Leadership Paradigms in Engineering Education: a Learning and Teaching Reflection

Alison-Jane Hunter [a]; Dorothy Missingham[b], Kieran Bennett [c] and Gianni Severino[d].
The University of Adelaide
Corresponding Author Email: Alison-Jane.Hunter@adelaide.edu.au

Introduction

Development of leadership skills is a key priority in tertiary education, sought by students, institutions and industry alike. However, understanding of the leadership, belonging and self-efficacy concepts involved is often amorphous and rarely taught explicitly through subject-based courses. It therefore requires innovation in learning and teaching practices in order to match stakeholders' needs. This paper reflects on the development, impact and outcomes of the diverse leadership skills formed by current and former student tutors through a structured framework of tutor training in Engineering Education.

The approach taken to training and working with the tutors in Engineering Systems Design and Professional Practice (ESDPP) at the University of Adelaide falls under the broad approach known as Students-as-Partners (SaP), a relatively new pedagogical model. Matthews et al. (2018) define SaP as having three major strands: as counter-narrative, as values-based practice and as cultural change.

In Mechanical Engineering Design courses at the University of Adelaide, the approach devised values the students as having expertise in both the discipline and in terms of teaching or marking skills and, consequently, an ability to both speak for and simultaneously lead their peers. Tutors are selected by application from their second year in their Engineering program and can remain in the tutor group until the end of their postgraduate courses. In this sense, it is strongly argued that a mutual learning or reciprocal relationship model is being explored, as a part of values-based practice.

For the group, the SaP approach enables high levels of creativity as well as leadership training: the tutors shape and co-create the courses and then lead them. Early leadership is defined in terms of confidence, willingness to put their names to courses and marking of work, and the ability to work as equals with the formal teaching team. In this way, the group of tutors is encouraged to seek an egalitarian relationship with the academics and leadership roles for a cohort of students at least one year below the tutors' current year level (two years below for marking) within their degrees. Co-teaching the course involves interacting with a wide range of industry leaders, guest lecturers and advisors, and many of tutors have benefited professionally from this networking, as well as in the additional growth of confidence and leadership skills.

The following discussion represents a preliminary reflection on the tutors' own perceptions of their roles and development within this innovative approach. The purpose of the reflection is to explore the grounds on which to build a more formal, more detailed and broader study.

Methodology

This paper provides an early case study (Sandover et al 2012) of some of these experiences, as shared by a small sample of the tutors: n = 8; gender balance = 4 men: 4 women; with 2-6 years of tutoring experience; of whom two have graduated and moved into industry and six have continued as either undergraduate or postgraduate tutors throughout 2019.

The method of approach applied in the case study was to invite a sample of the current and past tutors by email to respond to two open questions about the benefits of being a tutor. Those

who chose to respond were asked to send their responses as an unnamed attachment, which was then printed separately, as a deidentification mechanism. However, all of the tutors were happy to be identified, so where specific projects are mentioned it is with the full and free permission of the participants.

Those students who are successful in their applications to become tutors are invited to discuss their philosophy of learning and teaching with more experienced tutors and markers and explore their own learning experiences within the practice. In this way, experienced tutors have the opportunity both to contribute to appointing and confirming new and inexperienced tutors and to take part in further training ready for specific lessons; shaping and guiding the course in the light of their experiences, strengths and stage of development. The Communication element of the course (part of Professional Practice) mirrors the training for the Design component of the course in terms of training and support for the SaP tutors and markers.

This small-scale case study addresses the impact and outcomes of student-tutors' leadership skills training. It considers the impact and outcomes of this training on developing, actual and desired leadership skills. Questions were sent to a targeted list of experienced current and former tutors. The responses were analysed qualitatively, with conclusions drawn from the data. Alongside leadership skills development, we consistently seek to evaluate how the tutors' sense of being, either as a consumer of/or belonging to the university, impacts on both their well-being and their academic outcomes. It is argued that the counter narrative produced by this training enhances both their sense of belonging to the university on which they impact at a leadership level and their own academic outcomes, as they seek to go beyond the 'straight-jacket' of course norms. It is no surprise that many of the tutors go into research and development posts, at start-ups, multi nationals or through high level academic study. Participant 8 was clear that a sense of belonging was highly encouraged through the SaP model, "*Firstly, it enabled me to further develop my professional practice skills as a tutor of the subject and brought me to a higher level of understanding of what is taught to students. Secondly, this approach helped develop my leadership skills as after three years of tutoring first level professional practice I was given the opportunity to run workshops with junior tutors to brief them on upcoming tutorials as well as provide guidance on their tutoring styles. This was the largest managerial role I had taken at that time and helped me identify leadership traits of mine that I excelled at, and ones that need refining. Lastly, the SaP approach has helped me financially at university. Being a tutor at a university level is amazing as it does not involve late hours, allows you to work where you study (i.e. no extra commute to what you would already be doing as a student), and reinforces the culture and sense of community in the school / discipline that you work and study for and within".*

The information gathered was instigated from an initial email, which invited answers using a semi structured interview format. It asked: "*How did the Students as Partners (SaP) approach affect your university life and what are the long term effects of this teaching style on your career trajectory and capabilities?"* It then offered a broader guiding question, outlining the basic theory (this is not normally named formally) behind the approach taken: *"Students as Partners (SaP) is a philosophy that is just what it sounds like - the idea that lecturers and students can work together as equals to enhance courses and learning together. The second angle to the paper is how this applies to leadership skills, so the question goes beyond 'did it help you learn to work in the way SaP works' and asks about the bigger impact on your living and experience of learning and working."* Thus the respondents focused on the two aspects: 'university life' and 'career trajectory' of their learning as tutors. Their responses were broad-ranging and detailed.

Discussion

This case study reflects on the leadership training offered and the efficacy of a model SaP program. It takes the notion of leadership directly into classroom practice, questioning and validating the rigour of the training processes and evaluating its impact on the targeted group of L1 and L3 undergraduate learners. There are a number of advantages of this approach, as

defined by the tutors: "*The opportunity to work as a student partner made me realise my lecturers are people too. It fast tracked my understanding that everyone (including my future bosses) are approachable humans just trying to do their best"* (Participant 1). This is a critical understanding in terms of the egalitarian nature of the SaP project. It also reveals the well-being aspect of the work, which induces confidence in learning and transmitting knowledge and thereby helps overcome imposter syndrome. This view of the project is supported by other participants in the review, such as Participant 4 *"The teaching style has allowed me to become a more confident person as well as worker"* and Participant 3 *"Through this process, I have gained confidence in participating and contributing to discussions with those who I view as senior or superior to me. This is particularly evident in my work life, where I work as an undergraduate engineer and hence most of my colleagues are more experienced than me and hold higher levels of qualifications than myself. Despite this, I am able to speak freely and participate in discussions with them as I have the mindset that we are all working together as equals, regardless of our particular roles. I am able to take initiative and have open discussions with my lecturers at University, which is something I had not considered early in my University life. I feel comfortable approaching them with issues or questions and I feel that this stems from the students as partners approach. I do not see my lecturers as my superiors, but rather as someone who I can work with to solve my problems".*

The interpersonal benefits continue into the workforce: *"I grew the confidence to engage and build rapport with people in much more senior positions than myself"* (Participant 1). It is notable that this benefit is perceived to have lasting value, that supports leadership growth into the students' early careers and beyond. Participant 6 states, *"It gave myself, and others, the opportunity to lead the classroom to develop public speaking and leadership experience. Personally, I often got very nervous before speaking in front of the class, but these experiences developed the confidence needed to increase my ability in both public speaking and leading a team by example. Consequences of this include better University grades in communication orientated courses/aspects of courses, more opportunities for employment (as many recruitment processes require these skills to be displayed within interviews/assessment centres), better leadership qualities within teams (final year projects) and greater interpersonal communication within day-to-day life".*

The confidence gained from this process encourages the students to undertake a wide range of further activities, often based around service leadership. Thus, for example, current and former tutors have instigated and found funding for groups such as RoboGals, who go out into city, regional and remote communities to train young women of primary and middle school age in coding and robotics, encouraging their ambition in both STEM and to achieve a university education, despite the complexities of their home geographical location. Participant 2 explained: *"Robogals gave me the confidence and leadership skills to operate professionally in the students as partners dynamic. I learnt how to facilitate and mentor other students (others on the committee when I was President) in a similar way to what is required in ESDPP".* This commitment requires both service and innovation in the leaders and prepares them well for future high level careers by making visible the behavioural correlations between practical leadership and academic study. This behaviour and accomplishment is an active outcome of values-based, SaP practice leading directly to cultural change in the broader community. In addition, by representing the university in this way, these women are generating a counter narrative of the very definition of an Engineering student: that this now encompasses far greater diversity as a normative feature of university life.

The ability to connect with leaders in industry, developed throughout the SaP tutorship approach, clearly also results in positive career outcomes as the tutors surveyed have all gained accelerated entry into the workforce. Furthermore, the participants claim that the SaP model enabled them to gain skills at a powerful, accelerated rate: "*It fast-tracked my growth as a young professional"* (Participant 1). The students are clear that the project supported their own learning as much as their leadership skills: "*The opportunity to teach others solidified my knowledge of the domains I was supporting"* (Participant 7). As educators, we are well aware

that the saying ‘you can’t teach what you don’t understand’ is true and it is important to remember that this cliché also contains truth, which is recognised by the SaP tutors. Participant 6 explains *“This framework also gave us access to industry professionals from our lecturers’ network of engineers, students and academics alike, who mentored the tutors on how we could best work with students to develop industry needed skills. One example is how my tutor group regularly met with Stuart, a highly experienced mining engineer within Boart Longyear, for him to mentor us to develop the skills he saw necessary within industry. It speaks volumes of her* (the lecturer’s) *approach that these people, who graduated many years ago, still want to be actively involved in the communications curriculum”.* Similarly, industry recognises outcomes of our SaP program and thus tutors who have been part of the SaP approach, are regularly sought for internships and graduate engineering positions.

Critically, these benefits are seen explicitly as extending into the students’ careers long term: “*Some of the most useful life lessons I learned during my degree were due to my time as a student partner and I am extremely grateful for those opportunities”* (Participant 1); *“The student partner experience promoted my development of a growth mindset and belief in my ability to grow to achieve any task”* (Participant 7) and *“My leadership skills have been recognised as highly developed for my level of experience in industry. My time as a student partner certainly supported the growth of those skills”* (Participant 1). This is where the case study shows that the benefits of an SaP approach extend far beyond the scope of the individual Communication project in which it is explored. Participant 6 explains, *“The way of thinking and working with others demonstrated in this curriculum has had a profound impact on my life and consequently the opportunities I have had since graduation. If you look at the success of other former tutors in this space, you will come to the same conclusion”.*

Of the vast range of types of leadership that have been defined and explored, the training on offer in this course largely covers group and team leadership (balancing the needs of the course, the tutor team and the groups of students involved); situational leadership (ensuring that delivery is appropriate and targeted to this cohort at this university) and is part of organisational development (working as a form of resistance against the common hierarchical models in place in other parts of the degree course as a whole). Participant 6 puts it thus*, “The students as partners approach allowed former pupils (now tutors) of the course the ability to provide their opinions on how the course could improve from previous years. This was almost like an open forum, wherein great ideas could be voiced, later to be unpacked by the tutor team and the Lecturers into a first class teaching framework. OPS is obviously an example, but one thing I was personally involved in was the tutors acting as engineering consultants within Small Group Discovery, which was an idea I provided within a tutor training, later fleshed out by Sid (a fellow tutor) and refined by the Lecturer. This was implemented in the teaching framework that year to improve course outcomes. It was refreshing and even motivating to work with a group of such talented people, getting the best out of each other, rather than having one dominant figure dictating how the course should be delivered, as in the majority of university courses. Contrary to a belief that I have encountered within some students at University, people are not born leaders - leadership is a skill that anyone can develop. Using the students-as-partners approach, the Lecturer gave myself and others, who would not consider themselves as natural born leaders, the platform to develop this skill while positively contributing to the classroom, with encouragement. Without this, some of the tutors who benefited from this framework would have been unlikely to have been offered the opportunity to learn leadership skills within their University group projects”.*

Group and team leadership are the most commonly used forms of leadership in business and can be defined using five key principles: “Leaders-followers - leadership is shared; influencing is the process of a leader communicating ideas, gaining acceptance of them, and motivating followers to support and implement the ideas through change; organizational objectives - effective leaders influence followers to accomplish shared objectives; change - influencing and setting objectives is about change; people - leadership is about leading people through relationships” (Lussier and Achua 2016). These are principles which align strongly with the

training program offered, particularly as the tutors are trained in communication skills, asked to motivate students at least one year younger than they are, and invited to participate equally in the training and leading process throughout the courses they are teaching. Participant 5: *'As a previous student of this course and current tutor, I have found that the students-as-partners approach was highly effective in its ability to communicate ideas to me and others. Unlike the traditional teaching style, students-as-partners really allows the students to feel as though they can ask questions, and learn at their own pace, without the same fear of judgement or disengagement that other courses sometimes offer. It also allows for a more personalised teaching experience, which is critical as all people learn a little differently. Additionally, the learning experience was more enjoyable in general, and made me genuinely look forward to talking to tutors, Lecturers and the workshop experience in general".*

In this sense, the approach used is in alignment with other SaP and leadership training projects, such as that described by Schuhmann (2010), yet it is apparent that the experience is so powerful that, for the tutors involved, it extends beyond the norm due to the level of engagement and freedom to be co-architects of critical core courses across Levels 1 to 3. Like Schuhmann (2012), we seek the following leadership attitudes or traits: "Continually learning; service oriented; radiate positive energy; believe in other people; lead balanced lives; see life as an adventure; synergistic; exercise for self-renewal" and we believe the following leadership behaviours are vital: "Integrity and character; leading by example; responsibility; purpose, passion and ambition; credibility; visibility and personal presence; expertise and competence". Participant 3 states, *"The students-as-partners approach allowed me to understand the course content in greater detail, which was reflected in my teaching throughout the course. Being able to help shape the course and provide input based on my experiences resulted in a more 'student friendly' course, which then increases student engagement".*

Kumar and Kent Hsiao (2007) have argued that leadership is taught not innate: yet the SaP approach aligns with many who would dispute this. Critically, Engineers Australia (2019), in their key competencies (1.3, 2.1, 2.3, 2.4, 3.1, 3.2, 3.4, 3.5, 3.6), notably 3.6, require that each student: "a) Understands the fundamentals of team dynamics and leadership. b) Functions as an effective member or leader of diverse engineering teams, including those with multi-level, multi-disciplinary and multi-cultural dimensions. c) Earns the trust and confidence of colleagues through competent and timely completion of tasks. d) Recognises the value of alternative and diverse viewpoints, scholarly advice and the importance of professional networking. e) Confidently pursues and discerns expert assistance and professional advice. f) Takes initiative and fulfils the leadership role whilst respecting the agreed roles of others". Participant 2 recognised similar competencies being enacted during SaP work: *"Working with the students-as-partners model allowed us to approach and discuss topics in a more informal, authentic setting. It created a more flexible learning environment and dialogue between teachers and learners, and allowed areas indirectly related to the course material to be discussed also. This was particularly useful when students asked to discuss feedback given for their formative assessment tasks, as the conversation could move past grades and requirements and into a more holistic reflection of the scaffolded learning and abstracted course outcomes".*

In terms of the development program, students are invited to apply to become tutors at the end of L1 as they must be at least one year ahead of those for whom they tutor. Letters of application are studied by the current cohort of tutors and interviews are undertaken on the basis of the current cohort's recommendations. This promotes ownership to the group of tutors and supports their ability to discern values and qualities in people to an extent rarely found in any degree. Carmeli and Paulus (2014) argue that the ideational and creative benefits of leadership stem from having a transformational leader and a situational space where young leaders are encouraged to work in an egalitarian fashion, which is exactly the SaP approach taken in Mechanical Engineering. "We conceptualize team creativity as a process of looking for and exploring new solutions and examine whether and how CEO leadership fosters

creativity in top management teams (TMT). Data collected from senior executive teams indicate that CEO ideational facilitation leadership is positively related to team knowledge sharing, which in turn results in enhanced team exploratory behaviours" (Carmeli and Paulus 2014). The views of the tutors are sought actively, both informally and formally. Weekly meetings about both content and forms of delivery are undertaken. Rubrics and tasks are shared and developed collectively, and the course pathway is individualised annually, according to the input of the leaders, within a common framework.

The responses from current and past tutors/markers focus on how the exigencies of time caused tutors, as individuals and in groups, to increase their level of focus. They were paid as tutors to do a specific job and they took their roles very seriously: "*Before I entered the tutorial, I was interested in the task but perhaps not fully engaged with it. The undergraduate students taught me to take every aspect of the partnership seriously and to ensure I made the time to work effectively at both my own studies and at supporting the students" (Participant 1).* The work is well paid, especially when compared with most jobs available to students, and so it supports them financially without detracting meaningfully from their learning time. The student tutors are also introduced to the visiting speakers to the course and spend time with them, apart from the lectures. This enables the tutors to network with potential employers and to show them that they have powerful leadership skills. The student tutors recognise this as a powerful reason for engaging in the work: *"I genuinely believe my time as a tutor gave me an enormous advantage as a young professional"* (Participant 1).

Alongside tutoring, we also offer positions in the marking team, led by a more experienced marker. The training pack is drafted by the senior marker and then modified in the light of the other team members' experience. This year one key outcome of this developmental approach was that a way of adapting from L1 to L3 marking would be to offer more direct articulation of instructions, rather than pure Socratic questions. This shift was devised to match the need for efficiency at the higher stage of the course. The deliberateness of this approach was also devised to align with the higher levels of self-directed learning required of students in the subsequent L4 Honours Project. The first set of marking, therefore, was very clearly Assessment as Learning, rather a simple summative grade. NSW Education Standards Authority (NESA) (2019) defines Assessment as Learning as having the following benefits as it: "encourages students to take responsibility for their own learning … provides ways for students to use formal and informal feedback … and self-assessment to help them understand the next steps in learning and encourages peer assessment, self-assessment and reflection". There was then an opportunity given to every student to resubmit their paragraph, redrafted in the light of the marker's comments.

The rubric was carefully designed to distinguish the levels of response to the marking, rather than define the new standard achieved for this summative draft. Five marks were made available for those who engaged in a sophisticated way with the elements of the redrafting process and almost 100% of the cohort took advantage of this offer. It is evident that by supporting the students and offering them the opportunity to improve, they engaged strongly with the process and sought a positive outcome. This suggests that the SaP approach not only works for those who engage with it actively as young leaders, but that it also encourages the course cohort to engage more fully with the tasks and take greater ownership of their own learning.

This case study demonstrates strong, targeted development in leadership skills in tutors who undertake a tutor training framework in an SaP environment, demonstrably linked to review criteria for accredited Engineering courses created by Engineers Australia. The student tutors and early career Engineers who are former tutors are consistent in their view that the SaP approach supported their growth as young leaders as well as young learners. Participant 4 explains, *"The students-as-partners approach allowed me to develop my personal style and leadership capabilities. Long term, this has helped in my research career, becoming more confident in my work and work ethic. The students-as-partners approach provided firsthand*

knowledge from both students and partner lecturers that the work that we were doing was important and will help both me and the students throughout our learning".

The well-being elements and academic outcomes presented in this early case study engages with international dialogues about perceptions and pedagogies of tertiary learning opportunities, notably in STEM disciplines. The SaP leaders have formed their own training paths and broken new ground in terms of the complexity of their thinking and their approach to teaching and learning over a number of years. For example, it was an earlier group of the Engineering Tutors (2014) who created and introduced the concept of the Optimising Engineering Pentagon (OPS), mentioned by Participant 6, which has now been adopted in a number of countries and which supports all aspects of Engineering problem-solving.

Conclusion

The outcomes of this project can be used as a foundation for course coordinators who plan on developing an SaP learning environment. The knowledge of leadership development in tutors will assist coordinators in directing their tutors' learning, using a new, practical approach to leadership development which is grounded in both need and theory. There is early evidence that the approach assists individuals, groups and cohorts and that the influence extends into the workplace, making it an important opportunity for young people who are forming their own philosophies and paradigms and influencing those who follow them in myriad ways.

Future Work

Evidence from this early case study suggests that it would be valuable to assess a similar case study that goes beyond the small number of tutors who cover five years of the program amongst them and consider how SaP training affects middle and senior leadership in both industry and academia in order to establish our arguments even more strongly.

References

Carmeli, A., Paulus, PB., (2014) CEO Ideational Facilitation Leadership and Team Creativity: The Mediating Role of Knowledge Sharing, Journal of Creative Behaviour, Vol 9, Iss 1 (2015)

Engineers Australia (2019) https://www.engineersaustralia.org.au/sites/default/files/resource-files/2017-03/Stage%201%20Competency%20Standards.pdf, accessed 27.09.19.

Engineering Tutors (2014) https://www.adelaide.edu.au/rsd/framework/frameworks/ops_rev5.pdf, accessed 27.09.19.

Kumar, S, Kent Hsiao, J, (2007) Engineers Learn "Soft Skills the Hard Way": Planting a Seed of Leadership in Engineering Classes, *Leadership Management Engineering*, 7(1): 18:23.

Lussier, R.N., Achua, C.F. (2016) *Leadership: Theory, Application and Skill Development*, 6th Ed, Cengage Learning.

Matthew, KE, Dwyer A, Hine, L, Turner J, (2018). Conceptions of Students as Partners, *Higher Education* 76:957-971

New South Wales Education Standards Authority (2019) https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/assessment/approaches accessed 29 September 2019.

Sandover, S., Partridge, L., Dunne, E., and Burkill, S. (2012). Undergraduate Researchers Change Learning and Teaching: a Case Study in Australia and the United Kingdom. *Council on Undergraduate Research Quarterly*, 33(1), 31–39.

Schuhmann, R.J., (2010) Engineering Leadership Education – The Search for Definition in a Curricular Approach. *Journal of STEM Education*, Volume 11, Issue 3 and 4.