we should go ahead and like try to break some rules here [laughs].

There was some difficulties about [learning to work with boys], but we should like speaking [with others in English] and learning new things. Because if we still thinking about the same roles like I have in my country, I can't do anything here. Just, I will not learn anything new. So I try to mix.

As for working in her current, all-male team, this student quoted just above said:

Actually, I feel like I hate them [laughs]. Yeah, I'm like, I feel like just want to go with my friends—the girls—and work with them. I feel free, actually, when I'm sitting with girls. It's more than when I'm sitting with boys. Because boys when they said [an initial idea for something] that something they want to build, they go straight. This is the idea, no one can change it. When I speak, they see, like, one girl, "No, we don't have to take this idea, so what's the next step?" So they hide me sometimes, but when I say a good or excellent idea, maybe they take it, maybe not. I don't know [yet].

Her male teammates seem to say:

“No, this is a bad idea” or “it’s not strong idea. We just, we need another idea.” So when they start saying that, I feel like, inside me I, “I will not say anything. I just, I will be quiet and I will listen to them. And if there is something wrong, I can say my idea again.”

To what degree have PBL pedagogies helped support our participants?

Specific frustrations with group projects had to do with: being ignored or inherently assumed to be wrong; feeling rushed or feeling the males on the team too quickly adopted an idea without considering enough options; being the only female on the team; laziness of others or self; being left to do all the work; managing deadlines; having female-only teams without enough diversity of skills/perspectives/abilities; lack of follow-through by teammates or self; people who don’t show up; and feeling excluded. Working in groups took adjustment and provided some hindrances, and participants soon realized that working in teams of people too much like themselves could be problematic:

I wanted to ask [the male teacher], but he was busy with another student, so I didn't have that chance. And then my partner was from Oman too, so, we couldn't figure it out. And then the lab ended and we didn't connect the circuit.

They came to see benefits of peer-to-peer learning:

We are doing an experiment—we had to do like a programming for the circuit and I am not good, really, at that. But he finished it, in I think just like two minutes. When we did something, he explained all for me. And I understand from him.

Similarly, a different participant described interaction with a male classmate:

he is a kind person and he's good at explaining something—more than the teacher.

People who don’t contribute their fair share often came up when discussing group projects. Teams with too many non-English speakers will have trouble submitting refined work, and participants dislike being on teams with all members from the Middle East, as they feel that too much of the work is left to someone else—most often to them. Even their friends will leave the work for them to do, participants said. On the other hand, Irish and native English speakers were seen to contribute well to group assignments. Levels of participation and motivation varied greatly among the interviewees, with the one who left the major having the lowest level of engagement. She described regret over letting her teammates down, and her strategy for avoiding that pitfall:

actually we [got] to choose our groups, but I didn't choose anyone because I know I'm too lazy and I didn't want to let anyone down, so I just didn't speak up. So this person/guy, he Facebooked me, and asked “Do you have a partner? Let's work together.” I told him, “Dude, I'm too lazy. Let me just warn you: I'm lazy and I'm not good in coding and all

that stuff.” I just wanted him to know I don’t want anyone to get stuck because of me. I was willing to work but I’m afraid I might just give up. I don’t want anyone to -- I don’t want to affect anyone by me giving up.

By third year, a different participant had noticed:

when they let us choose our groups, the boys go and choose themselves—like a boys group—and we’re left with just the girls.

I prefer when the lecturer makes the group... he will try to put [different levels of students] in each group. And this is much better because you know, we have to improve our language. That’s, uh, one part of this, when we work with English or Irish group, because you have to speak English at that time and you will improve your language, even listening to them. Yeah, it’s positive.

They were reluctant to ask students to be in their group who they didn’t know well. They usually waited to be invited or assigned to a group.

The last project we pick[ed] our friends to be in the same group. But the second project they ask[ed] us to change the groups. But actually, I left with no one with me. There was a boy does not have a partner so they sort of put us together. And I think he’s good [laughs].

Difficulties and challenges experienced

Sources of difficulty included language, workload, adjusting to the pedagogy, logistics of money/housing/transportation, not meeting some course requirements and having to repeat modules, missing family, and letting peers or family down.

Other challenges had to do with cultural or personal characteristics: sickness, feeling dread or lack of satisfaction, feeling doubt and lack of confidence, or being polite or cautious. Individual participants also mentioned difficulties due to feeling shy and avoiding meeting people or feeling lazy.

Language caused a great deal of stress. In first year:

there is a lot of Irish people, and the teachers speak quickly and sometime we can’t understand it, but we try to focus in it and we take the main point from what he say (...) When I was in my country, I [took] these subjects, in my language. And it was really, really easy, in Oman, in my country, to do these subjects. But here because I understand the calculation things, but when he speak[s], I didn’t understand it. But I tried to understand it.

During third year, a participant explained:

sometimes, when the teachers say a [word that is new to me], I have to take my phone and search what this word is. And I miss everything he said after that. ... [One time] I didn’t

understand what teacher said in the lecture. But when I went home and I start my report, I understand then what this experiment was about. But in the lab itself, I don't have any idea. I just do what the students do. And then, then when I get home, I start.

Specific challenges included unknown vocabulary (particularly physics terms), sloppy handwriting or words only partially written on the board, and some teachers' heavy Irish accents and speed in talking. At third year, two different students explained:

even some of handwriting. The teachers, when they start writing on the board—like, I don't know the words, like all letters [run] together. I don't know where they start. But I try to copy, [by sitting] near my friends, what he writes or what she writes.

Because they write something too fast and it's like a drawing. ... I have a lecturer this semester that, sometimes when he writes on the board, he didn't complete the word. Just make a few letters of it and just complete the others. And I have no idea what that word is. Maybe the Irish... from the sentence, would know what that word is. But for me, no.

The quote above hints at the problem of tacit knowledge—knowledge the teacher assumes all students already have and thus doesn't need to be mentioned.

But the teacher there, he didn't explain because he was expecting that all students have done this before. So, I didn't do the experiment. I didn't know how to do it [laughs].

When I don't understand in classes, I feel really frustrated. Like, "Why is everyone getting it and I'm not getting it?" I know I'm not stupid because I've done really great in high school. Like I've got As and Bs.

Enjoyment or satisfaction experienced

Sources of enjoyment were personal, family-related, and academic. Learning-related satisfaction included learning from mistakes, hands-on learning, successfully speaking in public, and feeling excitement for learning. They described satisfaction in setting boundaries and building confidence. Teachers sometimes bolstered their confidence, as explained third year:

Like when we did something, and the lecturer was like happy for what you did? That's, normally make you proud of yourself and you'll feel happy and you want to do more and more and more.

Helpful interactions with instructors were appreciated:

he paid attention to international students. He would come and ask, "How are you getting on in your studies?" And such things. So that's why I went to him directly.

Beginning to identify their own strengths, developing independence, and learning when and how it was acceptable to “break rules” and adjust their cultural norms provided satisfaction. Many described developing independence and their personal identities:

Honestly, I don't think it's a waste of time at all, because I've learned lots of stuff. So much stuff. And they say that I've kind of become more independent. And I know what I want to do in life. And like, I know who I am. I have my own opinions and things and not just because, like say, in Islam, people are separated in different groups. I don't know if you do this. So basically, my friends, the Omani ones, they had, like wrong [stereotypes]. And they discussed their religious views on certain things we have, and they don't have. I explained to them that I actually started to search, “Why I'm doing this?” and “Why I'm doing that?” Like, I still want to learn more about why I'm --, I want to make sure that I'm not just following my parents. And it was a great. Like, it was great experience, for them to correct their views on [those assumptions]. And also it's like they made me notice that I'm missing knowledge on why I am Muslim. So I want to learn more about that.

Other sources of satisfaction were host families in Dublin and close ties with family (both at home and in Dublin). These participants either stayed with Irish hosts they connected with through their Embassies or with family members already living in the city. Only one moved to Ireland by herself, with her mother's help for the first two weeks. Her sister has followed her over since. Most participants described very close, ongoing ties with their mothers, but their fathers' support was also highly visible and valued. One father came over with his daughter for her first year in Dublin. Her father did all the cooking, shopping, and housekeeping so that she could focus on her studies. In subsequent years, she shared an apartment with her brother, who had already been living in the city.

Irish host families were a central feature of several participants' experiences, significantly enhancing their time in Dublin. Although not every host situation was ideal, poor hosting arrangements did not last long and the student was able to quickly move on. In some cases, the host mother became like a “real mom” to the students, hosting several Omani students at once, and even learning to cook Omani foods. Discussion with host families—including host brothers and host fathers—was mentioned as helpful and enjoyable. Kindness of others, particularly Irish people and taxi drivers, was frequently mentioned.

Balance of challenge and support experienced

The students in this sample experienced somewhat different challenges and support systems than other students studying in the same college. They had added issues of foreign language, dealing with boys for the first time, teachers with very little knowledge of their country, and assumptions by some classmates or teachers that they were slacking or lacking appropriate knowledge. In contrast to Irish and other international students, this group had to deal with being far from home and from their close-knit families. However, they had more visible and direct support from their government—in the form of scholarships, orientation programs, and housing assistance. At times, one participant sensed resentment from non-Arabic peers regarding the level of financial support they received. Interestingly, they felt little prejudice or bias against them on the streets of Dublin or among the Irish in

general. Each related one or two instances of bias experienced in general society, but described these as minor and not of concern. Before leaving their countries, they had been advised that Ireland was a supportive environment for Muslim people, and they concurred.

They felt no bias from teachers with regard to their ethnicity or religion. There were, however, implicit problems having to do with styles of communication and teachers' assumptions what regarding knowledge an entering student would have. Primary sources of frustration had to do with heavy workload and weak communications from instructors:

I don't know. I feel I just can't ask him because I know he's not going to explain it fully for us. He's going to repeat the same thing. So why would I go?

Knowing at what point to ask for help is often a problem for students in PBL, and sometimes teachers also do not know when to intervene or how much to help students:

he was giving out, actually. Because he said, "Why didn't you talk [or, ask me about this] from the beginning?" And then we said just, "We were trying to figure it out." And then we didn't know, so [they waited until the end of class to ask, but the teacher was leaving].

Peers were generally helpful—typically quite understanding and willing to cover for each other when another peer was sick, unsure, or disengaged:

they're just so nice and I feel so lucky that I have been put in such group, though I wish they were strict with me. But they weren't. They were just nice and whatever.

Despite facing different, and probably more, challenges than the Irish students in our larger sample, this sub-set was able to overcome the challenges and obstacles they faced. All participants with interest in engineering persisted through to final year, although one transferred from level 8 down to level 7 and one will extend her stay by a semester in order to finish. Many of the challenges faced could be eased for future students, if teachers were to better enunciate and check for understanding before moving on.

What guidelines can be put forward for engineering educators?

We offer the following recommendations to aid educators wishing to understand and empathize with such students and do an effective job communicating and supporting their learning. Recommendations fall into five groups: consider approachability, facilitate peer learning, reduce distance, consider language, and balance teams.

Consider approachability. We recommend teachers project a sense of approachability (via eye contact, recognizing individuals, getting to know names, and openly welcoming questions) and availability (letting students know when and where people are available to help and preferred ways to reach these people/teachers).

Facilitate peer learning. Teachers can promote collaborative learning by helping the students conceptualize their cohort as a team and view their classroom as a laboratory for

learning together. Teachers may want to consider how their classrooms can become more interactive, and what opportunities exist for students to teach each other some of the content (e.g., pairing students so the stronger students share what they're learning, and they learn to say it in new ways).

Reduce distance. Break down the distance between student and teacher by making sure that career mentoring and personal advising are available and your students know where and how. Encourage students to take risks and see failure as a step toward success. Explicitly discuss the importance of finding mentors in the profession as well as how to identify possible mentors and how to establish and cultivate relationships with them.

Consider language. Answer questions using different words than used to present the content, in case there's a vocabulary issue. Students have to connect new content to prior learning and may have used drastically different vocabulary in the past; saying the same thing over again in the same way does little to help. Check for communication/tacit knowledge issues. Pose some questions to check that students understand basic background and foundational concepts and that they can connect what you are saying to prior knowledge or experience. Understand that while they may have foundational knowledge, they may not be making connections that educators or native-speakers make implicitly. Also consider that foreign students may need a bit more definition about a project brief than local students, before they can get started on an assignment. Local students may understand implicitly that you want a report as opposed to a model or a strategic plan, or the type of chart or graphic convention you're using, whereas foreign students must make far more inferences—key details can get lost in translation.

Balance teams. Recognize that minority students typically feel uncomfortable asking mainstream students to be in their group. Nevertheless, all participants in our sample wanted to work with native English speakers—every participant described this preference. We recommend providing group assignments where the group is selected by the instructor, as well as opportunities to work in student-selected project groups. Teachers should monitor student engagement by observing teams in action and provide feedback on team dynamics. They should model good decision-making practices whenever possible and identify best practices with regard to collaborative work.

Conclusions

As a result of our observations with these students since 2014, we are finding it helpful to diversify teams as much as possible. When assigning groups, we now take into account gender, national/non-national status, attendance records and/or performance on past projects. We aim to have students work on projects with many different students during their first year. We assign teams for diversity as so as not to isolate anyone as the only female or only minority student in the group. When students are unfamiliar with each other, we provide icebreakers to help them get to know several people before assembling their teams. We emphasize that participants often felt their ideas were ignored by all-male teams. They valued having someone more like themselves—whether female or speaking their own

language—to bounce ideas off before posing them to the whole team so that the idea would be strong enough to be taken seriously and to contribute.

Overall, we believe we are developing crucial understanding of how this sub-set of students navigates through a higher education engineering program and what unique challenges, opportunities, joys, and frustrations they face. By following Moustakas' (1994) structured process as best we can while using NVivo software and staying true to the data we have collected, we aim to provide valid findings to the research questions identified above, and to report these in an internationally recognized education journal.

One underlying purpose of this study has been to identify an existing theory, or set of related theories, relevant to our data that we could use as a framework in subsequent research. The immediate project uses the student engagement theory developed by Stanford and Adelson (1962). This theory emphasizes keeping students actively engaged in learning and helping ensure readiness to take on new tasks, in a “plus-one” approach where the assigned task stretches the student to stretch, but not insurmountably. At the core of this theory is the belief that the level of readiness and support must balance in order for the student to meet any new challenge. Appropriate balance is evident within the cohort analyzed here, but the linguistic and tacit understanding challenges are overly burdensome and seem to be greater than necessary. Teachers can address these by being more attentive to how quickly and carefully they speak, and trying to see the international students' perspective when giving writing assignments and presenting material.

Findings of this paper suggest Chickering and Reisser's (1993) seven vectors of identity development are applicable and may provide a helpful framework for interpreting results of our interview data in the future. Although this theory was developed in a Western context, various aspects of Chickering and Reisser's theory relate to the interview data we have collected. We may opt to use template analysis (King, 2004) to help us assess to what degree interviews from the female Middle Eastern engineering student in our study support this identity theory and what aspects of their development might be un-recognized or under-recognized in this Western-based theory.

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