

Breaking Barriers: Promoting inclusive research culture among PGR engineering students

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Abstract

The academic community increasingly advocates for a more inclusive research culture, prompting universities to actively foster diversity, equity, and accessibility. This inclusivity is crucial for meaningful participation and recognising diverse perspectives in academia. In response, we organised an interactive seminar and developed a board game for engineering postgraduate research (PGR) students to grasp the concept of inclusive research culture. The seminar facilitated open discussions, allowing students to share experiences and comprehend the significance of a supportive environment. Emphasising inclusivity's role in generating innovative outcomes, the seminar showcased its potential through interdisciplinary collaborations. Based on and modified from 'Snakes and Ladders,' the accompanying board game enhanced understanding by providing an immersive experience that encouraged teamwork and creative problem-solving. This approach effectively promotes an inclusive research culture among engineering PGR students, imparting insights into the importance of a diverse and supportive research environment. By embracing inclusivity, universities unlock the research community's full potential, inspiring future generations to contribute significantly to diverse research endeavours.

Keywords: inclusive research culture; postgraduate research students; engineering education; inclusive seminar

Literature Review

Definition of inclusive research culture in academia

An inclusive research culture is a research approach that recognises and values diversity, equity, and inclusion in all aspects of the research process. The concept has recently gained increasing attention in higher education as researchers and institutions have sought to promote more equitable and inclusive research development and recognise and value individual perspectives, experiences, and knowledge differences in the research process (Pless & Maak, 2004; Shore et al., 2010). Similarly, an inclusive research culture could be an effort to address power imbalances in the research process and to empower marginalised communities to participate in research on their terms (Passmore et al., 2022). An inclusive culture can involve critically reflecting on one's perspectives and experiences and being open to feedback and alternative viewpoints (Hattery et al., 2022), and making the research process transparent includes methodologies, data, and findings and sharing information openly with stakeholders (Mahony, 2022; Rawlins, 2008; Wallach et al., 2018). By developing an inclusive research culture, researchers can build trust and credibility with research participants and the broader community while ensuring their research is reproducible and accessible to others.

By understanding the different definitions and concepts of inclusive research culture, we can see no single approach to achieving Equity, Diversity, and Inclusion (EDI) in scientific research and education. By embracing an inclusive research culture, research members and academic communities can help to ensure that scientific research and education are conducted in a way that is respectful, transparent, and relevant to diverse cohorts. In addition, research students and early career researchers can establish themselves as leaders in the field and build a reputation for mutual collaboration, funding opportunities, and professional development.

Impact of Inclusive Research Culture in Academia

Developing inclusive research cultures in higher education has become increasingly influential within research and education communities. O'Donnell (2016) provides an in-depth examination of the impact of organisational policies on building an inclusive environment and the individual and organisational factors that facilitate or hinder the transition toward inclusion in higher education learning and teaching from a critical realist perspective. Contemporary research culture emphasises the societal value of research, as highlighted by Gooch et al. (2016), who examine the impact of interdisciplinary and cross-sector research, outlining opportunities and challenges to generate a more inclusive impact on various levels. Meanwhile, Brauer et al. (2019) evaluate the UK

government's assessment of research impact, critically commenting on implications for future research conduct and discussing the consequences of the Research Excellence Frameworks' (REF) research impact assessment in terms of fostering a transformative research culture. Moran et al. (2020) contribute key findings from interviews and e-surveys to investigate the factors influencing researchers' well-being and work-life balance. Furthermore, Jiang (2006) reveals that the higher education curriculum can serve as a potent yet under-utilised tool in creating a more inclusive experience and promoting intercultural communication for all students.

Inclusive Research Culture for Postgraduate Research (PGR) Students

In higher education, PGR students (PhD students) and all other students (including undergraduate and postgraduate taught) constitute vital elements at the foundational level of the research community, which reinforces the significance of establishing an inclusive and positive research environment to foster both academic and personal development for these students. An exploration into the impact of social capital on the scholarly capabilities of PhD graduates participating in a writing group reveals that a robust social factor played a pivotal role in facilitating accountability in their writing endeavours and enabled meaningful contributions to the broader research community (Tyndall et al., 2019). Another study discusses the development of the Inclusive Environments and Metrics in Biology Education and Research (iEMBER) initiative to comprehend how inclusive, supportive, and engaging environments can be crafted to enhance the success of all biology students and trainees (Ibid). Also, in the pursuit of creating welcoming and intellectually stimulating classrooms for a diverse student body, Cook-Sather and Des-Ogugua (2019) present recommendations to build the academic learning environment by shaping students' learning experiences, scholarly identity construction, and socialisation into the academic culture. Hemmati and Mahdie (2019) investigate the experiences of PhD students, examining their learning environments and the associated challenges, such as barriers to research participation and access and the variation of programmatic structures, research culture, and campus climate. Moreover, to address the need for diversifying research participation, Haeger et al. (2021) continue to present findings on these barriers, along with successful initiatives and strategies for creating more inclusive research environments. Martin et al. (2023) employ system mapping to examine the role of PhD training programs and policy interventions in shaping research culture.

In the evolving landscape of UK higher education, where institutions increasingly admit more students from diverse ethnic backgrounds, academics have a bigger responsibility to cultivate inclusive, welcoming,

and affirming learning environments. Thus, within this context, there is a notable emphasis on enhancing research integrity and quality and providing guidance and support for researchers. To address this imperative, Azevedo et al. (2022) discuss the need for a holistic approach to fostering inclusive educational environments and building research integrity: teaching, mentoring, and monitoring students through open scholarship, emphasising the interconnections between pedagogical practice and research integrity. Training on research integrity for doctoral students can promote the development of an inclusive research culture as it can be treated as a place to develop and clarify their responsibilities in research policy development and implementation at all levels (Sarauw et al., 2019). Also, embracing a positive research culture during doctoral study and research at the institution is beneficial for science and engineering PhD students' development (Chiang, 2003; Deem & Brehony, 2000).

Methodology

This study aims to help PGR students deepen their understanding of building inclusive research environments and provide viable approaches through an interactive workshop. The workshop included slide presentations, questionnaires (close-end and open-ended questions) and an interactive board game to promote student participation and interaction. By engaging participants in various learning activities, this workshop aims to promote comprehensive knowledge and awareness of building an inclusive research culture among PGR students. Through data collection and analysis, it is expected to provide substantive recommendations for enhancing inclusiveness in broader engineering research environments.

The seminar emphasised the significance of cultivating a supportive and welcoming environment that values diverse perspectives, backgrounds, and experiences. It also highlighted how embracing inclusivity can lead to more robust and innovative research outcomes through interdisciplinary collaborations and increased productivity. Participants interacted during the seminar via effective group discussions. The seminar and questionnaire surveys have received ethical approval from the Department of Electronic and Electric Engineering Ethics Committee at the University of Sheffield.

Workshop structure

Stage 1: Slide presentation (3 rounds of 30 - 60 minutes)

The workshop begins with the first presentation, which introduces the background, importance and relevant concepts of building an inclusive research environment. By explaining the theoretical framework, students' interest in inclusive research culture can be stimulated.

Stage 2: Questionnaire (4 rounds of 15 minutes each)

Each round of questionnaires (5 to 7 questions) aims to assess the level of awareness and perception changes in the student's understanding of the inclusive research environment. Each round was followed by a short group discussion to facilitate the exchange of ideas and interaction. The questionnaire covered topics including:

- Defining inclusive research culture
- Creating an inclusive research environment
- Addressing bias in research and promoting diversity
- Committing to an inclusive research culture

Stage 3: Interactive Board Game (45 minutes)

The interactive board game was designed and modified based on the open game framework created by the Open University Engaging Research activity 'Snakes and Ladders of Social Media'.¹ The card template is shown in **Figure 1**. The total number of cards is 33. The interactive game can deepen students' understanding of inclusive research culture through role-playing and situational simulation. The board game is designed to include multiple scenarios, individual and collective views and assumptions of inclusive research culture that require students to think and work in groups, envisioning and reflecting on how they would respond to these issues and situations in the real world. While playing the game, students deepen their understanding of learning about inclusive research cultures and gain opportunities for teamwork and interdisciplinary communication.

Figure 1: The template cards for the 'Snakes and Ladders of Creating Inclusive Research Culture in Engineering'.



Stage 4 Group Discussion and Summary (10 minutes)

After each round of questionnaires and games, students will be engaged in a group discussion to share their views and experiences. This will provide real-time feedback and a conclusion, which will help researchers better understand students' needs and confusions and help students improve their awareness of inclusive research culture. Additionally, in this stage, the research team can obtain students' feedback on the workshop as guidance for future improvement.

Findings and Discussion

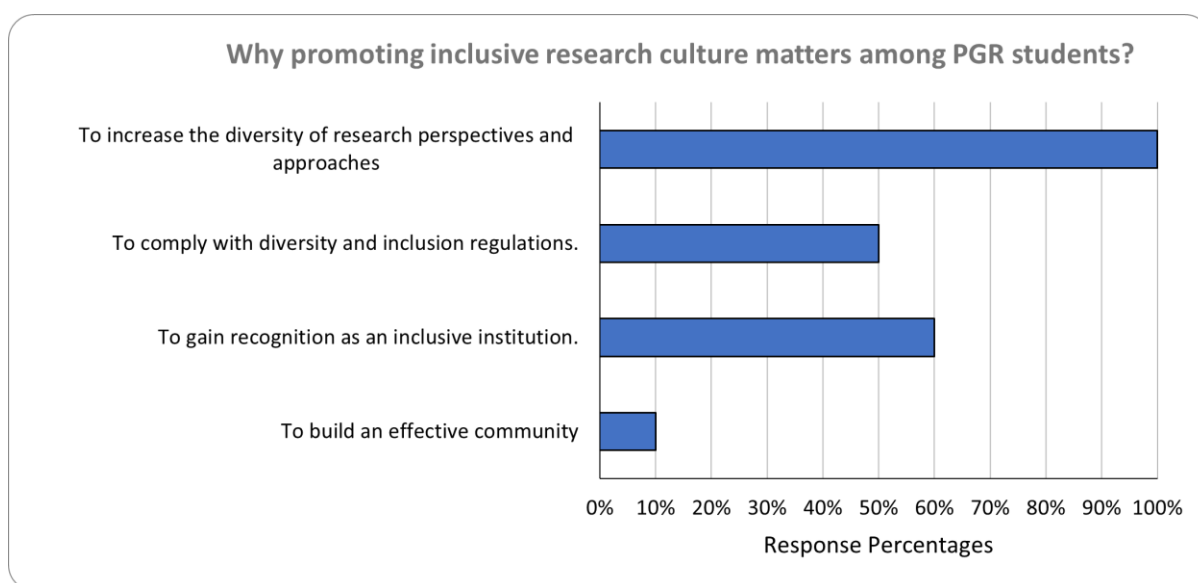
Through this inclusive research seminar, we hope to involve more students (not only limited to PGR students) in creating a better inclusive research culture within the Faculty of Engineering. We expect the seminar to serve as a platform for students to deepen their understanding of inclusive research culture and a place to share their opinions. Thus, in this paper, we reflect on the students' voices and further explore the direction for developing an inclusive research culture in the faculty.

Aspect 1: Students' voices

What is clear from the students' voices gained from the seminar questionnaires is that they have developed an initial understanding of the inclusive research culture created in their departments. Regarding the importance of promoting an inclusive research culture in engineering departments (as shown in **Figure 2**), there was consensus among the students, with 100% affirming that promoting an inclusive research culture can enhance the diversity of research perspectives and approaches, underscores a collective recognition of the significance of inclusivity in

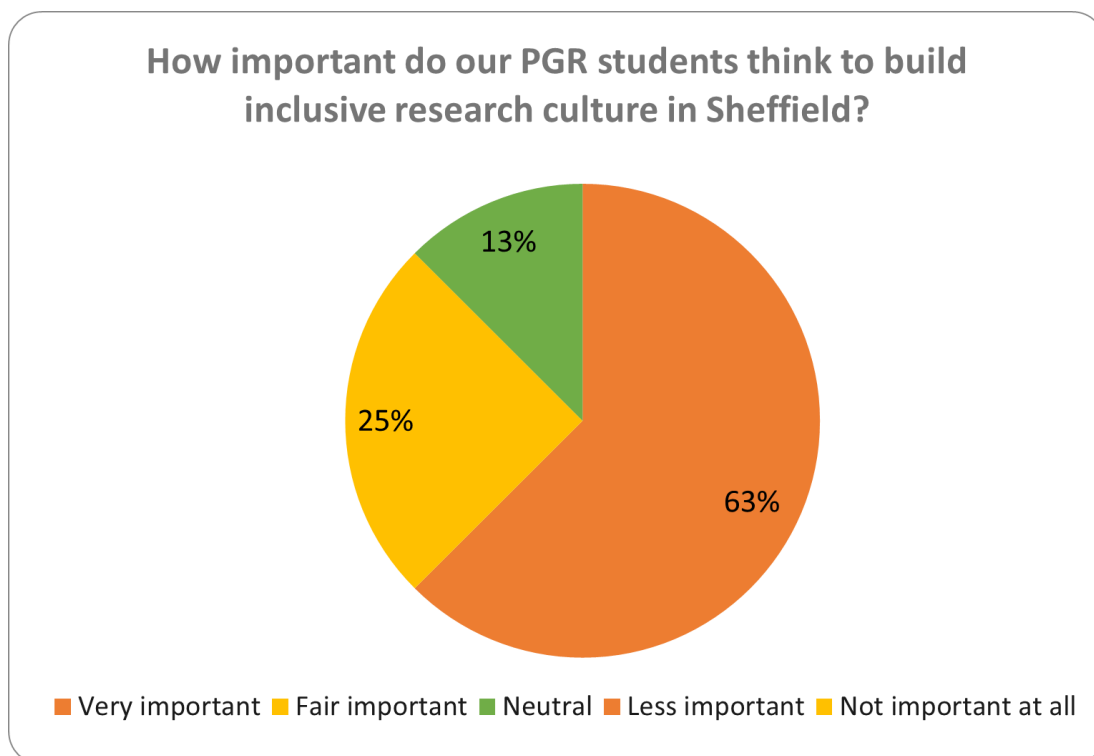
academic settings. This overwhelming agreement suggests a shared understanding among students that diverse perspectives contribute to a more robust and innovative research environment. Moreover, the survey results reveal additional dimensions to students' perspectives on inclusive research culture: 60% of students believe such a culture can lead to institutional recognition as an inclusive community and foster inclusivity within education and research. 50% of students associate the importance of an inclusive research culture with compliance with diversity and inclusion regulations. This finding indicates a nuanced understanding among students regarding the regulatory frameworks governing academic institutions and suggests a recognition of the need for alignment with broader diversity and inclusion goals. Furthermore, the data also reveals that only 10% of students emphasise the role of an inclusive research culture in building an effective community. This minority viewpoint offers an opportunity for further exploration, prompting questions about the perceived relationship between inclusivity and community building within academic research settings.

Figure 2: PGR students' perceptions on the importance of promoting an inclusive research culture in engineering departments.



In terms of building an inclusive research culture in Sheffield (as shown in **Figure 3**), the majority agreement of 88% (63% think building inclusive research is very important, and 25% agree it is fair important) on the importance of building an inclusive research culture for a university signifies a strong collective commitment among students toward creating an academic environment that embraces diversity and inclusion. This perspective positions inclusivity as a core value that should be prioritised in the overarching goals and strategies of the academic institution. However, 13% of the students remain neutral on this point of view.

Figure 3: PGR students' perceptions on the importance of building inclusive research culture in Sheffield.



Aspect 2: What are we missing in creating an inclusive research culture?

From the students' open-ended feedback, we not only learnt about their thoughts on an inclusive research culture but also had the opportunity to identify areas currently missing and neglected in developing the research culture at the departments and faculty.

A comprehensive analysis of survey responses underscores a pervasive sense of inadequacy in communication, training, funding, and accessibility of resources within the department, which may hinder the promotion of creating an inclusive research culture. The identified deficiencies include the absence of clear information on supporting facilities, funding, and related training. Learned from students' views, the lack of relevant information about inclusive research culture in supervision meetings, research support and networking opportunities may reflect their awareness of how to create and recognise the inclusive culture around them. Some students also mentioned that they received few words of encouragement in their studies and research, which may also lower their initiatives to create a positive research environment. Furthermore, the students felt that their colleagues and co-workers were unfamiliar with the concept of an inclusive research culture, which would prevent them from engaging in relevant discussions and collaborations. This also indicates that the broader understanding of inclusive research culture is not adequately communicated and integrated into the organisational composition of the research community. Thus, it becomes evident that a

comprehensive strategy is required to address the identified shortcomings such as enhancing communication channels, providing relevant training, securing funding avenues, and disseminating clear information on available resources are imperative. Additionally, the expansion of working spaces and collaboration opportunities within the institution should be explored to encourage cross-disciplinary engagement.

The survey responses show a landscape marked by communication gaps, training deficiencies, funding limitations, and a general lack of awareness within the department regarding inclusive research culture. These findings emphasise the need for strategic interventions to bridge these gaps, fostering an environment that supports individual researchers and promotes collaborative, inclusive practices across the academic community.

Aspect 3: How can the departments improve?

After understanding the students' perceptions of inclusive research culture through the seminar and questionnaire investigation, the results shed insights on further establishment of a better inclusive research culture in the departments and faculty. The survey responses helped the research team visualise the PGR students' understanding and expectations for developing an inclusive research culture within academic institutions. It is also worth noting that a recurring theme in students' responses emphasised providing clear information and interdisciplinary collaboration. As student researchers, they expected to have more cross-disciplinary working groups and opportunities to share and discuss their research with diverse audiences. Also, with the ongoing internationalisation of the research community at British universities, it was mentioned that multi-national projects and the establishment of a PhD hub for sharing research progress across different areas could benefit students to integrate into the research community. For instance, supporting international PGR students early on during their study and research to understand the inclusive research culture, cultural differences and challenges is also valued. This reflects an awareness of the unique needs of international PGR students to understand research culture and the potential cultural barriers they may encounter during their academic journey.

From the PGR students' view, the desired practices for cultivating a more vibrant and inclusive research community can be a multifaceted approach to fostering collaboration and a supportive academic environment. Increasing group work and meetings between academic staff and students can provide a more interactive academic setting for knowledge-sharing. Enhancing departmental advertisements on research culture can create greater visibility and awareness of the available resources and

opportunities within the academic community. This suggests an awareness that effective communication is vital in creating a positive research environment.

Conclusion

In conclusion, the insights gathered from the study are evident that PGR students view an inclusive research culture as essential for their academic and personal development. The emphasis on collaboration, diversity, and support for individuals indicates a desire for a holistic and nurturing research environment. To enhance this culture, the faculty and departments could consider implementing measures such as creating interdisciplinary platforms, providing resources for international students, and fostering an ethos of inclusivity in team dynamics. By engaging everyone in the research community, particularly in disseminating essential information to new students and confirming a commitment to inclusivity between research groups, the information gaps and unfamiliarity can be minimised, promoting a sense of belonging and security among students. In addition to formal events organised by the faculty during working hours, the organisation of out-of-work events can extend the building of an inclusive culture in the broader community. These informal activities can serve as platforms for social interaction, bridging social gaps and creating opportunities for students and staff to connect on a personal level to form the cohesiveness of different research groups.

Additionally, the importance of departmental promotion of related activities on caring for students' well-being cannot be overstated because the development and embracement of an inclusive research culture involves not only supporting students in their academic journey but also maintaining their physical and mental well-being. The faculty and department's promoted activities can contribute to creating an environment where PGRs feel supported, both academically and emotionally, fostering a culture of inclusivity and mutual respect from everyone. As these events inevitably include students from different cultural backgrounds, recognising and addressing cultural differences, particularly between Eastern and Western perspectives, is integral to developing an inclusive research culture. Then, in organising these activities, the PGR supervisors and research groups can also play a vital role in facilitating the integration of different students. For example, a research group supervisor or a senior student can lead a new student to participate, playing as a role model and providing advice to help new students adjust to the new environment.

In essence, the key to building a better research community lies in a comprehensive approach that encompasses early introduction for PGR students, fostering social connections, providing effective supervision, promoting departmental activities, prioritising student well-being, and embracing cultural diversity. By embracing these practices, academic institutions can create a robust and inclusive research environment that nurtures all students' academic and personal growth, developing a community where diversity and inclusivity are acknowledged and celebrated. These aspirations gained from this study provide valuable insights for academic staff and institutions seeking to strengthen their research communities, highlighting the importance of formal and informal initiatives in creating a rich and supportive academic environment. This study has also indicated the direction for institutions to consider and adjust practical steps to build inclusive research cultures that meet the diverse needs and expectations of various PGR student cohorts.

Future Work

Future efforts to enhance the inclusive research culture within academic institutions should focus on implementing concrete strategies derived from the identified needs and aspirations of postgraduate researcher students (PGRs). Recognising the significance of early introductions for new PGR students, institutions could develop orientation events that familiarise students with departmental resources and emphasise inclusivity and collaborative research values. Thus, building on the insights gained from the current studies, our future work will involve more active implementations of targeted strategies to address the specific needs identified by students through providing early introductions for new students and training series at all stages. Through these activities, we expect to enhance students' understanding of and embrace inclusive cultures while better caring for students' well-being and cultural diversity. We will also continue to conduct investigations to obtain student feedback to understand their changing perceptions of the inclusive research culture around them. This will pave the way for a more inclusive and collaborative research community in academic institutions, benefiting all postgraduate researchers' academic and personal growth.

Ya He: a PhD student in Engineering Education from the University of Sheffield, researching how digital tools and gamification can enhance teamwork and learning experiences for international engineering master's students in UK universities, also participating in promoting the positive research culture amongst engineering students as the PGR researcher for this paper study.

Ziyang Hu: a PhD student in the Electrical and Electronics department at the University of Sheffield, focused on developing cutting-edge three-dimensional computational microscopy imaging systems. Since joining the departmental research culture group in early 2023, Ziyang Hu have actively contributed to fostering a supportive and inclusive environment for engineering postgraduate researchers, through initiatives such as training programmes, diversity workshops, to enhance the overall research experience for all students.

Rola Saad: Academic and RF engineer at the department of Electronic and Electrical Engineering (EEE), the University of Sheffield. Rola is specialised in phased array antennas and electromagnetic structure design, finding novel solutions to 5G/6G technologies. Rola has keen interest in implementing novel blended teaching models and fostering a positive research culture within the engineering community. Rola leads the research culture project at EEE looking at upskilling researchers on research excellence, impact and entrepreneurship.)

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Endnotes

ⁱ For research details please see: https://www.open.ac.uk/blogs/per/?page_id=6171.