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COMMUNITY-BUILDING AMONG PHD STUDENTS IN ENGINEERING EDUCATION RESEARCH: THE SEFI SUMMER SCHOOL AND AAE WINTER SCHOOL

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ABSTRACT

Engineering Education Research (EER) is a rapidly evolving and increasingly valued research field. This supports the number of PhD students to grow steadily, but unfortunately, they are often limited to a few within the large engineering faculty/department, having different backgrounds and interests. Additionally, the

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research methodologies needed by EER researchers are usually different from the classical technical engineering research (TER) methodologies. This translates into a need for specific training and opportunities to get to know each other better in order to promote international collaboration and develop a community of practice. SEFI and the Australasian Association for Engineering Education (AAEE) both organized a summer/winter school for EER PhD students in 2022, attended by 34/14 participants respectively (note: attendance at the AAEE winter school is not limited to PhD students). We have designed a survey to elicit a mixture of background information (facts), perception data (opinions), and evaluative data (evaluation of the school).

By using confirmatory factor analysis on half of the items and descriptive statistical analysis of all data, we aim to provide insights into the success factors of these schools. Both schools attracted a diverse group of EER-PhD students in different areas. The SEFI summer school excelled in building an inclusive and international research community, whereas the AAEE winter school was superior in gaining domain-specific knowledge needed for EER research. The results contribute to a more nuanced understanding of the issues experienced by researchers who are beginning their career in EER and support organizers in designing international research schools.

1 INTRODUCTION

1.1 Engineering Education Research

Engineering Education Research (EER) is continuously growing as an internationally connected field of inquiry (Godfrey and Hadgraft 2009; Borrego and Bernhard 2011; Bernhard 2018), strongly intertwined with general Higher Education research (Henderson et al. 2017). EER is one of the many research fields (such as CER (computing education research), sitting at the intersection of a STEM discipline and education research, called 'discipline-based education research (DBER)', one not ascendant over the other but rather equal in contribution and outlook (see Fig.1.).

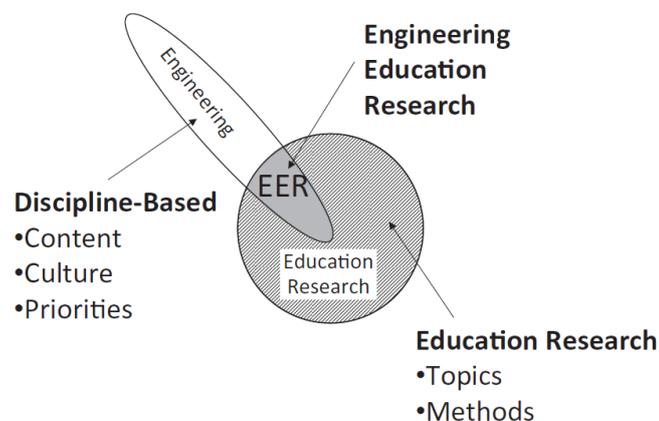


Fig. 1. EER at the intersection of the discipline of technical engineering research and the discipline of education research (Henderson et al. 2017, 349).

The importance of porous boundaries between EER and other relevant academic disciplines has been highlighted by Klassen and Case (2022). EER is by consequence an interdisciplinary research field, resulting in specific opportunities and challenges, but it also has specific needs and stumbling blocks because of its emerging nature (Baillie, Ko, Newsetter and Radcliffe 2011; Edström, Kolmos, Malmi, Bernhard and Andersson 2016).

In summary, we can say that the community of EER-PhD students is heterogeneous with various paths into the field (engineering, social sciences, educational sciences, psychological sciences, etc.) and different working conditions. Often EER-PhD students work isolated from other PhD students in EER and have a unique profile within their local institutional group of PhD students in technical engineering research (TER). So, it is no surprise that Kristina Edström and colleagues (2018) wrote: “In order to learn from the complementary perspectives, it will be necessary to support dialogue and collaboration between researchers.” and “unless there is an arena where interaction within EER can be accommodated, there will be no identity as EER researchers, and no sense of belonging in a joint endeavour”.

1.2 Summer/Winter Schools in Engineering Education Research

Doctoral training is often performed in structured programmes operated by individual universities. However, few formal programmes exist for the training of EER-PhD students (Borrego and Bernhard 2011). This makes sense given their small numbers in the universities concerned. However, formal training programs are important not only for community building and generating the feeling of belonging but also due to the fact that many researchers starting their EER journey are making a transition from a technical engineering discipline to engineering education research (Dart et al. 2019).

A logical solution is to organize this much-needed training during an international residential summer or winter school which fully immerses the participants into the subject and supports community building. AAEE has a long tradition (since 2011) in organizing such winter schools for EER-PhD students (<https://aaee.net.au/winter-summer-school/>). The topics are diverse (research methodologies, partnerships, grant opportunities, etc.) and are facilitated by experienced Australasian researchers in the field of engineering education who have undertaken different paths in their transition to EER (Wiley et al. 2022). SEFI organized in 2022 the first summer school for EER-PhD students with a focus on research methodologies and community building, supported by a diverse group of experts not only in EER, but also in statistics, education and psychology (https://www.sefi.be/wp-content/uploads/2021/12/programme-SEFI-Summer-School_2022-v3.pdf).

We want to know how the purposes we have in mind with these summer/winter schools have been experienced by the participants. Our research questions are by consequence:

RQ1: What’s the profile of the participants in these summer/winter schools?

RQ2: To what extent have the participants experienced our intended aim to support them in building an inclusive and international research community and in gaining domain-specific knowledge needed for their research?

To investigate these questions, we conducted an anonymous survey of the participants of the summer/winter schools organized in 2022. The following paragraphs present the survey design, sample, results, and discussion.

2 METHODOLOGY

The PhD students of both summer/winter schools received by email at the end of their school the invitation to participate at a very similar custom-made online survey.

2.1 Survey design

The 20 questions of the SEFI-survey prompted a mixture of

- background information (5 self-designed questions focusing on facts about involvement in EER);
- perception data (5 self-designed questions probing opinions on EER);
- evaluative data (10 self-designed questions focusing on the evaluation of the summer/winter school, more specifically community building and knowledge acquisition during the summer school).

The 21 questions of the AAEE-survey included a number of questions that were multidimensional and asked additional information compared to the SEFI survey. However, except for some slight differences in wording the questions reported in this paper were common to both surveys.

The questionnaires were distributed online to the participants of these winter/summer schools after completion.

2.2 Sample

The SEFI summer school 2022 was hosted by KU Leuven from 2-6 May 2022, and was attended by 31 participants who were PhD students at a European university, 2 were affiliated with an American university and one with an Indian University. The AAEE winter school 2022 under investigation was hosted by the University of Technology Sydney from 18-22 July 2022. There were 17 registrations, all from Australia, and unfortunately 3 participants cancelled because of illness.

24 PhD students filled in the SEFI-survey, resulting in a 71% response rate and 9 participants (PhD students and transitioning researchers) completed all questions in the AAEE-survey, representing a 64% response rate.

3 RESULTS

3.1 Background information (5 items)

Most participants had less than 2 years of experience in EER (55%/67%). Before starting their PhD in or transition to EER, some of the participants first conducted TER (33%/56%), we call them the 'switchers'. Most of these 'switchers' experienced a large to moderate skills gap while making their transition to EER (100%/80%). The

16 PhD students of the SEFI summer school who did not start in TER first, had less transition-problems (44% of them indicated that they had minor or even no missing skills).

There is a large variety in the size of the EER-research groups the participants belong to: 13%/20% of the PhD students are undertaking their research topic in isolation, most of them have 2 EER-PhD colleagues (58%/40%) and 21%/20% have more than 2 EER-PhD students as near colleagues. Although most EER-research groups are small compared to regular TER-research groups, most participants of the SEFI-summer school are not compensating for this by being engaged in an EER-network beyond their own institution (71%). In contrast, 63% of the respondents of the AAEE-winter school are active in an EER-network within or outside their state or even internationally.

3.2 Perception data (5 items)

We were interested in the attendee's reasons for becoming an EER-researcher. Participants were provided with a list of reasons from which they could choose or an option to enter another reason not listed. In both schools, most respondents chose to be involved in EER because of their 'personal interest in learning and teaching' or 'a desire to positively impact students' educational experiences and the engineering profession'. A very limited number of participants chose the answer 'opportunity to access additional funding' or 'a way of generating research without needing a large budget'.

A relatively large portion of the respondents experienced ambivalent support from their institution, faculty or department (50%/33%). At each summer/winter school there was only one PhD student present who did not feel supported at all and 46%/22% experienced strong support.

As expected, many respondents felt that EER is part of the engineering discipline (58%/89%) only 2/1 respondent(s) at each school disagreed. However, the participants of the AAEE winter school are not convinced that their university also regards EER as an engineering discipline.

Almost all participants of the SEFI summer school indicated they see themselves still being involved in EER in 5 years' time (92%).

3.3 Evaluative data (10 items)

It was our initial aim to survey with these 10 items the perceptions of the participants concerning the two goals of the summer/winter school, i.e., community building and knowledge acquisition, assessed using a five-point Likert scale (1 = 'Strongly disagree' to 5 = 'strongly agree'). We have performed a confirmatory factor analysis on the two-factor structure of the 10 items, part of the SEFI summer school. This assessment has confirmed the internal structure of two scales:

- Items 1 – 8: community building (Cronbach alpha = 0.75)
- Items 9-10: knowledge acquisition (Cronbach alpha = 0.65)

Table 1 presents the descriptive statistics of the items. Note these 10 items were slightly adapted for the AAEE winter school (a) where a four-point Likert scale was used.

Table 1. Descriptive statistics of the evaluative data (5-point Likert scale for SEFI summer school and 4-point Likert scale for AAEE winter school).

	item	SEFI summer school		AAEE winter school	
		Mean (<i>max 5</i>)	SD	Mean (<i>max 4</i>)	SD
1	I met people with whom I will cooperate in near future	3.75	0.94	3.33 ^a	0.71
2	I met people who will support me if needed	4.00	0.59	3.00	0.50
3	I experienced the added value of the diversity of the background of the PhD students in EER	4.63	0.58	3.78 ^a	0.67
4	I experienced the EER-community as inclusive and welcoming to researchers from different backgrounds	4.67	0.48	3.56	0.53
5	I experienced the international character of this rapidly evolving field	4.75	0.44	2.11	0.78
6	I have a stronger identity as an EER researcher	4.08	0.93	2.33	0.71
7	I have an improved feeling of belonging to the EER research community	4.25	0.74	3.00	0.71
8	I have more confidence in the importance of this type of research	4.29	0.81	3.33	0.71
9	I have more methodological awareness and understanding of possible research designs	4.25	0.74	3.33 ^a	0.71
10	I have the standardized terminology at my fingertips	3.63	0.97	3.33 ^a	0.50

4 DISCUSSION

The profile of the participants of both schools (RQ1) is homogeneous (i.e., years of experience in EER) on the one hand, but also heterogeneous (i.e., experienced skills gap) on the other. It should not surprise us that most of the SEFI school participants were commencing PhD students since it was explicitly stated in the announcements that this was the focus of the schools. Conversely, the AAEE school welcomes any participants who wish to transition to or improve their capacity to undertake EER. The experienced skills gap was much greater among the switchers compared to the non-switchers. Switchers, on the other hand, have the advantage that they have to learn relationships among disparate fields of knowledge (cognitive complexity) and this increases their innovation potential (Akay 2008). We estimate that the SEFI switchers have a Master's degree in a technical field, but we cannot prove this explicitly because we did not ask for their prior education (in the AAEE school many switchers already hold a PhD in a technical field). Comparably, we did not ask their

nationality or maturity. This might have provided useful insights to understand the difference between the two schools concerning the extent to which the participants engaged in an EER-network outside their university. Possible reasons for more AAE than SEFI participants for maintaining external networks might be because there are very few universities in Australasia that have EER programs, requiring EER-researchers to seek support and maintain networks external to their university. The participants are proud to undertake EER and selected EER as their research topic because of their personal interest and motivation to have impact on students' educational experiences and the engineering profession, in line with the third motivation for doing EER according to Borrego and Bernhard (2011). Despite these valuable objectives, they experience ambivalent support from their institution, faculty, or department. And the impact of this university environment on their development as an engineering education researcher cannot be neglected (Gardner and Willey 2018). But the good news is that Gardner and Willey (2018) also found that participation at an Engineering Education conference is an important contributor to identity and competency progression of EER-researchers at all stages of development.

And this brings us seamlessly to the second research question (RQ2) that focuses on the experiences of these doctoral students during the summer/winter schools. The participants experienced our aim to build an inclusive and international research community and to support them in gaining domain-specific knowledge needed for their research. The analysis of the evaluative data shows that the mean score of community building is 4.3 (SEFI summer school) and 3.8 (AAEE winter school rescaled to a 5-point Likert scale) and the mean score for knowledge acquisition is 3.9 (SEFI summer school) and 4.2 (AAEE winter school rescaled to a 5-point Likert scale). Possible reasons for the differences between the two schools in community building probably relate in part to the fact that the SEFI school is a residential school whereas participants in the AAEE school organise their own accommodation. In addition, many of the AAEE school participants are at different academic levels and at different stages of their career. This means they often have to undertake catch up work on their usual university activities during the evenings and hence are not socialising with the other participants out of school hours.

It is harder to speculate as to why there is a difference in the results in regard to knowledge acquisition. However, contributing factors could be that the AAEE school runs for five days while the SEFI school only runs for four days. The extra day allows for more participative activities to be undertaken during the school. For example, the AAEE school is very hands-on and includes discussions on participants' research interests and current research topics. Because of the limited time and the comprehensive content, the SEFI summer school was more lecture style. The authors experience suggests that the residential school suits the SEFI environment where all participants are PhD students and at similar stages of their career, where for AAEE a non-residential school has proved to be effective to meet

the needs of participants who are often at different stages of both their research and academic careers.

A significant difference in the results for each school was in response to the statement “I experienced the international character of this rapidly evolving field.” The SEFI summer school participants experienced this feeling as the strongest, whereas the AAEE winter school participants scored this as the lowest. This is not surprising given the relative geographic isolation of Australasia. The only international exposure participants of the AAEE school receive is typically through the facilitators describing their networks or through discussions about the significant international EER conferences and journals. The opposite difference emerged when looking at “I have the standardized terminology at my fingertips.” It’s clear that the AAEE winter school was better in supporting the participants in knowledge creation, compared to the SEFI summer school. The latter is an important skill because the understanding of the international literature is an important prerequisite for quality scholarship (Bernhard 2018).

5 SUMMARY AND ACKNOWLEDGMENTS

Additional research is required to unravel the influence of specific personal or organizational characteristics on the perceptions of the participants. What can be confirmed is that the schools are helping to promote participation in and visibility of EER through developing research quality, capacity, and scholarship. They are also establishing an international network of researchers in EER (our future EER-professors) to encourage international collaborative research projects and papers about Engineering Education and the advancement of engineering.

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