Introduction & Context

The Australasian Engineering Education community has been deeply involved in the debate about research quality in Engineering Education (EE), and what to do about it. The perceived lack of rigour of Engineering Education Research (EER) was an early concern (e.g. Streveler & Smith, 2006). In 2008, AAEE set up an educational research methods special interest group to foster discussion and experimentation around the topic and, in 2011, the first AAEE Winter School in Engineering Education was held. The aims of the school were to:

- improve research practice through workshops with experts,
- share research methodologies and data analysis techniques,
- provide an opportunity for peer review of work and development of academic writing skills,
- build community and a reference group for PhD candidates and academics whose interests are often unique in their home departments, and
- develop career paths for early career academics through clearer articulation of skills and interaction with visiting academic experts.

The AAEE Research Winter School ran initially as a residential school and more recently as a week-long program or intensive 3-day program (Summer School in New Zealand). There have been 17 Winter Schools—14 in Australia (2021 online) and 3 in New Zealand (2020, 2023 & 2024). Almost 200 individuals have attended the Winter/Summer School, the majority of whom have become active members of the AAEE community.

There is no single defined path into engineering education research (EER); however, the literature highlights common threads amongst a variety of journeys and experiences. Those drawn to EER are often those open to multiple perspectives (Allendoerfer et al. 2007) and many researchers move from their discipline-based technical engineering research (TER) into EER out of a desire to improve engineering teaching practice (Dart et al. 2021; Rodrigues et al. 2021; Williams & Figueiredo 2012). This move can be particularly challenging due to the shift in research paradigms, and from quantitative to qualitative research, as well as the lower value often ascribed to EER than TER (Dart et al. 2021; Goldsmith et al. 2023). Gaps in the understanding of the requirements of educational research often led to the 'show and tell' approach to EER, as can be seen in AAEE conference presentations in the early years. The Winter School addresses these challenges of supporting researchers in their transition into EER and improving the quality of EER.

In recent times, the participants of the Winter School have moved from being primarily PhD candidates to including more engineering academics, educational designers and professional staff, many of whom already have PhDs in technical fields and who want to transition to EER. In the last three years, 60% of Winter School participants had only been involved with EER for 1–3 years and 46% had conducted technical research for more than 3 years before commencing EER. The Winter School has made a significant contribution to helping these researchers transition to the field, developing their expertise, getting support for their research and developing their networks. This highlights the utility and value of the Winter School in building and developing the AAEE community, and expanding both EER in Australia and Australia's contribution internationally.

Focus & Relevance

In 2011, EER was an emerging field, struggling to be recognised as a legitimate research endeavour by engineering faculties. There was a need to establish an engineering education research community, and to increase the number and quality of research publications. Most early participants in the Winter School had a background in technical research, and lacked both the knowledge of education research practices and research networks to support them in this emerging field. The epistemological difficulties of transitioning from technical to education research for engineers have been well-documented (e.g. Bernhard 2018). A key challenge was the need to support a diverse cohort with diverse needs, ranging from PhD candidates (some with supervisors new to EER) to established researchers with many years post-PhD in technical research. The Winter School has met all these challenges.

The Winter School organisers have strived to meet what participants perceive to be their needs. Specifically, there has been consistent demand from participants to learn more deeply about research. As a result, while there are some variations from year to year, it has been found useful—indeed critical—to spend the first two days of the week-long school on the epistemology and methodology of qualitative interpretivist research so that participants gain a better understanding of why certain methodologies might be used, as well as how best to use them. The subsequent days primarily focus on methods, data analysis including coding, and ethics, publishing, networking and writing. A broad cross-section of theoretical frameworks and methodologies are discussed and in addition to the popular qualitative methods (e.g. open-ended surveys and interviews), some less familiar approaches (e.g. transect walks and systematic observation) are introduced.

Since the first offering, the Winter School has provided a space for early EE researchers to become socialised into the language, practices, methodologies and methods of this emerging field (e.g. Dart et al. 2021), in addition to building a valued and worthwhile identity as an EE researcher. The research networks established at successive Winter Schools have provided novice EE researchers with opportunities to collaborate with more experienced researchers, and to develop networks. This has been evidenced in publications which have resulted from cross-institutional research collaborations emerging from Winter Schools (e.g. Baradaran et al. 2022; Matemba et al. 2018, Dart et al. 2019).

Participants have highlighted an interest in undertaking research to investigate their teaching and learning interventions, to evaluate and understand their outcomes, and to support the dissemination of their innovative practice. In line with this, the Winter School has provided an interactive, participative and collaborative environment that has guided participants in learning and developing the skills to advance their own EE research. It has thus enhanced research into teaching and learning practices within EE and encouraged greater dissemination of knowledge about innovative teaching practices—both nationally and internationally.

The broad range of theories and methodologies currently used in the AAEE community has been significantly impacted by the training provided by the Winter School, which gives participants the knowledge and confidence to explore these different theoretical perspectives and frameworks. This experience enables the participants to develop proficiency in educational research, thus enriching the AAEE community, by broadening the types of questions that can be asked, and the ways of responding to those questions. We see this in the greater use of a wider range of theoretical perspectives and frameworks by participants of the Winter School (e.g. Bourdieu's Theory of Practice in Dart et al. 2021; identity trajectory in Gardner & Willey 2015; phenomenography in Daniel et al. 2017) and the subsequent broader shift within Australasian engineering education papers more generally.

By increasing the visibility of the social and cultural capital of EER (Dart et al. 2021; Goldsmith et al. 2023), the Winter School builds a sense of belonging and identity as EE researchers, as well as making pathways to EER more accessible. The Winter School also fosters opportunities to participate in collaborative projects, the Early Career Academy and the AAEE conference, contributing to the broader development of the AAEE community.

Contribution

The Winter School has made a significant and sustained contribution to the AAEE community. More than just the numbers of participants, the richness of the experience for participants—in terms of inducting them in to the field, their professional development (e.g. in expanding the depth and breadth of their understanding of theory and methodology), and cultivating a strong sense of community and fellowship—is what ensures the growing legacy of the Winter School.

The quantitative measures are nevertheless impressive. To date, there have been 196 School alumni, of which three are AAEE past-Presidents, 12 have served or are serving on the AAEE Executive committee, 11 have won at least one AAEE Award, nine have won at least one multi-institutional AAEE grant, nine are members of the Early Career Academy and four are now Winter School facilitators. Alumni have also taken on Editorial roles with the Australasian Journal of Engineering Education, as well as with other Q1

engineering education journals, and served on the Research in Engineering Education Network Board. More recently 16% of delegates (one in six) at the 2023 AAEE annual conference were Winter School alumni. This demonstrates how the Winter School has met the aim of developing paths for early career academics, building community and making a significant and sustained sector-wide contribution to AAEE. The Winter School has also directly led to six publications either evaluating or reflecting on participants' experiences (Baradaran et al. 2022; Dart et al. 2019; Dart et al. 2021; Langie et al. 2023; Matemba et al. 2018; Willey et al. 2022).

However, as any Winter School alumnus will attest, we need to go beyond this quantitative analysis to understand its real impact on AAEE and the broader engineering education community. For this, we have consistently collected survey evaluation data every year since 2016, from which most of the following reflections are drawn.

The transition from the culture, norms, and practices of technical engineering research to those of engineering education research can be challenging. One strength of the Winter School approach is in being able to empathise with those challenges (through the facilitation team having wrestled with this ourselves) and in adjusting the curriculum to suit the unique needs of each cohort:

> *I personally found it very reassuring to be able to hear from more experienced academics that the discomfort I've been feeling through this transition is valid and normal.*

Participants highlighted skills gaps resulting from the differences between education research and traditional technical engineering research and noted that the Winter School had exposed them to and equipped them with skills in qualitative approaches. The most beneficial aspects of these are:

> *Learning about the differences between technical engineering research and EER - like differences in methodology and what that means and all of the theories that exist in educational research*

> *Hands-on experiences with methods and analysis e.g. interviews, coding, etc.*

Another area where participants demonstrated changes in their epistemological beliefs was regarding theory. In technical engineering research, theory was described as implicit:

> *As engineers, you know, we just do things and we don't necessarily think about the theory behind it.*

This is related to the high level of consensus present within the technical engineering disciplines, which results in the theoretical frameworks that researchers use becoming accepted as standard (Borrego 2007). In contrast, the low consensus around our understanding of educational phenomena means theory needs to be explicitly selected from a range of viable options in educational research to guide the inquiry. One participant described this as:

> *...By discretising the steps of the research process in engineering education and dissecting each step in detail, it has allowed me to grasp the links between theory and methodology that I've always found nebulous prior to this.*

The Winter School has empowered participants to seek developmental opportunities—both formal and informal—as well as generating their own opportunities, such as forming working groups:

> *I would say that our winter school [working] group is [one of] the most sustained groups I've communicated with beyond my School.*

In fact, the authors of the Dart et al. (2019) paper maintained weekly Zoom meetings for 7 months, which demonstrates how much they valued these discussions, and the research practice involved in producing their paper. This is particularly important given that participants frequently discussed the lack of interest in engineering education research within their home institutions:

> *There is no one that I can talk with [about engineering education research] ... like I said there is no team.*

As a result, engagement in EER networks beyond the institution has been important for many of our participants, who identified the Winter School and AAEE conferences as key opportunities to develop these networks. For example, one participant said:

> *It was good to make some connections I guess, that was one of the other big things from Winter School was to meet some other people who were talking about some cool things, and I was like oh that's a little bit like what I'm doing, we should do something.*

The Winter School played an important role in the establishment of an EER Australian Research Council Field of Research (FoR) code in 2020, with the paper by Dart et al. (2019), which emerged from the 2018 Winter School, being used as key evidence by advocates for the establishment of EER FoR codes. These codes allow EER publications to be categorised together, which enhances EER's visibility, contribution and value to the discipline, and enables EE researchers to gain a higher profile within the field and at their institutions.

Evidence of continuous monitoring and evaluation

Evaluation and monitoring have been built into the Winter School since its initial offering. Post-Winter School surveys have been conducted to evaluate participants' experiences. This information has been used in debriefing and planning sessions to refine the offering in the following year. In the last 3 years, we have also used pre-Winter School surveys to understand our participants' backgrounds and actively tailor the program to best meet their needs.

This continuous evaluation has allowed us to track the changing cohorts and adapt the Winter School to meet both the participants' and the Engineering Education community's needs. These evaluations have informed the development of an extensive set of resources to proactively facilitate the Winter School sessions and adapt to meet the emerging needs of the participants in real-time. These resources have also enabled new facilitators (e.g. Tania Machet, Scott Daniel) to be brought smoothly on board supporting the sustainability of the program beyond the current facilitators.

In the last three years, ethics approval was obtained for an ongoing research project to investigate the contribution of the Winter School to the successful transition of participants to EER. Most participants are relatively new to EER, but a majority have already conducted significant technical research. They are interested in learning the theories, methodologies and methods associated with EER, and in building their network to assist their development and transition to EER. These needs have been successfully met by the Winter School:

> *I feel that the Winter School helped me transition through several threshold concepts (theory, methodology, validity) that had seemed completely 'other' beforehand.*
>
> *In my opinion the opportunity to hear from a number of facilitators with varied experiences was quite unique, with each sharing their insights and tips on the topic of discussion.*

Over 85% of all respondents reported that attending the Winter School allowed them to feel more confident to begin/continue their journey in engineering education, develop a stronger identity as an EE researcher and improve their feeling of belonging to the EER community. Participants report the most common benefits of attending the Winter School include: "receiving guidance and assistance from experienced researchers", having "more awareness of different methodologies and possible research designs" and having "a better understanding of how to find and use a theory as a lens through which to investigate a phenomenon I want to research".

In addition, there have been several research studies that have investigated the success of the program including Matemba et al. (2018), who found that Winter School participants acquired "not only a vocabulary about research but a grasp of some of the fundamental concepts that allowed them to judge other work in the field more critically". Langie et al. (2023) compared the AAEE Winter School to the European offering and found the "AAEE school is very hands-on and includes discussions on participants' research interests and current research topics" and "that the AAEE winter school was better in supporting the participants in knowledge creation, compared to the SEFI summer school". Moreover, Willey et al. (2022) found that "Attendance at Winter School facilitated the establishment of networks of supportive academics and was seen by most participants as the best aspect of their attendance".

The AAEE Winter School is unique in the global EER context in that it caters for a broad cohort from PhD candidates, academic developers and teaching assistants to post PhD technical researchers who wish to transition to and/or improve the quality of their educational research (the European SEFI Summer School which began in 2022 only caters for PhD candidates). Its hands-on, informative, supportive and practical approach facilitates an inclusive and accessible pathway for participants not only to transition to EER and

develop their network but also introduce many participants to the AAEE community and the annual conference.

Building a strong and vibrant engineering education research community takes time, resources, and expertise, and has a positive impact on students, academics and other stakeholders. For more than a decade, the AAEE Winter School has been supporting its participants to develop skills in EER, nurturing research networks and collaboration, increasing the visibility and recognition of EER as a discipline, and more. Through the almost 200 alumni, the ripples of positive impact have spread far. In short, the Winter School has made a sustained and significant contribution to the Australasian Engineering Education sector.

Photo of 2012 Winter School participants and facilitators

Photo of 2024 Winter School participants and facilitators minus the one that took the photo

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