USING QUEER METHODS TO CREATE EQUITY IN ENGINEERING EDUCATION

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ABSTRACT

Engineering education research traditionally adopts a positivistic approach, focusing on quantitative data and objective facts. While ensuring reliability and granting confidence, it can overlook outliers and marginalised voices, contradicting the principles of human-centred design. Human-centred engineering should be inclusive, addressing the needs of all groups. Historic efforts to diversify engineering have primarily aimed at increasing female representation, neglecting other identities and intersectionality. Queer research methods, emerging from queer theory in the 1990s, aim to disrupt power dynamics and emphasise marginalized perspectives, and encouraging innovation. This paper explores applying queer methods to equity, diversity, and inclusion research in engineering education through examining the research methodology of a master's in education research thesis. The queer ethnographic approach incorporates interviews, collaborative framework reviews, and the analysis of images and digital artefacts. We immerse ourselves in queer methods to reimagine an engineering and design curricula informed by queer theory, and how this might amplify marginalized voices and promote equity.

Keywords: Queer methods, EDI, engineering education

1   INTRODUCTION

This paper follows the journey of a female engineering lecturer specialising in equality, diversity and inclusion (EDI), undertaking research for her Master's in Education. The current status quo within engineering is reviewed, setting the scene for the author's specific setting, and the wider context. The findings call for a change in research methodology if a change in outcome is to be attained. Queer methods are proposed, and described, as a transformative approach, offering alternative methodologies that challenge the status quo. These are then applied to the author's work, with detailed description of how queer theory has informed their master's research approach. The paper focuses only on the methodology of the research, allowing space for a detailed analysis of their application in this context.

This introduction is written in the third person, in the tradition of engineering papers, giving readers familiarity. Echoing the author's own journey from traditional methods into qualitative and highly unfamiliar queer methods, this paper will now similarly fluctuate between a first- and third-person style, embracing both the value of individual perspectives, and traditional approaches in engineering education scholarship. This changing of voice reflects the dynamic nature of queer theory and methods and immerses the reader in the challenge of moving from one familiar method to a new approach.

2   ENGINEERING EDUCATION RESEARCH BACKGROUND

2.1 The Status of Engineering and Engineering Education

Though women represent 56.1% of UK workers, they make up only 15.7% of engineering and technology in the UK [1], and 32.9% globally [2]. Similarly 87.6% of UK engineering and technology workers are white, as compared to 84% in all other occupations [3], and 82% of the English and Welsh population [4]. Efforts have been made to improve equity in engineering; a Royal Academy of Engineering (RAEng) review of UK literature found publications on EDI in engineering have increased more than tenfold in the last decade [5]. However, women in engineering in the UK has risen only 6 percentage points in ten years [6], even though most engineering EDI initiatives aim at increasing female representation [7] [5], with similar findings globally. Furthermore, whilst women may be one of the most underrepresented demographics in engineering, racial equity remains a more divisive issue in terms of both awarding gaps [8] and pay gaps [9]. Similar disparities exist for low socio-economic class students, and for other demographics we have not even truly begun the analysis. So why do these disparities exist, and are they important?

2.2 The Nature of Engineering and Engineering Education Research

Engineering is broadly considered to be a "hard, applied" subject [10]. Its practitioners are highly numerate and analytical, focusing on calculating correct answers using quantitative data. This objective approach is also found in educational research within engineering. However, an increasingly wide range of voices are criticising engineering educational research as being positivistic [11] [12] [13]. Positivism grants comfort to engineers due to its similarity to their technical research. I am frequently asked about quantities of students experiencing issues and the magnitude of impact; without sizable quantitative data to hand, an engineer can be difficult to convince. However, basing educational practice and research in positivism ignores barriers faced by individuals and marginalised groups. The small numbers within minority groups mean these voices go unheard when we seek consensus, placing greater value on addressing high frequency or easily measurable occurrences. This places traditional engineering practices in conflict with EDI research. Our identity as engineers, desirous of solving problems we can observe, measure and objectify is at odds with the need to understand and empathise with experiences which are ephemeral, personal and subjective.

2.3 The Need for Equity in Engineering Design

In design especially, engineers must empathise in order to create inclusive, ethical outcomes. Positivistic design approaches [14] are unable to account for end users from marginalised groups. The RAEng states engineering must "build a sustainable society and an inclusive economy" [15], yet inclusion cannot be achieved through positivism alone. Furthermore, strong evidence exists that increased diversity on teams increases profit [16] and innovation [17], thus it is essential that we recruit, retain and value a wide range of individuals within engineering. Yet having diverse engineers and approaches conflicts with the current status quo of engineering and engineering education. Therefore, I have elected to examine the nature of the relationship between EDI initiatives within engineering education, and the identity of the EDI practitioners carrying them out.

3 QUEER THEORY AND QUEER METHODS

3.1 What are Queer Methods?

Queer methods arose from queer theory, which emerged in 1990, from lesbian, gay and gender studies [18]. It originally focused on the nature of gender and sexuality, taking fluid, disruptive and interpretivist approaches to both knowledge and research and occurring in parallel with the LGBTQ+ community reclaiming the term 'queer.' Queer methods encourage innovative ways of researching which enable us to challenge the existing status quo and seek out and value the narrative of lived experience within the margins [19]. There is no set way of using queer methodology, instead they are an approach or mindset inviting us to reinterpret our processes, examine power dynamics and biases extant within our practice, and create more dynamic, reflexive research strategies which amplify voices not previously heard [20]. Queer, both as a term and as a method, rejects the binary, instead embracing multiplicities of identities, experiences, paradigms and approaches; there is no longer a right and a wrong, a consensus and other, qualitative and quantitative. Instead, there is blending, nuance and multitudes in methods, in participants and in findings [21].

3.2 Using Queer Methods for EDI Work

From its roots in empowering marginalised voices, queer methods seem to me an ideal approach for EDI-related research. As my question relates to practitioner identity, queer methods' origins in identity research also aligns well. Queer methods, and my own EDI research, seeks to move away from finding consensus through traditional practice and instead seek to empower and understand the "other." Additionally queer methods have been adopted within social sciences to reverse the hold of positivism on research [22], and thus could address the same concern in engineering educational research. Lastly, many EDI initiatives within HE, and engineering education, take a deficit model approach; consider the provision of extra time in exams. By taking a queer methods approach we are facilitated to subvert, or resist, what constitutes "normal," therefore moving away from deficit model approach. Without a pre-conceived "normal," reaching asset-based or systemic conclusions is more feasible. Therefore, queer methods support both the individuals this research aims to benefit, and the research process itself.

4 QUEER METHODS WITHIN ENGINEERING EDUCATION

4.1 Connecting up the Dots

It is an engineering habit of mind to be a problem solver [23], however, when we are using quantitative data to find those problems the small numbers will never rise, never be addressed, as highlighted by Pawley [24]. On reflecting on EDI within engineering education and its practitioners, I began to wonder whether my peers and I, as a cis-gendered, heteronormative, able-bodied white middle class woman, might be the problem. Might we primarily be addressing gender, and primarily assisting white, middle-class women because the EDI practitioners are generally white, middle-class women? Hence my research question: What is the nature of the relationship between EDI initiatives in Engineering Education, and the positionality of the EDI practitioner? To address this question, I needed to step away from traditional engineering education research methods and seek alternative ways to investigate positionality and EDI work, resulting in finding queer methods, an approach beginning to be encouraged for diversity and inclusion related research within engineering education [25]. Using a framework centred around queer methods empowered me to challenge the norm of positive within engineering, as well as to embrace qualitative, subjective and personal approaches rather than "conflating objectification with "good science"" [21, p. 16].

4.2 Research Methodology

To answer the research question using a queer methods approach, staff working within HE in engineering and who self-identify as EDI practitioners were recruited to participate in queer ethnographic interviews, approved by the Imperial College Educational Research Ethics Panel.

Historic equity issues exist with ethnographic approaches resulting in potential exploitation and bias. In queer ethnography there is no power hierarchy between participants and researcher, both can switch between learner and expert throughout. The approach acknowledges fluidity and multiplicity of self, accepting a paradigm where the researcher is neither outsider nor insider. Having research subjects implies subjugation; our queer approach has participants, and the researcher is a researcher-participant and member of the community being studied, thus prioritising ethical connection. The participants were the author's existing contacts working in EDI in engineering education. This provides a "safe" group with which to pilot new approaches though the intention is to widen this recruitment pool following completion of the MEd to provide a wider data set for publication. An overview of the data collection and interview processes can be seen in *Figure 1* below.
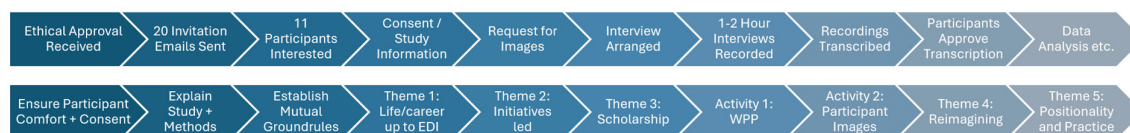

Figure 1. Overview of Data Collection and Interview Processes

The interviews took a life/career history and storytelling approach, empowering participants to share as they wished, talking about experiences and practices based on their own values. Having themes rather than specific questions enabled me to ask reflexive questions, creating an interrelational element by querying dynamics within the interviewee's organisation but also drawing on cross-interview themes.

Theme one of the interview asks about life and career history leading to EDI practice. This identifies parallels between EDI practitioners and enables a Foucauldian approach of "using history as a means of critical engagement with the present" [26, p. 367], scaffolding later discussion examining power relationships in society. Secondly participants talk about their own EDI initiatives, aligning with recurrent elements of queer theory; self-narration and self-reflection, giving the participant power over their own story and creating space for self-growth through supported reflection. The third theme asks about scholarship, publication and influential authors. This gives structure to examining the engineering education system, facilitates self-reflection and provides data for later triangulation during analysis.

The fourth theme of the interview uses "reimagining" questions to support the destabilising nature of queer methods, challenging the "norms" of behaviour and history. Here the researcher returns to one of the prior stories shared and asks what if something had been different, for example "How do you think that might have been different if your line manager had been Black?" or, "If a women's network had existed, do you think you would have remained in that workplace?". The activities are usually conducted after theme 3, though there can be moved earlier if they fit into the discussion in a relevant manner. In

the first activity the participants, and researcher, map themselves on the Wheel of Power and Privilege (WPP), see Figure 2:
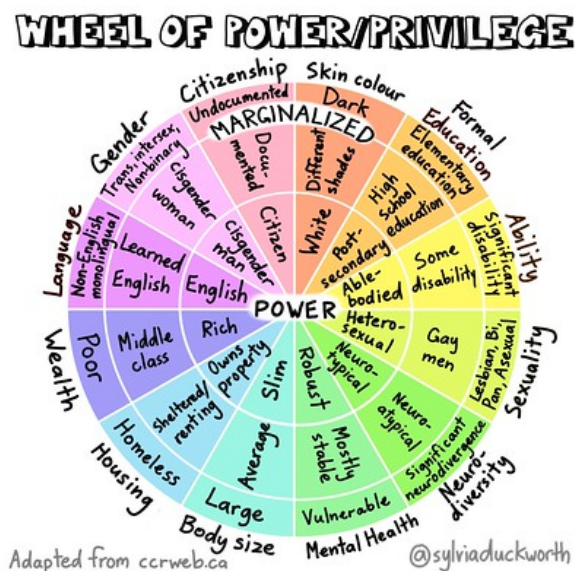

Figure 2. Wheel of Power and Positionality [27]

The activity enables participants to describe, reflect on, and discuss their positionality to develop a greater nuance than check box labelling permits. The researcher's disclosure is included to build comfort and rapport but also to indicate their shared status as participant and equal. Both parties critique the WPP as an EDI tool collectively, to allow for reflection on EDI work, the disciplinary specificities of engineering, and the relationship between our positionality and our work. The activity allows for comparable research question outcomes despite differing initial levels of participant awareness regarding positionality and labelling. In terms of queer methods, using the wheel is a means of "illuminating messy chaotic interstices" [18, p. 18], showing the impact of intersectionality and the dynamic nature of identity. The second activity, optional to allow for differing time commitments, is the annotation of images selected by participants to represent their EDI practice. We discuss how the images represent their practice, and the researcher probes what is visible, or absent, in the image and what this might mean for practice and positionality. This activity is an aid to the self-narration and self-reflection process supported by reflexive questioning from the researcher. It adds variation to the interview process, moving between differing tasks to encourage a more fluid mindset.

The final theme asks participants how their positionality relates to their EDI practice, directly addressing the research question. The prior questions and activities provide context and data, but predominantly they exist to create a framework of reflection and discussion. This scaffolds a journey facilitating a socially transformative experience for participant and researcher, as is the aim of queer methods. This a paper based on the queer methods approach to data collection, and the data analysis is not complete at the time of writing, so will not be discussed in this paper.

4.3 Discussion of Methodology

Queer methods encourage adoption of multiple processes to allow for the multitude of identities, and experiences within one person, hence the two activities accompanying the semi-structured interview. To create the "social transformation" asked for by queer methods, the interviewer must be reflexive, and the interview structure must scaffold growth. Though data analysis has not yet been completed carried out, and this paper is methodological in focus, participants have indicated that the process has made them think about things differently, or that new ideas have come to them from it. Queer methods was used for this research due to a desire to move away from positivist approaches, and whilst participants often cited numerical data as initiating or informing their EDI initiatives, during the interviews participants rarely mentioned data in terms of outcomes, instead talking about impact on students in terms of belonging, on themselves in terms of emotions and talked about barriers in terms such as discomfort. This shows the approach enabling more subjective and qualitative factors to arise.

Queer methods have required a level of bravery to engage with, but they also build on the foundations of activists in gender and sexuality studies who have come before me, allowing me to borrow from their bravery. In particular, coming from engineering and its positivist landscape, I found it challenging to understand that queer methods are dynamic and cannot be pinned down, much like a gender fluid identity. There is not one correct approach to transfer and apply to our context. However, one unanticipated benefit is that using a queer methods approach has encouraged participation due to participant curiosity in the methodology.

5 APPLICABILITY TO ENGINEERING AND DESIGN EDUCATION

One direct example of applying queer methods in the engineering classroom is the Wheel of Power and Privilege, which can be a useful tool for enabling students to map themselves and their teams as they embark on human-centred design work. It allows them to see gaps in their empathy and awareness, and to recognise where they may hold more power than a teammate or end user and thus act as an ally. For the more marginalised students it enables them to have a framework through which to discuss the associated barriers with teammates, but also to view their experiences as an asset in design work as they will have alternative perspectives and life experiences; aligning with queer methods recognition of the value in multitudinous identities. Beyond this, it is challenging to present specific examples of applications as this is a methodological paper and also because little literature exists on the application of queer methods in engineering. However, one of the facets of queer methods is to reimagine and create future possibilities. In this spirit, from my experience, queer methods could be used as a framework to give students, staff and researchers a new perspective on what engineering is, moving from pure maths and physics to tackling global issues with humans at the heart of our thinking. Queer methods could give a platform from which to leap into uncertainty (a necessity for meeting our AHEP requirements) and managing the "wicked problems" which are prevalent within engineering industry. By using queer methods in design modules we can permit ourselves to value outliers and challenge normative assumptions [28] in order to do new things and therefore innovate and be creative [18]. By leaning into the multiple-methods approach of queer methods in learning and assessment design, we can make our classrooms more inclusive and equitable (e.g. offering notes, slides and lecture recordings to suit different learning styles, or choice in assessment methods). Applying the critical analysis aspects of queer methods would support our students critical thinking skills in problem solving throughout the curriculum. By embracing the queer methods attitude that we are all equal participants, we can co-create with mutual respect and better empower our students. As we are reimagining, let us picture a classroom where we tell students we are using an approach based in queer theory; imagine the sense of belonging and safety this would afford to LGBTQ+ students. In that classroom we explain to our students that this means challenging the norms and valuing marginalised voices. Put yourself in the shoes of students who have not previously felt heard by their peers or the academy and how this might empower them. Think back to being a teenager or young adult who wanted to push boundaries and challenge everything; now feel the excitement of this opportunity to be rewarded rather than admonished for being challenging. As such a new area of research, it feels to me there are so many possibilities for queer methods in engineering just waiting to be explored and experimented with.

6 CONCLUSIONS

Queer methods aim to create a socially transformative experience in research, and consequently in teaching. As engineering aims to make the world a better place, engineering design and queer methods are surprisingly well aligned. In the interviews undertaken at the time of writing, queer methods have been an effective, a positive experience for researcher and participants, and had begun to generate surprising results. To fully understand the impact of queer methods on engineering education, this study must be completed and outcomes shared. In the meantime, though, through extrapolation and imagination we begin to see that queer methods offers opportunities to create curricula and research which is socially transformative, inclusive and human-centred for all humans.

The historic norms of engineering have stood for decades, if not centuries. As a community great efforts have been made to make engineering more diverse and inclusive, yet numbers of women are still low and outcomes for racially marginalised students are still inequitable. We need to destabilise these norms if we truly want change, and queer methods are an approach specifically intended to create that destabilisation. Whilst change and instability are scary for those of us privileged to be settled into academic careers, it is our responsibility to use that privilege to make the world a better place, as engineering hopes to do and as queer theory can enable.

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