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Perspectives on Engineering Education Research in the UK: what is being done, why, and for whom?

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ABSTRACT

CONTEXT

Engineering education research (EER) continues to be an emerging field of research in many parts of the world. Unlike other countries within Europe, the UK has a long history of EER, with effort focused on advancing a technological workforce during the post-war era. Despite this, there currently exists a lack of engagement in EER activity within the UK and it does not share the same level of prominence as other countries including the USA and Australia.

PURPOSE OR GOAL

In a UK context, there is a lack of information pertaining to: who identifies as an engineering education researcher or is involved in engineering education research; how they define engineering education as a field of research; who they consider their audience to be; and the factors that inform their research questions, methodologies and whom they choose to collaborate with.

APPROACH OR METHODOLOGY/METHODS

The research is based on the qualitative analysis of semi structured interviews with individuals who identify as engineering education researchers, and who are involved in EER within a UK context. Invitations to participate in the interviews were sent to members of the UK and Ireland Engineering Education Research Network (EERN). The interviews were transcribed, coded, and thematically analysed.

ACTUAL OR ANTICIPATED OUTCOMES

The findings suggest that UK EER is primarily conducted by intrinsically motivated teaching focused academics. Research questions tend to be of personal interest and focus on the participants' local context. It is uncommon for those involved in EER to collaborate, especially with colleagues external to their own institution, or with education researchers and social scientists. There is a preference for disseminating work at conferences as opposed to within journals and an acknowledgement that UK EER is not yet of the quality needed for either funding or publication in some journals. There is a distinct lack of professional development and informal mentoring opportunities, as well as funding, time and recognition for partaking in EER.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

Our preliminary conclusion is that although EER is not yet considered to be a recognized research field within the UK, the perceived need for both an emerging research agenda, and a consensus in quality criteria. are indicative of a move toward the establishment of EER as a bone fide field of research. More investigation and utilisation of quantitative approaches are needed to enable us to reach fully evidenced conclusions and will form the next stage of our investigation.

KEYWORDS

Engineering education researchers, researcher identity, researcher agency, UK.

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Introduction

Previous work has highlighted a lack of clarity around the goals, identity, and status of Engineering Education Research (EER) (Jesiek, Newswander, and Borrego, 2009). There have been several publications which focus on EER within different contexts, including the U.S.A. (Froyd & Lohmann, 2014); Portugal (Sorby et al., 2014; van Hattum-Janssen et al., 2015); Ireland (Sorby et al., 2014); Australia and New Zealand (Godrey &Hadgraft, 2009); Europe (Bernhard, 2018); and within the Nordic Countries (Edström et al., 2016). Elsewhere, work has considered EER within a global context (Jesiek et al., 2010a; 2010b; Streveler, & Smith, 2010) and compared approaches taken by researchers in different locations (Borrego & Bernhard, 2011). These studies highlight the relative lack of EER within the UK.

EER in the UK stretches back to the end of WWII (Bosworth, 1963; 1966; Heywood, 1969; 1970; Heywood & Monk, 1977; Ministry of Education, 1945; 1956). Despite this long history, more recent studies have found that UK academics dedicate little time to EER; the field is marked by low levels of publication, and a lack of resources and financial support (Shawcross & Ridgman, 2013). A later study, which focused on research conducted within the UK between 2000 and 2017, showed that most of the published work was single authored, or from single institutions (Nyamapfene & Williams, 2017). These studies highlight a lack of consistency in research questions addressed. However, neither of these studies provide qualitative information pertaining to engineering education researcher identity, and factors informing research questions, collaboration, and dissemination.

Focussing on a UK context, this work-in-progress study set out to investigate who identifies as an engineering education researcher or is involved in EER; how they define EER as a field of research; who they consider their audience to be; and the factors that inform research questions, methodologies and whom they choose to collaborate with. The study follows the approach taken by Borrego and Bernhard (2011), which focuses on answering the w-questions (what, why, to what end, where and who) of education. It is hoped that, in light of the "persistent state of déjà vu" (Wisnioski, 2015, p. 244) experienced by engineering educators, that this study will help reveal factors needed to support the development of UK EER and inform conversations about its future.

Methodology

This study aims to provide a snapshot of the state of EER in the UK. The nature of the research question necessitated the use of a purposeful sampling approach to identify those involved in EER in the UK. A call for participants was distributed via the UK & Ireland Engineering Education Research Network mailing list. The authors also sent emails to colleagues within their own institutions. Email recipients were asked to identify as "an engineering education researcher or (be) involved in engineering education research". Eleven individuals initially consented to participate. Through a snowball sampling approach, a further three were recruited. Participants came from eleven different universities with eight having previously worked in industry. Further participant information is given in Table 1.

Table 1: Participant information

	Engineering/STEM	Non engineering/STEM	Total
Teaching Specialist	9	1	10
Research & Teaching (Traditional Academic)	3		3
PhD (Engineering Education)	1		1

A semi-structured interview protocol was developed to encourage a conversation about topics including: participants' career path, job role and motivations for taking part in EER; the factors that informed their research questions, methodologies and choice of collaborators; the means by which their research was disseminated; the ways in which their work was

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recognized and rewarded; and the extent to which they engaged in EER conferences, networking and professional development opportunities. The research methodology was approved by the Swansea University College of Engineering Ethics Committee.

Interviews lasted between 45 and 60 minutes and were conducted, recorded, and transcribed by the authors. The researchers met following their initial interviews to adjust the interview protocol. The transcripts were sent to the participants for approval before analysis. A thematic analysis (Braun & Clarke, 2006) was undertaken with an initially inductive and semantic approach taken to identify themes. The researchers coded the data independently, and then compared themes and sub-themes. The transcripts were re-read and re-coded following agreed theme identification. Both authors agreed that the data obtained during the final interviews did not lead to identification of any significant new themes.

Findings

Who is doing Engineering Education Research and Why?

Ten of the participants interviewed were on a teaching pathway. This, despite the limited sample size, would suggest that these individuals make up a large proportion of those engaged in UK EER. One participant noted that it was not until "you are somebody designing and reassessing courses" that you consider EER. Another participant suggested that the narrow technical specialisation within UK engineering education meant that "people who are studying engineering are not then particularly interested in engineering education research". This is consistent with Figueiredo's view (2014, p.27) that "most of those who decide on the future of engineering education are already one-dimensional engineering scientists in a process of fast convergence towards self-perpetuation".

Conducting EER was generally intrinsically driven by a motivation to improve teaching. The majority of the ten teaching specialists described a preference for teaching, with one saying they had not wanted a role "heavily involved in research and with minimal teaching" Another said that EER is, "never going to become my full career because I really like teaching". The same was true of academics on a traditional academic pathway, as indicated by one such participant's claim that technical research was "not necessarily satisfying all the curiosity".

Three of the participants had moved from a traditional academic 'teaching and research' role to a 'teaching and scholarship' role. One claimed to have a "wider interest in research" which they described as "making solutions, improving things, making something better". They considered that this, alongside being "fascinated by education" and wanting to help in "supporting others to also learn and understand", was what drove their EER. These findings point toward participants taking an engineering-centric problem-solving approach to EER, which was then primarily viewed as a 'tool' for solving perceived problems in teaching.

These findings suggest that EER is primarily conducted to support teaching. This is consistent with previous research in which it was found that EER is viewed as a "teaching activity" as opposed to a "viable research area" (ASEE, 2009, 2012; Olds et al., 2012).

What is considered as Engineering Education Research?

EER was viewed as existing on a continuum which includes scholarship. One teaching specialist did not consider themselves a researcher because their work was "more about observation and action research around my own practice rather than saying I'm going to start out with a research question" and that their findings were instead "emergent from practice". This distinction was even less clear for some, with one teaching fellow saying that scholarship "can be reading journal papers… can be presenting at conferences… that could just be engaging with the literature". These findings suggest that the participants felt uncomfortable referring to their work as research, possibly because they viewed it as somewhat less rigorous than technical engineering research.

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What are considered as research questions and how are they informed?

Research questions were primarily focused on issues of personal interest. In general, research topics tended to focus on issues to which individuals were "really drawn to on a personal level", as stated by one of the participants.

There were perceived shortcomings in research questions that focused on local context. Research questions tended to focus on the local context, with typical research activity focused on teaching. One interviewee suggested that "the university expects it (EER) to be within the university at that level". This contrasted with the participant's desire to engage in wider research, "looking across the department or looking across universities".

There was a move toward asking wider research questions and creating a research agenda. One participant suggested that EER needed to focus on wider issues like "where engineering needs to move… what do we need to do to change the sector", with another participant suggesting that there needed to be an "ongoing conversation to refine and agree what our real benchmarks are". Another participant felt "emerging agendas are a good thing …people who could come together and identify their common interest". One teaching fellow believed this would "make it (EER) into something bigger than just the individual people doing that." The emerging shared belief in the need for a common research agenda to underpin the growth of UK EER is consistent with views of historian Michael Mahoney (2004), that a common research agenda can help foster disciplinary unity in emerging research fields.

How are skills in Engineering Education Research developed?

There was a lack of formal development opportunities for those engaged in EER. Participants thought EER was "different from the kind of research that they would do" and that "people don't really know how to go about it". They saw a "need to find a way to bridge this gap and help people in that scenario to actually have the skills, but also the confidence".

The difficulties faced during the transition to EER indicated a need for wider support. Those who had begun to develop such skills had varying experiences, with one educator saying that "it's quite hard to admit (you don't have the expertise) and work in a space where you're a complete beginner". Another, who had obtained an MSc in Research Methods said that having "come from the positivistic backgrounds…it really opened my eyes to how important the qualitative research was". This gap in knowledge was, according to one participant, worsened by early subject specialisation in the UK education system, with decisions to study engineering being made "at 18" when you "to some extent…stopped writing essays."

Some teaching specialists were unsure of their ability in EER with one saying, "I don't see myself as an engineering education research person because I'm not embedded in the social sciences enough" and another saying, "I just don't feel like I know the politics enough to be able to navigate the system to make the case for it". They questioned whether this was because they were on a teaching pathway and excluded from the Research Excellence Framework (REF), which is used to determine the allocation of "quality-related" government research funding within the UK. These findings suggest a need for wider support which focuses on identity development and increasing the confidence of those partaking in EER.

Academic development departments played a role in introducing participants to education research but there was desire for discipline focused training. Three interviewees spoke of obtaining a teaching qualification, with one saying it "got me more excited again about pedagogy". A different participant claimed that teaching support was "way too generalist… not very impactful" with another saying that it "didn't really go into any depth when it came to engineering specific education research… I don't think I even realized it even existed".

Who did participants work with and how were collaborations formed?

Collaborations were generally informal, with limited sustainability. Collaborations were predominantly formed between engineers who taught on the same programmes. One

participant spoke of belonging to an institutional EER group but said “things change quite rapidly” and had “kind of gone back to the beginning” when a key member left.

The role played by education researchers varied across institutions. Working with social scientists and education researchers was considered a form of development for engineers. However, one participant said that their education department had “never been particularly interested in the overlap” with EER and another considered that the education department “train the schoolteachers” and that very few were involved in “proper research”. Participants had varying levels of engagement with internal education research networks, with one teaching specialist saying that they “don't necessarily feel invited” and that collaboration relies on “individual relationships” and ‘luck’. However, another participant, who had co-founded an institution wide education network, claimed it is “valuable because it means we're bringing together people who have different perspectives and different expertise”.

There was some evidence of an increasing effort to engage in external collaboration. Those with external collaborators were either senior research professors, or those who had transitioned from industry and had “kept those contacts going”. It was less common for participants on a teaching pathway to collaborate externally, with one interviewee saying that they had “spent two years finding my feet and teaching” and that they needed to “go and do a bit more networking”, and another that they “just don't feel like I have the external contacts or the time to develop them”. A different interviewee described finding collaborators by looking “for more teaching fellow type people” on “the staff pages” of other universities.

Where do participants share their work and access networking opportunities?

Conferences were viewed as opportunities to receive feedback from like-minded people. Participants viewed conferences as an opportunity to meet “networks of likeminded people”, and, to a lesser extent, to facilitate collaboration. Almost all of those interviewed valued the annual conference held by the UK and Ireland Engineering Education Research Network (EERN) with one saying “it's very friendly, it's really small. It feels very supportive.” This seemed particularly important for those who lacked support in EER in their own institutions. The opportunity to “get feedback” was reiterated by several participants, with one teaching specialist indicating that they were “craving that interaction and discussion…that feedback”. Participants also felt that conferences were more accessible than journal publication as, in the words of one interviewee, “you don't have to jump through the same hoops,” as publishing, with another saying, “it's less daunting … and less daunting in terms of time”.

Desire to grow the EER community was considered to lead to a compromise in research quality. Some interviewees acknowledged that “we want the community to grow” and that “almost anything is accepted”. This was seen to result in “very little cohesion or consistency or themes that allow you to dig into any depth”. It was also considered that there was “too much I made this change to my module, and this happened”, and “a lot of scholarship”. Interviewees were also critical of the more general higher education conferences and symposiums, with one individual stating that they “ended up talking about the paper in a room with three people” and considered it “ridiculous. It was pointless…so I published a paper that's been lightly peer reviewed to speak to three people. I'm not doing that again”.

There was considered to be a lack of information about which conferences to attend. Several participants said that they did not know which conferences to attend, with one saying that they “just picked one that seemed to have a theme that looks interesting or relevant” and another saying, “it’s a bit random.” One interviewee questioned “who am I supposed to find out from, where’s the list of conferences that are acceptable or not”.

Where is Engineering Education Research being published?

Few of the participants had experience of publishing their work, with the barriers seemingly being associated with their roles as teaching specialists. Perceived barriers to publication included a lack of time to conduct and publish research and high teaching workloads, with one interviewee saying that “the people who are often well placed are those of us that are on

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teaching focused pathways… are quite time poor when it comes to do this kind of work, because… you have a huge teaching load". One participant said that they were "rubbish at writing my research and publishing it" and another that they had "lots and lots of part written papers". In some cases, this appeared to be associated with a lack of confidence, with one participant saying that they did "not feel very competent about" the use of "language". One participant, who was a senior research professor, acknowledged that those mainly involved in EER were teaching specialists, some of whom had "never done research". This was viewed as a potential obstacle to publication as they may not "understand what world leading means…don't understand what the world stage is" and "don't read widely enough".

Some participants highlighted the variation in journal standards and criteria. From the participants' perspective, the two main journals for EER publication were the Journal for Engineering Education (JEE), and the European Journal for Engineering Education (EJEE). Of the two, participants felt that the JEE was the more difficult to publish in, with one interviewee suggesting that that whilst the JEE was "the place that they (the university) would look on", publishing in it would be like "taking on a bit of a Goliath". This was considered implicit from the relatively small number of "papers from Europe they publish" and was put down to the fact that UK EER studies were typically either qualitative or were based on small sample sizes, with one interviewee saying that the UK and USA had "very different perspectives on what we're expecting from research". Another participant instead suggested that "one of the key places that perhaps at the moment most of us should be publishing is the EJEE." However, they added that whilst they had presented at SEFI conferences that has "a very mixed track record with getting things into the journal".

What is considered as 'quality' Engineering Education Research?

Those who had experience of research in other disciplines saw a need for high quality EER. Where to publish EER was linked with conversations about criteria for quality. It was noticeable that the majority of those who spoke critically about the quality of EER were those with successful research careers. One professor who had "sat on four research assessment panels" and had reviewed EER articles, considered it "the brutal reality" that "nobody in the education REF panel will take the slightest notice of EER because they don't think it's sociologically valid…nor is it going to be believed by the engineering panels, because they think it is copping out because it's not quantitative enough and it's not hard enough". In contrast, a teaching specialist said "you can do the smart things, but unless you read a lot of literature to say why you're doing it, you're not allowed to publish based on common sense".

Who is Engineering Education Research considered to be for?

There was a perceived mismatch between the intended target for EER and the current mediums for EER dissemination. Some participants felt that their target audience were fellow engineering education practitioners. However, there was a general feeling that they were "not talking to those people", partly because this target audience did not read the targeted EER journals or attend EER conferences. One participant commented that they "have no expectation that anyone will ever read" the papers published in highly technical journals, and it would be "a retrograde step to start worrying too much about only writing for the big journals." Another participant observed that the way in which EER was written and the use of "sociology language" can put "your target audience (here considered to be engineering educators) off", saying that it "comes in how you write it". Such findings support Jesiek et al. (2009) who questioned whether the development of EER was consistent with the promotion of practical interventions or if researchers risked isolating themselves from practice.

Who is funding Engineering Education Research?

Lack of funding for EER was considered to limit research quality. The ability to publish in "the big journals" was linked to securing funding for EER. One interviewee suggested that "we need to show that we've got research credentials to be able to get the stuff we need." Another participant agreed with this sentiment, saying that "it's kind of a bit chicken and egg."

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One participant believed there was “a lot of expectations from the funding bodies, that the institutions should be funding this work and the institutions say like go and find your own funding’”. They described this as “an impossible situation”. One participant believed that “unless you were kind of leading the field...it'd be a very hard sell”.

The EER community is not yet recognized within the Higher Education System. Although one participant thought that “it is helpful that there is a stream of teaching only people…because it means there is an identifiable community that needs funding”, another teaching specialist countered this view, saying those involved with EER “don't exist for the research councils”. Another expressed a lack of optimism in EER researchers’ chances of securing research council funding, saying “the proposals just won't look very impressive alongside you know really rigorous studies that people want to do within their discipline”. Another interviewee said that “the educationalists want to ring fence” education research funding and that you would be “an outsider …in terms of terminology and track record”.

Funding opportunities were generally considered to be inconsistent and limited. One participant considered that “industry will support you…. so, if it's something to improve …improve the graduate quality, you tend to find the local industry are quite interested”. One interviewee who had been successful in obtaining some external funding attributed this to “fitting with the opportunity because that is where the funding was”. The Royal Academy of Engineering was considered as a potential source of funding but was understood to be a closed shop, having a “approved list of suppliers ... a small number of authors they go to as consultants to produce their reports, …they’re buying the reliability of a known supplier”.

How is Engineering Education Research supported and recognized?

There was a perceived opportunity cost associated with partaking in EER for ‘traditional’ research and teaching academics. One academic queried "if you've got 40% of your time to work on research. Do you put that into engineering education research where the impact factor is going to be relatively low? Or do you put it into your disciplinary research, where you can get a higher impact factor and so will advance your career because you're going to get good metrics that are going to enable you to get promoted?”. One professor believed that “if you're looking for respect from all your colleagues, you're not going to get it if you go into education research”. It is notable that all the participants who showed least concern about the value of education research were all professors who were well established within their fields of technical research. Similar findings were discussed in the context of Australian higher education, where early career researchers were claimed to be “more vulnerable” (Gardner & Willey, 2018) and the USA where it was suggested that some consider EER to be a “hobby” or “as a side activity”, conducted “later in [one’s] career” (Jesiek et al., 2009).

There was a perceived disparity in recognition for teaching focused staff. One teaching specialist described a “real disparity” between teaching and research staff because “you can't get promoted without doing this work (EER), but you're not being given time… you have to be able to commit more than you're contracted.” Another perceived disparity was that traditional academics were likely to “have a pot of money”, which allowed them to share work externally and via open access. This meant that “somebody who's able to publish something open access is likely to get more citations... than people who are prevented from doing that.”

The level of institutional support for EER was perceived to be variable and inadequate. *S*everal participants alluded to support being dependent upon chance, with one saying that they were “quite lucky” to have a line manager who supported their involvement in EER. In comparison, another said, “my line manager is not interested in the teaching” and had refused to fund their EER research. One teaching specialist said that EER is "not supported or resourced” but was “tolerated”, whilst another believed that their institution supported EER “on paper” and that “whether the resources, the time, the processes are well designed for scholarship…that's another matter”. This lack of institutional support was perceived to be due to the belief that the “institution doesn't understand what it means by scholarship.” A recognized effect of EER being a developing field was that “we’re all just on our own”. There

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was a lack of mentors, one participant claiming that “this is one of the most frustrating things and I just don't feel like I have any one more senior to rely on or call on for support. “

Conclusions

This work-in-progress study highlights multiple factors that are needed to support sustainable growth and development of UK EER. Our preliminary finding is that although EER is not yet considered a recognized research field within the UK, findings which highlight the perceived need for an emerging research agenda and a consensus in quality criteria indicate a move toward the establishment of EER as a bone fide field of research. This research has several implications for the development of EER within the UK. There is a need; to assess workload of teaching specialists in relation to promotion criteria and expectation for scholarship and EER; for sector wide discussions about the funding of EER; for the development of training opportunities for staff involved in EER; and for increased opportunities for collaboration.

The nature of the research question meant that this study only reflects the views of a small number of self-selected participants who “identify as engineering education researchers, or who consider themselves to be involved in EER”. The study is therefore subject to selection bias. The email invitation made it clear that “the growth of EER within the UK has been somewhat stifled” and that this study provided an opportunity to gather data which may “inform ways in which the growth of EER may be supported”. It may therefore be reasonable to propose that those who took part empathised with this message and wanted to contribute towards the growth of EER. It is possible that such participants would focus more heavily on negative aspects of EER within the UK, thus biasing results. Future work may benefit from a quantitative approach that includes a sample that is more representative of the EER community, as well as the audience of the research, researchers within humanities, social sciences or education or other stakeholder parties, for example, funding bodies and journal editors. It would also be of interest to explore the views of those from contexts in which EER is better established. Hence more investigation is needed to enable us to reach fully evidenced conclusions and will form the next stage of our investigation.

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