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## A Longitudinal Study of Middle Eastern Women's Experiences Studying Engineering Abroad: Emerging Results

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### SUMMARY

What is it like to study engineering in Ireland when you are female and you come from somewhere far away, in the Middle East, which has different social customs and norms? What is the lived experience? What aspects of the experience are common to all Middle Eastern women enrolled in your course? As education researchers, we aim to understand the essence of the experience such women have had studying engineering in Ireland; we focus on what life has been like for them and what unique challenges they have faced that may be invisible to us as instructors.

In this work-in-progress, a longitudinal study that uses phenomenological methods, our research team investigates and interprets the experiences of eight women from Kuwait and Oman who started the four-year Bachelor of Engineering program at Dublin Institute of Technology (DIT) in 2014. Of the eight, seven were still enrolled in 2018 and in their fourth year of university-level study. One participant had returned to her home country to complete a degree in an unrelated field, but the seven others were on-track to earn engineering degrees. Across this four-year period, we conducted 15 interviews with these eight students. The lead author had opportunity to observe their participation in PBL design projects (that we were not assessing) during the students' first year. We report preliminary findings of our analyses in this conference paper.

### BACKGROUND / CONTEXT

The two lead authors started this line of research together in 2014, with a particular interest in students' experiences of collaborative and problem-based learning (PBL). We began by interviewing a broad group of female engineering students in multiple locations across Europe. The selected locations—Ireland, Portugal, and Poland—reflected a range of cultural values and provided good access to participants. During the Academic Year 2012-13, we conducted semi-structured interviews 60-90 minutes in length with 46 female engineering students studying various types of engineering (see Table 1). Of these, 28 were studying in Ireland, 11 in Poland, and 11 in Portugal.



<b>Interview Location</b>	<b>Native</b>	<b>Non-Native</b>	<b>Total Number</b>
Ireland	10	14	28
Poland	11	0	11
Portugal	10	1	11
Total	31	15	<b>46</b>

Our analyses of the overall set of interviews conducted in AY 2014-2015 indicated that international students from Middle Eastern countries (n=8) were having a much different experience in European higher education than the other women. Their experience differed from native-born women (n=31) and also from international students from other parts of the world (n=7). In response to this finding, we conducted follow-up interviews with the Middle Eastern women in our overall sample.

### **AIM AND OBJECTIVES / RESEARCH QUESTIONS**

We aim to develop a deeper understanding of the lived experience of this sub-set of students because we believe this particular group faces unique barriers when studying STEM subjects in a Western country. We wanted to identify aspects of the experience that we and other educators might be overlooking. Finally, we wanted to help ourselves and other educators do a better job supporting this sub-set of students. We chose to let the findings arise from the interview data provided by students, rather than start with a pre-determined theory or framework, and this is consistent with the phenomenological methodology we have been using from the outset of this study. Consistent with this approach, the research questions take final form as the data are coded and better understood. In that the participants were encouraged to raise their own topics during interviews, we had to examine the data to identify what questions could be answered from these data. Based on initial analyses, we were able to refine our original research questions, ultimately asking:

- Q1) What prior experiences led the women to study engineering? What has the phenomenon of engineering study been for these women?
- 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 and challenges have the women experienced? What moments of enjoyment or satisfaction? To what degree have the challenges and supports balanced effectively?
- Q4) What guidelines can be put forward for engineering educators as findings of this study?

## METHODOLOGICAL APPROACH

As noted above, we interviewed the entire cohort of Middle Eastern women who joined our DT066 common core Bachelor of Engineering program in September 2014. We conducted initial in-depth phenomenological interviews with them (and 38 other women) in 2013. As a result of initial findings, we conducted follow-up interviews with the sub-set of women from the Middle East in 2017. At this point, 15 have interviews conducted with Middle Eastern women studying on this course in Ireland and 13 of these interviews have been transcribed in full. We coded these 13 interviews using NVivo, and in the process, we identified several pertinent themes and developed some preliminary recommendations for educators.

As is common in phenomenological studies, we conducted open-ended, semi-structured interviews; the interviews were conversational in nature to allow topics most important to the participant to rise to the forefront. The interviewer made sure to address all the topics on the interview schedule, with most of these arising in the normal course of the conversation. The initial interviews started with the question, "How have you been getting on here in Dublin and at DIT?" Follow-up interviews began with the question, "When you think back over your past years here in Dublin and DIT, what stands out most in your mind?" The initial interview invitation indicated that we had interest in collaborative learning.

In keeping with phenomenological methods, we let the findings rise from the data. 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 are seeking 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 can better understand through careful, systematic analysis. We are using the transcendental phenomenological approach defined by Moustakas (1994) to produce a refined synthesis regarding meanings and essences of their experience.

Moustakas' (1994) book describes a highly structured approach that we have implemented previously and that we deemed appropriate to meet our research goals. This methodology yields textural and structural summaries that we will ultimately use to create composite statements reflecting the overall essence of the experience on specific themes that have arisen and have informed our research questions. An example of this is the question on challenge and support, which stems from an existing theory by Stanford and Adelson (1962) that appeared relevant to our participants' narratives.

As per Moustakas' methodology, the textural summaries will explain "what" happened whereas the structural summaries will explain "how" the phenomenon was experienced—which can happen in a range of ways. We will explore similarities and differences in the way they perceived and interpreted their experience, as indicated in Table 2.

<b>Table 2: Moustakas' (1994) Methodology for Transcendental Phenomenology</b>	
<b>Textural</b> <i>What</i> happened? What did participants experience with regards to this phenomenon?	<b>Structural</b> <i>How</i> did participants experience this phenomenon? How did it feel? How did they understand and conceptualize it?
<b>Composite</b> What was the <i>essence</i> of the participants' shared experience? This combined statement reflects a synthesis of textural and structural aspects.	

Creating these summaries will help move us toward creating a final, composite statement that synthesizes what we've learned. As such, developing the textural and structural summaries helped us build valid, well-synthesized interpretations that equate to Moustakas' composite statement. As mentioned earlier, we aligned the research questions to Moustakas' approach after finding that some of research questions had clear textural and structural aspects and that other research questions required synthesis (of the sort commonly found in the composite statement). This was done in an iterative process wherein the content of each interview was broken down into invariant meaning units (Moustakas, 1994) and these units were sorted into clusters. The research questions were then refined based on what we could answer via the narratives provided.

## EMERGING FINDINGS

To date, coding and analyses have focused on the first research question, which involves two parts. We provide examples to show the direction of our future work.

Q1a asks what prior experiences led the women to study engineering. Common themes arose regarding earlier schooling, including: school context, decisions about career trajectory, the option to study abroad, choosing Ireland, experiencing foundation studies and preparation work, and choosing DIT.

*School context* is a theme that has to do with texture, or *what* happened. Interview data indicated 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 during primary or secondary school. They did study maths and physics in school, but learned the terms of science in Arabic. Parents had important supporting roles—encouraging their independence and higher education.

*Determining career trajectory* is a theme than has more to do with structure, or *how* engineering education was experienced. Under this theme, we discovered that 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 in secondary school—and even earlier for many. They perceived

that engineering was a good career for women and that engineering jobs in their country would be plentiful. Consideration of job opportunities was crucial to their decision-making, and they saw their governments encouraging high school graduates to pursue engineering degrees. Many had parents encouraging them to pursue subjects that would provide them 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 pursue medicine, while others realized they preferred maths and engineering technologies.

Participants received valued and trusted input on career choice and study options from close family members, particularly siblings and cousins with prior experience studying related topics, often in the UK or Ireland. Early on, 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. Many anticipated balancing work, marriage, and motherhood in the future, and planned to live with their parents until marrying. 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 that 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.

Q1b asks what the phenomenon of *learning engineering* been like for the women. With regards to what happened (i.e., the texture), all engineering students in the B.Eng. program take the same first year classes (called the common core) which provide a sample of the three major streams of engineering available for specialization: civil and structural; mechanical and manufacturing; and electrical and electronics. At the end of the first year, after completing basic course work applicable to all streams as well as a hands-on team-based design project in each of the three streams, each student selects and enters one of these streams, often making a more fine-grained selection of speciality within the stream after year two. Participants made reference to this process in their interviews; they described their relationship to and reflections on the process.

*How* this process was experienced (i.e., the structure of the experience) is of interest to us. For this group of students, adapting to the style of teaching at DIT—and the way of learning promoted by the institute and the college—required some adjustment but most found ways to navigate the system satisfactorily. They described their first year tutors as extremely helpful and supportive—as people they frequently visited with questions. All the women in the cohort/sample stayed on at DIT beyond the first year. It wasn't until the end of the second year that one participant left engineering and DIT, when she provided her only interview two days before departure, and saying "*in my case I didn't used to understand the classes (...). I was in classes that didn't make any sense to me.*" She had avoided the interview previously since she felt unengaged and disinterested and felt she'd have little to offer. Although the others often had difficulty understanding, they typically found ways to connect with what was being said, but for her it was a constant hardship and struggle to try to learn things she found unappealing.

For all the women in the sample, the presentation and delivery of material in class provided challenging. Participant descriptions focused on: how material was communicated, practicing new techniques in class / lab, learning through observation, asking the teacher for help, and resolving concerns about marking/grades. We identified several themes relevant to Q1b, "What has the phenomenon of engineering study been for the women?" These were: presentation of material in class, 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. We have summarized the results for each of these themes.

## UPCOMING WORK

As our analyses continue, we will create summary statements aligned with each research question. We will continue to integrate fundamental principles of Moustakas' (1994) method. For textural analysis, we will utilize Moustakas' techniques of: (1) bracketing or *epoch* (setting aside preconceived ideas); (2) horizontalizing (treating every statement as equal in value to every other statement); (3) clustering horizons into themes; and (4) organizing the horizons and themes into a coherent textural description.

For structural analysis, we will utilize Moustakas' (1994) technique of imaginative variation. This will allow us to consider "alternate outcomes" to help validate our interpretations and distil findings down to the core essence. Steps in the process of imaginative variation involve: (1) systematically varying structural meanings (about individual and shared perceptions) that underlie their experience of the phenomenon itself; (2) identifying themes and contexts that underlie and allow the phenomenon to appear; (3) giving consideration to universal structures such as "time, space, bodily concerns, materiality, causality, relation to self, or relation to others" (Moustakas, 1994, p. 99) that precipitate the thoughts and feelings people experience alongside the phenomenon; and (4) pinpointing examples that adeptly illustrate structural aspects to create a structural statement.

In creating composite statement to address the more complex research questions, we aim to describe core aspects of the phenomenon that could not be changed or altered without affecting the overall experience described by participants. Such a composite will help us answer two of our sub-questions:

Q2b) To what degree have PBL pedagogies helped support our participants?

Q3b) Regarding the balance of challenge and support (Sanford & Adelson, 1962), to what degree have the challenges and supports balanced effectively?

Through this structured process of analysis, we intend to derive a list of recommendations:

Q4) What guidelines can be put forward for engineering educators as findings of this study?

## **EMERGING RECOMMENDATIONS**

Although Q4 cannot be answered accurately and fully prior to careful and iterative analysis, we have outlined our emerging thoughts on the subject, derived through observation and interaction with the sample group. We offer the following, preliminary recommendations to aid international educators wishing to understand and empathize with such students and to do an effective job communicating with them and supporting their education. Preliminary recommendations can be summarized under five headings: 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 welcoming questions) and availability (letting students know when and where people are available to help and preferred ways to reach these people/the teachers).

### **Facilitate Peer Learning**

Teachers can promote collaborative learning by helping the students see their cohort as a team and their classroom as a laboratory for learning together. Consider how your classroom 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). Explicitly discuss the importance of mentors, how to identify them, and the need to cultivate relationships.

### **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.

### **Consider Language**

Answer questions using different words than you 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 they understand basic background concepts and can connect what you are saying to any concepts they already understand or experiences they have had. 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 native 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 and can get lost in translation.

## **Balance Teams**

As a result of our observations we now 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 in 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 (e.g., our participants often felt their ideas were ignored by all-male teams, and they valued having some one 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). When students are unfamiliar with each other, we provide ice-breakers to help them get to know several people before assembling their teams.

It is important to 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 brought this preference up.

We recommend providing group assignments where the group is selected by the teacher-selected as well as opportunities to work in student-selected project groups. Monitor engagement by observing teams in action and provide feedback on team dynamics. Give students guidance in good practices in teamwork and project management, and model good decision-making practices whenever possible.

## **CONCLUSIONS**

Overall, we believe we are developing crucial understanding of how this group 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 to the greatest extent possible 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 international recognized education journal.

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