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Middle Eastern Women's Experiences of Collaborative Learning in Engineering in Ireland

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CONTEXT

This research project uses grounded theory to analyse interviews conducted with eight women from Oman and Kuwait. Members of the sample group were studying together at an institute of technology in Dublin, Ireland. All participants were practicing Muslims as well as Arabic speakers who had learned English. Interview data were collected from participants beginning in 2014 as part of a larger study of women's experiences learning engineering in Poland, Portugal, and Ireland. The eight women contributing data for this paper were enrolled on a four-year Bachelor of Engineering (B.Eng.) honours-level degree. They comprise the entire population of Middle Eastern women in this cohort of engineering students. This paper reports patterns in 15 interviews collected in the years 2014, 2015, 2016, and 2017.

PURPOSE OR GOAL

The authors began this line of research in 2014, to understand students' experiences of collaborative and problem-based learning (PBL) environments. They aimed to understand experiences women have via group projects, paired laboratory assignments, self-directed studies with friends, and other collaborative learning experiences in engineering. For this paper, the authors explore experiences of collaborative learning described by the sample group over a period of four years at one large, public institution of higher education in Ireland. To date, the authors have conducted, transcribed, and analysed 15 interviews with this sub-group. Seven interviews were collected in students' first year, one in their second year, six in third year, and two early in the fourth year. Five more interviews were conducted in the last half of fourth year, but are not included here because they have not been transcribed or analysed.

This report explores the research questions: *What has the experience of collaborative learning been like for these women? To what degree have PBL pedagogies helped support them? Which behaviours of friends, teammates, and teachers help these students in learning, and which hinder them?*

The authors started by interviewing a broad and diverse set of female engineering students. The lead author travelled to multiple locations across Europe to gather data from students in three geographically and culturally diverse corners of the continent. During the Academic Year 2012-13, she conducted a 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 (IPS), and Warsaw University of Technology (WUT). It happened that one-third of the women in the overall cohort of B.Eng. students at DIT had come from the Middle East to Ireland to study engineering. Because their first-year experiences were significantly different than those described by other participants, the authors chose to conduct follow-up interviews with this sub-group.

APPROACH

The report uses grounded theory to generate understandings of what this subset of students experienced and how they experienced it. Using a grounded theory approach allowed findings to emerge from the data, rather than superimposing an existing framework or *a priori* theory (Corbin & Strauss, 2008). In Strauss's view, the purpose of grounded theory is to raise generative questions "in order to develop concepts and propositions and to explore their relationships" (Grbich, 2013, p. 82) and to validate categories and findings through an on-going process of data analysis. Our work involved transcribing the interviews, reading transcripts in their entirety, and then conducting open, axial, and selective coding of transcriptions (Grbich, 2013). Literate we have reviewed on pertinent topics is reported elsewhere (Chance & Williams, 2018).

OUTCOMES

During the coding process, three major themes emerged having to do with the experience of learning with others and/or learning in groups. The first concerned communication within the group and the group's approaches to working together. The second identified specific emotions experienced during group work and the motivations that participants described having felt. The third theme centred on learning to navigate diversity, particularly with regard to ethnicity and gender.

Communication and Approaches to Group Work

On the theme of communication and approaches to group work, participants discussed forming groups, dividing work, effective collaborations, ineffective collaborations, providing leadership, and seeking advice or arbitration from teachers. They expressed clear desire to have Irish students on the team, as well as at least one other person (female or Arabic) who is easy to connect and communicate with. In situations where the participant was alone—as the only female or the only non-Irish person on a team—the woman often felt ignored, outnumbered, or unable to fully develop and explain ideas she was trying to pitch to the group. Having someone who shared a minority characteristic allowed her to bounce ideas off someone else and achieve an initial level of buy-in before presenting an idea to the larger group. This gave her confidence and the chance to develop ideas better.

F01a: for our [mechanical] project, there was two girls and two boys. And this is, I think, this was helping me. Because we were having different skills from them and then it comes together to form the right skills for such project.

In cases where she was the sole minority student in a team, particularly in the first couple years, her ideas usually fell on deaf ears and she felt forced to go along with the crowd, even when the team failed to consider enough options or to refine its work. One participant had many bad experiences before fourth year when she announced with glee that she now prefers working with boys. In her third year, she had said:

F07b: *Actually, I feel like I hate them [laughs]. Yeah, 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 of] 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. ... 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."*

At times, she had been doing projects as the only woman, on a team with eight men. Having an Arabic male peer on the team helped her.

F07b: *I explain[ed the concept] for him, for example. And he said, "Yeah that is maybe [the] right idea." And he will add a little bit. For example, [some] extra idea for [enhancing] my idea. So that's what makes a bigger idea to translate to Irish, and maybe they will accept it. Because it's my idea and his idea together, it's not just mine.*

Similar to F01a above, this first-year student described some level of effective team work across her group's six-week design project:

F03b: *I had a Filipino girl ... and [we] were two girls and two boys. So whenever we have something like, "[Hazel] let's tell them this," or like that. Yeah, it was much better. And we were like, "Do this. Let's do this. Let's do that." And we could understand each other better that way. I think that was a good group. ...at the beginning of it, it was really good. Because we were all together, working together.*

Recruiting others to join a team was difficult, and participants often fell into team of whoever was left over. They didn't feel comfortable approaching male Irish students and asking to join their groups. A first-year student explained when selecting teams:

F06a: *we'll just pick ... Arab people, of course. I will not go and pick, like, Irish people, because I just don't know them. And it will be easier to speak.*

Several appreciated when teachers composed the groups for balanced skills and abilities, because they did not like being on teams that were homogenous. They had difficulty on teams with poor English, as well as all-female or majority Arab teams. These groups lacked diverse enough skills, perspectives, interests, and/or physical strength. With regard to primarily-Arabic groups, participants cited problems of freeloading, others assuming they would do the work and take up the slack, and not getting to practice English. Although they socialize with a small group of Middle Eastern women, almost all preferred not to work on teams with these women after second year. Their desire from the outset was to work in diverse teams and in English, but getting to the point where they felt comfortable doing so took quite a bit of time and effort. Some did not feel comfortable working with primarily-male groups until final year.

Participants recalled ineffective team approaches they had encountered. These women contended with slack team mates who were under-contributing or underperforming, and at least one participant admitted to being guilty of the same on occasion. As previously noted, participants described teams rushing or under-developing ideas, and teammates who resisted rehearsing presentations or refining the final product. Their techniques for dividing work had both positive and negative aspects: in some cases the division of tasks was too strong and the participant failed to learn a wide set of skills. One recognized this as a problem but another continued the behaviour throughout her studies, focusing only on the portion of the project assigned to her and avoiding engagement or responsibility in areas assigned to others.

F05b: And it was a group of four students. We split the project into four parts, and everyone has taken a particular part to do. ... [And the teacher] would say, "Do something, show me some progress." And I'm like, "I don't know what to do, because we are working as a group, so I'm waiting for my colleagues to finish working with their parts." And then, "Do something, show me some progress"... because he's like, you know, "It's all about self-learning."

Fortunately, the students also described effective team situations and many times where good decisions were made by their teams. Participants noted the importance of being able to ask questions, get full and complete answers, and find peers who wouldn't mind being asked. They wanted to develop ideas together and valued being on a team that made decisions collaboratively. They described getting advice/critique and gaining ability to communicate using English. They expressed understanding when others needed to miss a class or meeting, and expected the same in return.

It was rare for these women to volunteer for leadership roles, although one seemed to be viewed by peers as an implicit leader who could be relied on to check the work of others because her work was consistently of high quality. Within this small social circle, some were more likely to organize gatherings outside school hours than others. Some wanted to study alone so they could concentrate, while others enjoyed studying with others on weekends. As the years progressed and they developed specialities, there were fewer instances these Arab woman had modules together. Their informal group study sessions were more frequent during first year when the eight had a common curriculum.

They understood the importance of self-directed learning and peer-to-peer learning. Most of them relied on the internet and on peers to help them understand important concepts. They tried to manage group dynamics themselves, going to the teacher only in cases where they had been heavily exploited by a partner or teammate. They rarely asked the teacher to arbitrate or give special consideration in grading to account for lop-sided contributions, but some instance of doing so were described, in cases where the teacher was highly trusted and took interest in supporting students.

Feelings and Motivations

Participants described a range of feelings—some positive and others not. They discussed things that motivate them to persist. Good feelings had to do with

excitement and joy, hopefulness, and respect for diverse approaches. Thinking back to first year:

F05b: I was involved with a group of Irish people and they were very kind and friendly and helping me to understand the subject and they said, "If you have any questions you can ask us." And "We can answer your questions. If you face any difficulties with the things you don't understand." Then overall it was fun, and I learned the things, which I didn't do before.

F22a: 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.

Negative emotions involved feeling stressed or unmotivated, lazy, or fearful of failure. Other than feeling alone and excluded, most bad feelings were similar to those described by the larger sample of women in this B.Eng. course, and are likely to be shared by most engineering students. In the specific case described below, the participant was in a team with six other women, and was the only one who was meticulous about attending meetings, completing work, and submitting the first assignment. She took her work quality seriously.

F03b: Once, we had the power assignment. It was like, you have an individual report and a group one, and the group one was supposed to be all the same. So I was asking them to come and do the work, "We'll do it together." And we were an all-girl group, and they didn't show up. And I kept doing the group work, all by my own. And I finished it and then I sent it to them, "This is our group work" and "submit that one." So the next time we had a group report, I went to another group because I was not going to do that anymore. ... It stresses me out. ... the week went by and I didn't get time to study at all, I just finished my eight assignments and that was it.

She found her way into team with a better work ethic, and her experience improved.

Motivations had to do with seeing the benefits of teamwork, not wanting to let others down, and recognizing the need to work with others in future jobs.

F02b: In the first year it was a little bit hard for me to accept [the small number of women in the course]. But 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 even like, one girl in groups of boys. And that's like—it's fine now for me to work with the boys.

They didn't want to let others down:

F01b: I do my part directly because I don't like people being late because I didn't do my work. So I [always] finish it very quickly and just give it to them.

This holds true for one who never enjoyed engineering and left the programme after second year to purse an English degree:

F22a: I didn't choose anyone [for my group] because I know I'm too lazy and I didn't want to let anyone down, so I just didn't speak up.

The other seven participants all stayed on to earn engineering credentials from DIT. During their studies they experienced panic and success, like most any student would:

F05a: When Week 6 came, I was kind of panicked. How can I present, the presentation, in front of [40] people? ... I asked [Fiona], to help me with presenting the presentation, and she was very helpful. So we divide the work between us.

Navigating Diversity

Topics of diversity centred on: forms of social support, being different, widening circles of friends, gender mixing, and coming to terms with gender differences. The biological family formed the core of these women's support networks. Families back home were important, and all but one participant had family members enrolled at the institution or already residing in Dublin before she moved here (and the younger sister of the remaining one enrolled in the same course three years after her). These prior residents provided valuable advice and encouragement. Embassies also provided support and coordination, and helped the participants find housing, often with host families. For many of the Omani women, host families in Ireland became an essential and ongoing form of support. Within the host families, they usually had other Arab girls to interact with, as well as Irish host 'moms' and other Irish family members.

Participants came into the engineering program already knowing and keeping in touch with some international students (female and male, Arabic and otherwise) who they had previously studied English year or Foundation year with, in Dublin, prior to entering engineering at DIT. They had limited experience of working in groups during Foundation studies, and no experience of group work related to engineering. Group skills had to be learnt in their B.Eng. course, because the first year involves three major group projects (that collectively span the year) and multiple labs that are conducted in groups or pairs. Participants described the frequency and scope of group projects increasing over the years. Conversely, the number of women, and particularly Arab women, in their respective program decreased over time. When asked at third year if she felt she belonged in engineering, one student explained:

F02b: In this year, yes. But in second year, no. I feel like this, because in this year, in my group, it's just me. No girls with me. Just there is Irish girl with me. And when I went to her and start to speak to her, it's like ignore me. And that's why I hate to be in this group. ... But it's okay because there are boys from my country and I can connect with them. ... [First year] I was in boy group, and I'm just keep myself. Like, [I waited to] see what goes on around me. And after we start building, I have a big idea what's going in this project. ... [It was hard for me] because it's first time for me to do the project, and also because I'm only girl in that group.

Their interviews show that they felt acutely outnumbered at the start of their course, discovering just 25 female students in their class of 180.

F06a: Well, back home is different. Girls who do engineering, are a lot. Back home, a lot of girls [do engineering].

They described feeling alone, excluded. They first found comfort working on teams with other girls present, and many were given this opportunity due to a concerted effort by teachers facilitating the projects. In two of the three projects, teams were assigned rather than self-selected, and after the first round of projects, the teachers aimed not to isolate any female member. This has not always been possible

to achieve, and in many instances the women in our sample found themselves in a minority position.

F07b: We work always in groups with Irish girls and boys—so we need to mix with boys and girls and we need to talk with them because if we just don't talk with them we would feel lonely and we can't connect with them successfully. ... We are five—four boys and one girl [laughs]. Because [the two other Arab girls are on a team] together, but me, I'm with all boys, no girls. I tried to be [on] a girls [team], but this is my group.

... I was worried about those things when I was in first year. But now I'm [on] the fifth year for me in Ireland. So that's a change now. Like I can connect with other people and it breaks down other things. 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 that, but we should like speaking [with others in English] and learning new things. Because if we [are always] 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.

For her, participating in a women's society helped, and although she had no classes on the days this organization met, she made the lengthy commute to the meeting.

F07b: Actually you know the Woman's Society of Engineering? Now, just for this year I am a member for them so I meet a lot of girls, actually. They are friendly and some of them [are] in fourth year doing civil engineering and we can ask them for anything like, because they have all the comment from last year and they can show me what we should be doing for this subject, and this subject, and this subject.... I find you can get close to the girls and speak about anything that's belong[ing] to college, teachers and subjects. You can share a lot of things that [are] happening in college.

Arabic women provided an essential form of support in early years, as they developed the skills and intuition to communicate with a wider group and request help.

F22b: When I came here, I only ha[d] one Arab girl with me, and that is [Sunita]. All the others are guys. But then, you have to start talking to the males. Because, when you need help ... like if I and [Sunita] got stuck—I'd ask others. And yeah, they'd be really willing to help.

During ten of the 15 interviews included this analysis, the participant identified benefits of working with girls. Three described times their all-girl teams grappled with an inadequate range of physical abilities and prior experience with engineering. Social and academic interactions expanded over time, from initial comfort in communicating with Middle Eastern women, to comfort interacting with women from other places, to comfort interacting with more males from the Middle East, and then to more diverse groups of men. Most came to avoid working on teams heavy with international students.

F06a: Unfortunately, I was working with three, from Kuwait, with me. So we're four from Kuwait. So then this semester I worked with Irish. Different people. ... [When] we were four from Kuwait, we always speak in Arabic. And we never speak in English. ... Like everyone is depending on the other to do the work. And they would

certainly be like, "She will do this. I know she will do this." And then they will not do. But when I work with Irish people, everyone does their own work, and everything is okay.

F06b: I don't want to be so rude, but most of [the Arab students] want you to tell them what to do. And then they just come and they just do their stuff, or they do their stuff very late, and most of them are like, huh!, the worst I've seen, so I need to go and, and re-do them again, which—we don't have time to do this.

It was in the deep conversations with close female friends from the Middle East, however, that some of the richest self-discovery emerged.

F22b: [And now] 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 … I want to make sure that I'm not just following my parents. And … it was great experience for them to correct their views on [their wrong 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.

The need for diversity became immediately apparent:

F01a: And then my partner was from Oman too, so, we couldn't figure it out. … We have the same problem—that he didn't do any stuff related with this subject—like me too. So we were having the same problem. We didn't figure it out. … That usually happens, I don't know why, but, that we'll not co-mingle. Like usually we're—Arabs will have their section, and groups—unless the teacher makes it.

The need for diversity was well-recognized, despite the discomfort it could cause.

F02b: Maybe we feel more comfortable when we chose our group because you know what these will do and how these will do in your group and maybe they will work or not. This is good. But when we meet different students every time, I think it's much better to have an experience and you make a point, because when we go and have a job you have to also work with a group you didn't know. So I think it's a good experience to work with a group you didn't know.

The need to practice and work in English was also frequently cited.

F05b: I have my friends, but I want to be more with the Irish people so I can improve my English language. [It's] one of the reasons I choose to study abroad, instead of studying in … my home country.

For a couple participants, men from the Middle Eastern became close collaborators. One developed a friendship with two males of Middle Eastern descent who were raised in Ireland, referred to as 'honorary Irish'. Another was bailed out of a failing project by a married Saudi man, with whom she was not permitted to make eye contact with or speak socially. Nevertheless, when he saw she was in trouble and lacking team mates, he developed a plan to include her on his team, get teacher approval, and catch her up on the necessary subject matter using on-line screen sharing software to tutor her without violating his cultural rules. Before coming to Dublin this participant had rarely spoken with males.

F22b: 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. ... 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. .... I do believe that God had put kind people in my way to make this journey tolerable, because honestly, I would have lost my mind if I didn't have anyone to help me. ... He just loves to help. And when I say "thank you" he doesn't like it, because he's like, "Why are you thanking me? God has put me in your way. You should thank God, you shouldn't thank me." And, he's so humble.

Familiarity helped increase comfort communicating across gender lines over time.

F22b: I also have like other male mates, that they help me like almost all the time ... from Saudi, Kuwait, and some of them are from Oman.

They also sometimes found the courage to take a stand.

F03b: And I know that our Middle East boys don't think we're right and they think we don't know anything. But this year, because we studied together from foundation year until now, he was okay with telling me he was wrong. Because I know him from foundation year, so he told me, "No, you were right" and he was wrong.

Interaction with Irish peers was highly valued and occurred in the university setting.

F03a: We didn't interact a lot with the Irish people in Foundation year. But in this year ... all of our classes are with Irish students and we are not a lot of people from Arabic countries. Less than 20, or less than 30 ... and we were like 160 students in this course and it was a good to like sit with Irish people in our ages and talk to them and do projects with them. ... I think it's good not to have a lot of people from your same country or region, so you can get to know other people's ideas and things like that.

Interaction with Irish students rarely occurred socially off-campus. When asked "Do you have friends who are actually Irish?" a second-year engineering student explained:

F22b: No. I didn't manage to be friends with any Irish women. Like, you know [Grainne]? We used to speak at first but then we just all of a sudden stopped talking and that. Yeah, [Grainne] is the only Irish woman I know.

A couple participants benefited from having a host brother studying engineering. Four of the students developed close and supportive relationships while staying in two specific Irish host families. Described during first year of the B.Eng. course:

F01a: the boy [in the host family is] really, really good at mechatronics engineering. He did RoboSumo and he won. He was the first year. And so, he's naturally, he's really good at these things. So when we talk about these things, the host mother just sits and says "What are you talking about!?" [laughs] ... my first year, I was living in a different family. And I didn't feel comfortable there. And then I moved to this family and actually I don't want to move to another place. ... I said to them, "I'm really comfortable here. I don't want to be feeling differently from this."

Social interaction rarely occurred with Irish peers, and this quote is more indicative of the overall group:

F02a: Sometime because my friend [another Omani girl living in the same host family to] take the subject before I take it, when we sit together, she told me what happened to her all day and I tell her what happened to me. And we share the idea, sometime. .... But ... outside the home, she takes her way and I take my way.

They were just learning to work with male students.

F06a: We've never worked with guys before, even in schools back home. We have separate schools for girls and boys. So I've never even sat next to a guy in a class. But, when I came and did the Leaving Cert, I got used to like, being to sit in the class with guys. But I didn't get the chance to work with them on projects and stuff, because I didn't have these sort of [group projects before I came into engineering].

Overall, participants provided thick, rich and highly phenomenological descriptions of their early interactions with Irish students, and particularly with male Irish students. This indicates that the experience was so new that the participant mentally registered a great number of details that would be overlooked were the situation commonplace. The following participant was in a robot-building team that had two Omani and one Irish girl. They described interaction with the other (male) teams.

F03a: In Week 6, we had the Race to the Wall. And that week, we couldn't get our robot to move. It wasn't moving, at all. And we went to the canteen and we found the boys from our class. And we told them, "Can you help us?" And he said, "Ok, I'll try." And he tried and tried [excitedly] and he did. And he said, "I don't know what's wrong." And, the other boy saw our circuit, and he said, "Oh, your circuit is different from our circuit." That's so, "I can't help you." And I told him "Ok, it's not a problem." Like, "we'll get [it]. We'll do something." And I sat with my friend in the canteen, and we tried, tried, tried, to make it work. And it was moving as we wanted, and then the boy who saw our circuits came, with his other friends, like six boys, and he sa[id], "Did you get the circuit to work?" And we said, "Yeah, it's working now." And they sat all around us [laughing] and we sat together. And, we were, like, chatting, in the canteen. "Oh, how's your robot?" Yeah, yeah, oh "What group are you in?" Oh, like that. And then I put something, and my robot fell. And, I broke one of the motors, before half an hour from the race. ... And they said, "What just happened? What did happen?" And like, "Do you need help, or anything?" I said, "No, no, I'll get it to work" [laughing]!

The interviewer asked: "Can you tell the boys apart? Do you know their names--?"

F03a: Now I know their names, but before, no. They're all—like what I see is they're all—alike [laughs]. They would have yellow hairs, or something like that [laughs]. Yeah, so, I don't know then. But now I started to get to know them and to know their names. Because now, even in our classes, we would joke around like that. And so we're more together now. We know each other better now.

Throughout the years new students joined their programme from other streams.

F03b: I know [many of my teammates] from my first year and until now. So it's not that hard to work with them, because we already know each other. But this year they combined us with another program, so I am still getting to know the new classmates.

They had closer communications with students from the Middle East and other non-Irish places, and generally saw these as beneficial. All participants identified productive and supportive collaborations with international students, although about half also expressed reluctance to join teams that had many non-Irish students on them where they perceived lower level of engagement, reliability, and ability to write and speak in English. Even these reluctant students, however, described many good experiences with international students, such as a male met during Foundation year, prior to joining DIT:

F05a: Two or three weeks ago, I think, I was absent... because I was sick. And then I came here to the college and then I saw [Carlos] and I told him, "What's missing, and what can I do?" And he said, "If you want, we can go to the library and then I can show you some works that you can do." And then, we spent almost two-and-a-half hours together, doing the [work], because he wants to help me to catch up. ... Then he said, "Do you understand? If you do, do one of the questions and then show me." Just, he wanted to make sure that I have understood and then he's going to show me the solution for that question.

FINDINGS

In speaking with these eight Middle Eastern women and learning about their experiences in Ireland, we gained insight into how they communicated and structured their group work, what they sensed and felt, and how they widened their circles of collaborators and friends over time. We developed greater understanding of 'intersectionality' much better, as we discovered what it was like to work with students from different language and culture groups and to learn to communicate at the most basic levels and then to effectively work on complex projects with male peers. At least seven of 15 interviews indicated greater ease in connecting with girls than boys. Participants had been surprised to find such a small proportion of women in the course they joined, and they felt obliged to speak with male students from the outset. A number of stressful and disappointing experiences with boys were described—most where the participant felt ignored or overlooked—but the frequency of these subsided as familiarity grew.

Several participants described what they saw as inherent differences between boys and girls. They mentioned the ease of connecting with other girls, but also the need for having teams with boys' more diverse set of engineering experience and physical strength. There were only a few comments expressing gender bias:

F03a: I wanted to take Mechanical before, but I think it's not suitable for me. I think it's not suitable for girls. ... There's girls who take Mechanical, but I think it's not suitable for a girl. So I don't want it.

Even though there was a preference to have other women on the team, particularly in the early years, there was not a sense that women were inherently better or worse. In fact, participants did not want to be on all-girl teams and this preference emerged quite clearly in their first year at DIT. They did not see women as inherently more organized or inherently better team collaborators, even though they did see women as easier to talk with. At third-year this participant responded to the interviewer's

question "So … when you have the Irish boys and girls on the team with you, it helps make it easier?"

F07b: Yeah, boys with girls, I find. Because maybe girls know something about that subject and boys excellent in another side. So girls can make a nice project or nice idea.

RECOMMENDATIONS

As a result of prior analyses involving these data, the authors generated recommendations to help educators do a more effective job communicating with diverse students. These are reported fully elsewhere (Chance & Williams, 2018) and summarized here. We recommend that teachers:

Consider approachability. Project a sense of approachability and availability.

Facilitate peer learning. Promote collaborative learning by encouraging interaction and helping students conceptualize their cohort as a team and view their classroom as a laboratory for learning together.

Reduce distance. Break down the distance between student and teacher. Discuss when and where and how students can get various types of guidance and mentoring. Encourage students to take risks and see failure as a step toward success.

Consider language. Check for communication and 'tacit knowledge' issues. Pose some questions to check that students understand basic background and foundational concepts and that they can connect new ideas 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.

Balance teams. Recognize that minority students typically feel uncomfortable asking mainstream students to be in their group. We recommend providing group assignments where the group is selected by the instructor, as well as opportunities to work in student-selected project groups. Monitor student engagement by observing teams in action and then provide feedback on team dynamics. Model good decision-making practices whenever possible and explicitly describe 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. Participants in this study 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.

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