

Northern Power: Making Engineering and Physical Sciences Research a Domain for All in the North of England

Best Practice Literature Review

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Version 1.0

25 October 2019

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1. Introduction

The Engineering and Physical Sciences Research Council (EPSRC) funded 11 projects across the UK through the Inclusion Matters 2018 call. This is the first initiative of its kind, launched as part of the collective approach by UK Research and Innovation (UKRI) to promote equality, diversity and inclusion.

There are frequent reports published by leading organisations linked with Higher Education which highlight disparities within the Higher Education sector for those from traditionally under-represented groups (Advance HE, 2017; Beeler, 2019; HEPI, 2019; Institute of Physics, 2019; Stonewall, 2018). These reports call for action to be taken to address the imbalance through a more inclusive and diverse workplace and to reduce the ‘leaky pipeline’ as staff leave academia for careers in other sectors. However, although there is a call to action, there is little evidence for what works or why particular initiatives have been successful or have failed to make a difference.

The overarching aim of the *Northern Power: Making Engineering and Physical Sciences Research a Domain for All in the North of England* study is to implement a series of initiatives aimed at shaping an actively inclusive culture in the Engineering and Physics Sciences (EPS) community (academic and beyond) in the North of England that supports, drives and sustains greater equality for all, including traditionally under-represented groups (e.g., women, disabled people, LGBT+, and black, Asian and minority ethnic (BAME) researchers). Alongside the initiatives, a detailed evaluation of each activity, the recruitment process and changes to policies and practice within the participating Higher Education Institutions (HEIs) will also be undertaken. The aim of the evaluation is to understand what has worked well within the project, what could be improved in the future and the impact that participating in the project has had for participants.

The objectives of the project are:

- to develop a better understanding of the challenges and opportunities faced by groups under-represented in EPS across our consortium and beyond;
- to share this understanding with HEIs, research councils, industry and policy makers;
- to present cross-institutional networking, mentoring and discipline specific opportunities for members of groups under-represented in EPS within our consortium;
- to establish and share best practice with regard to developing inclusive EPS communities from HEIs and industry (and beyond) with other HEIs, research councils, industry and policy makers through seminars, publications and an online platform.

During the inception of the project, a team of Equality, Diversity and Inclusivity (EDI) leads and academics from institutions in the project partnership met over a series of sessions to consider the challenges facing the sector. The discussion was significantly informed by the recent publication of the latest Advance HE Equality in higher education: statistical report (Advance HE, 2017). An exercise was conducted to develop a list of critical challenges which the project would aim to address. To do this the partners considered the findings of the Advance HE report, other research in the area, data collected by Higher Education Institutions (HEIs) in the project along with evidence gathered from discussions with members of the science community about their experiences around EDI. The seven critical challenges that were identified were:

- a lack of role models
- a leaky pipeline
- inequity in opportunities

- lack of synergy in initiatives
- lack of understanding of barriers by some senior leaders
- poor data
- poor analysis of progress.

Having identified the critical challenges, the partners then developed eight activities to address these challenges:

1. Shared characteristic and/or interest mentoring
2. Reciprocal mentoring
3. Online platform
4. Leadership Development Workshop
5. Networking for Career Development
6. University Industry Partnership – Work Shadowing
7. University Industry Partnership – EDI within EPS Events
8. University Industry Partnership – Engaging Collaboration: Being Prepared for Business Workshops.

To inform the development of the activities within the project, the following document presents a literature review of existing evidence around each of the key areas. The aim of the best practice literature review is to provide a concise summary of pragmatic evidence to support individuals and organisations implementing and evaluating the types of activities included in this review. It is important to note that this is not a systematic review. Sources referenced include peer reviewed journals as well as non peer reviewed sources. Non peer reviewed sources are included for additional contextual information and are included in the Other Resources section.

2. Shared Characteristic Mentoring

Key findings

- One to one mentoring (senior mentors junior) works but only if mentees choose their own mentors. The outcomes that can be improved through one to one models are retention, improved performance, improved academic performance, increased visibility of the mentee, satisfaction.
- Shared interest matters more than shared characteristics.
- Mentoring combined with incentives such as travel grants or residential courses are promising on academic progress targets.
- Matching on characteristics such as ethnic groups coupled with gender seems promising for students in STEM subjects, but has no clear evidence if it works in HE context of work, retention and job progression.
- Very few existing studies report measurable outcomes.

There is a growing body of evidence on the need for increasing opportunities for staff who are mainly in the categories of early career and/or underrepresented groups employed in the workforce, industry and academia. Theoretical underpinning of shared characteristics mentoring is based on self-determination theory (SDT) theory of human motivation which posits that people are most likely to experience optimal well-being and persist in their work when they experience relatedness to a community of others, feel ownership over the goals they pursue and how they go about pursuing them, and perceive a sense of competence and accomplishment in their activities ((Ryan and Deci, 2000), (Lewis et al., 2016)). Thus, programmes can be tailored around the concept of mentors, peer networks, and work environments that fulfil needs for relatedness, autonomy, sharing practice and experiences, and competence in order to foster positive outcomes for early career and and/or underrepresented groups .

Survey and feedback studies of early career and underrepresented groups have shown that having no role models and examples of people sharing similar characteristics or pathways in trajectories of careers is one of the most common barriers in progress and related outcomes of achievement in careers (Kinsey, 1990). Studies have shown that people frequently attribute their success to receiving mentoring in the form of sharing knowledge and seeking support from role models who have gone through similar experiences in their trajectory of careers (Edwards and Gordon, 2006, Gordon et al., 2005). The development of mentoring programmes are based on the premise that early career and/or underrepresented groups could be disadvantaged if there are not enough people and role models in the field to develop relatedness. In order to address gender and ethnic inequalities in professions, mentoring on shared characteristics is offered to underrepresented groups in their early career stages.

A scoping review of existing studies screened 2,200 abstracts leading to selection of 45 studies for detailed reading. The studies were further screened based on the quality of samples and research designs and 27 were further selected for some basic quality appraisal (Appendix 2).

Mentoring programme based on shared characteristics have conceived a wide range of combination of participant characteristics. Underrepresented minorities in these studies were academics and

practitioners from minor ethnic groups and women. The search could not find any mentoring programme evaluation, which targeted academics with identified disability or from LGBT group.

The only Randomised Controlled Trial (RCT) of a mentoring programme on shared characteristics of mentors and mentees measured satisfaction of their basic psychological needs (competence, autonomy and relatedness) with their mentor (Lewis et al., 2016). The junior mentees selected their own mentors, implemented the mentoring session as per their choice of place, and selected topics/ issues for discussion in the sessions. The results suggest no differences in the satisfaction of participants after one year of the mentoring programme. However, there were immediate effects in the satisfaction levels of participant in the treatment group during mid evaluation time in the 2nd month of the intervention. Short-term effects suggested feasibility of the programme, indicating no negative effects and potential for future study.

A longitudinal study assessed the impact of mentoring on academic self-efficacy of underrepresented groups in STEM (MacPhee et al., 2013). The study found that at the programme admission stage women perceived themselves as academically weaker than men despite similar academic performance. However, women's academic self-efficacy was equivalent to men's at the end of programme completion. Ethnic minorities who received mentoring also showed some positive changes in their academic self-efficacy at the end of the programme. Junior staff mentees selected their own mentors and implemented mentoring session according to their own needs and availability.

Two studies focused mainly on hard outcomes such as grant submission, publications, conference presentations (Viets et al., 2009) and perceived effects of mentoring on career path, and research productivity, including publication and grant success (Wingard et al., 2008). The study samples were very small and volunteering participants were not randomly selected therefore the findings are not robust. However, the outcomes were positive on progression and achievement of underrepresented groups. The Viets et al. (2009) program consisted of regular research meetings, collaboration with the community advisory board, monthly symposia with renowned professionals, funding for pilot projects, and conference support. Mentoring from experienced staff members combined with financial incentives and opportunities for increasing visibility are innovative ideas, and the evidence suggested that they are feasible for implementation. However, the research design was limited to the pre and post measurement of the mentees academic record, so although the evidence is positive on outcomes, it was not based on robust evaluation design. Wingard et al. (2008) and Benson et al (2002) also suggest positive changes in perceived academic outcomes after implementing a formalized proactive faculty development program. The sample of this evaluation is very small and comparisons between groups are not validated. A highly formalised programme mentoring could only recruit small number of participants. Mentoring programmes that are tightly structured and regulated with close monitoring schedules will are perhaps not feasible for implementation at a larger scale. Yager et al. (2007) is another slightly promising programme of mentoring based on shared characteristics of underrepresented and mentees with mentors. However, it is unclear if mentors and mentees were matched on criterion or mentors self-selected their mentees or vice versa. The programme evaluated involved mentoring around funding for travel, training, and tutorials for the mentees.

Beecroft et al. (2006) and Johnson et al. (1998) programme evaluations also suggest some positive impact of mentoring. In both mentoring programmes underrepresented participants volunteered to take part in the programme and selected their own senior mentees. Johnson et al. (1998) evaluated a mentoring programme that focused on counselling, mentoring, support for writing and a summer

residential. The outcomes were assessed on retention rates of underrepresented group. However, the evaluation only considered pre and post measures.

Rust et al. (1998) and Santos and Reigadas (2002) measured skills in teaching, research, cultural competence and administrative skills of the mentees in their impact evaluation. However, the evidence is very weak in terms of design and sample size. Santos and Reigadas (2002) matched mentees and mentors participants on their own criteria but there is not enough detail on the matching procedures. Self-efficacy and goal identification were the main outcomes of this evaluation but it is hard to assess if these outcomes were achieved because the evaluation is mainly assessing participant satisfaction of the programme.

Mentoring programmes based on shared characteristics of mentors and mentees failed to meet the quality appraisal criteria because most of the evaluation studies of these programmes do not provide details such as the nature of the programme, research design, participant samples and outcome measures.

3. Reverse Mentoring

Key findings

- No Randomised Controlled Trials (RCT) or quasi experimental studies or systematic reviews have been undertaken previously to evaluate reverse mentoring.
- Some qualitative work with no comparisons show that it is feasible if tailored according to the needful targets. However, the outcomes are very unclear. Only survey based studies measured satisfaction of the employees.
- Some weak evidence suggest promising effects on progression of women in leadership roles.
- Reverse mentoring programmes are feasible for implementation. However, there is no evidence on effects in organisational change.
- The programmes implemented were structured in terms of time, topic of discussion and records of the meetings.
- Matching of pairs (senior mentees and junior mentors) could be decided according to the expected institutional changes and policy developments.
- The target outcomes could be change in the perceptions of mentees and/or mentors. This change (or no change) can be captured through before and after interviews with mentors and mentees.
- For knowing the evidence on actual change in the organisational culture, the data needs to be collected longitudinally.

Reverse mentoring is perceived to be beneficial for developing catch up interventions for bridging the generational gap who lack information and skills in latest development trends in technology and computer skills and may be hesitant to learn these new skills (Meister and Willyerd, 2010), (Finkelstein et al., 2003), (Baily, 2009). However, their younger colleagues are better equipped with such modern knowledge and are aware of the techniques for transferring these skills. Reverse mentoring can be an intervention for finding out what is going on with other generations and/or culture groups. In order to address critical organisational issues or policymaking, senior colleagues and administrators can gain fresh perspectives from younger workers, male or female and underrepresented groups by working with them. The intent of such collaboration is to receive understanding that can contribute towards cultural change in the organisation, embedded in deeper knowledge of senior members, which they gained from a wider group through productive interaction with junior colleagues, and particularly interaction with those who are less visible or underrepresented in the population (Harvey et al., 2009). The research evidence on the effectiveness of reverse mentoring has not been established. However, the reverse mentoring programmes are popular in several organisations including academia and industry (Biss and DuFrene, 2006).

Reverse mentoring often known as reciprocal mentoring and upward mentoring concept takes orientation in constructivist and action learning, as well as in adult learning and transformative learning. The common core element of the theories is to take over responsibility for one's own learning and development process, which also accounts for the mentors and the mentees. Learning in reverse-mentoring is regarded as a self-directed, active process occurring in interaction and communication. Consistent to transformative theory, critical reflection in constructivism allows for the construction of new meaning which is integrated into earlier experiences (schemes) and there also

find its origins. Regarding the interplay between mentors and mentees, knowledge is co-constructed by both parties (Zauschner-Studnicka, 2017).

The *Collaborative Knowledge Exchange for Learning Impact* (Crannóg) is a partnership between Higher Education Institutions in Ireland which provides support and opportunities for professional development of those colleagues in roles such as Head of School/Department, Dean, etc. Specifically, the project focuses on aspects of leadership of teaching & learning. It builds on the work of Ireland's National Forum for the Enhancement of Teaching & Learning, and seeks to encourage the sharing of ideas, the dissemination of research and scholarship, and the development of a professional network. Crannog gives a working definition of reverse mentoring as a partnership where a younger individual mentors a more experienced individual. The main focus of the programme is transfer of knowledge and skills to senior mentors in relation to technology use. The programme is focused on matching a student with a Head or Dean. The student mentor is introduced to the Head/Dean (the mentee) and the interactions follow a structured approach in the meetings. The purpose of the initiative is to establish communication channels between senior management faculty and student mentors using students' knowledge and skill information technology to transfer to the senior staff members during the mentoring process. The Crannog reverse mentoring programme is highly established with a number of tools that can be used for preparing the mentoring sessions and recording the outcomes of the session. A full resource pack is available here (<https://www.jisc.ac.uk/guides/developing-successful-student-staff-partnerships/viewpoints>). However, there is no evaluation of the programme or any data as to the effectiveness of these reverse mentoring tools or the success of the sessions based on these frameworks or guidelines.

Wharton Fellows: Master Classes and Networking for Senior Executives was another reverse mentoring scheme which was introduced in the US for providing opportunities to learn from and dialogue with organizations and industries that are successfully navigating the business environment. Fellows participate in discussions with some of the world's leading business leaders and experts, and build a network of peers that affords fresh, personal insights; decision support on critical issues; and business opportunities. Each master class is limited to 50 participants to encourage interaction and dialogue, and the program is limited to top executives and high potentials/change agents. While Fellows can benefit from attending any individual Master Class, attending multiple sessions in different locations provides a more complete set of tools and new perspectives to challenge view of the world and their own business. This programme has received positive feedback from the senior fellows (mentees) but there is no clear and robust evidence, which suggests it has changed any organisational culture. The lack of evidence does not suggest if reverse mentoring programmes work or not in improving the organisational culture or policy development. This simply suggests that research in this area is very weak to give any clear indication of its effectiveness. However, in terms of gaining knowledge or learning new information about technology there is some weak evidence that reverse mentoring can propel progression of the senior colleagues (Zanni, 2009, Myers and Sadaghiani, 2010, Peterson, 2012), (Tayşır and Ülgen, 2017).

Reverse mentoring programmes also appear in studies where glass-ceiling effects have been investigated in relation to representation and progression of women as underrepresented groups (Mattis, 2001) (De Vries, 2011). The aims of reverse mentoring targeted change in organisational culture towards women's participation in leading functions of the industries and businesses. The reverse mentoring programme established frameworks and opportunities for mid-level women to develop quality relationships with senior managers. The program supported the development of a culture in which women could more easily advance by raising senior men's awareness of gender issues in the organization. The review of the programmes suggested that reverse mentoring of executive

leads and top management staff led to a 20% increase in the number of women in key leadership positions in a 2-year period, with the strongest results in the line organization responsibility (Giscombe, 2007). The study does not report any details about the sample and comparison groups, which are integral to evaluate the effectiveness of the programme.

4. Online Platforms

Key findings

- User satisfaction and level of usage of online platforms are affected by the quality of the service, system and information.
- A much higher proportion of members of online communities read content than provide it, but those who only read are also important to the success of an online community.
- Different factors make online communities successful at different points in their lifecycle. Focus on these different factors improves the chances of the continuation of the community.

Online platforms can be an effective medium for conveying information to a general or invited audience. The purpose of online platforms varies greatly, however, a distinction can be made between those whose primary purpose is to pass information in one direction from source to the recipients, and those where the platform acts as a medium for two-way communication. The hosting platform is not the main focus of published literature; rather it is the community that is formed from the opportunity to post and read messages/posts/opinions/questions of mutual interest that is of interest. The focus for this review is online platforms with two-way communication and the communities that arise from them. Note that the use of online platforms for online training is out of scope of this review.

The best online platforms encourage communities to develop and interact with opportunities for sharing opinions as well as information dissemination. Success is often measured in quantitative terms such as the volume of activity, but can also refer to qualitative measures such as user satisfaction (Malinen, 2015). The opportunity to network can allow mutually advantageous communities to form without regard to geographical boundaries. The success of such platforms relies on them providing something useful to the user. "Virtual communities are sustainable only when they provide benefits that surpass the costs of membership" (Koh et al., 2007).

The quality of the infrastructure is essential for people to use a platform. If the logon process is complex, the service is not reliably available or cannot be used on devices that users prefer, then the chances of success are lower. Therefore, service, system and information quality feed into usage and user satisfaction (Marjanovic et al., 2018).

Users in an online community engage at differing levels regarding both time and the type of activity. Important factors affecting participation are identification with the community and an alignment of values with others in the community (Zhou, 2011). The most common type of interaction is reading content provided by others (*Readers*) (Malinen, 2015). These users will commit time to being part of an online community because of the informational or social benefits that being part of a community brings to them (Malinen, 2015). Notwithstanding the need for quality content, a committed Reader within a community may continue to read even if they encounter some low quality content. However, low quality content may discourage new members from continuing to use the online platform (Bateman et al., 2011). The majority of online content is created by a minority of users (*Posters*). It should be noted that even the most committed Posters of content still read more than they post (Sun et al., 2014). Individual reasons for not posting include personal preference, individual-group relationships and security concerns (Marjanovic et al., 2018).

Posting content and undertaking informal moderating behaviours (directing discussions, closing threads) may not involve more time for members but shows an increasing investment in the community. These members are seeing the community as something that benefits them but also as a place from which they can help others. Efforts to create a clear and consistent community identity will increase these behaviours (Bateman et al., 2011). Some Readers will not convert to Posters because of concerns about security and privacy, so efforts to provide reassurance are important to increasing the level of engagement from Reader to Poster (Sun et al., 2014). Other factors that have been shown to increase posting include offering rewards either tangible (money, T-shirt) or intangible (access to restricted information), encouragement (a welcome statement to new users) or guidance (directions from more experienced members) (ibid.).

At the start, an online community can struggle to generate content and users. However, personal invitations have been shown to be a successful method of engaging users, especially those that emphasise social interaction (Malinen, 2015). When the balance between Readers and Posters is such that there are many Readers but few Posters, showing that the community has active members (e.g. by displaying numbers of page views/visitor numbers, including voting tools or user ratings) can be a way to encourage users to increase their level of interaction (ibid.)

Participation can be affected by the level of anonymisation conditions. Allowing Posters to be totally anonymous can lead to negative posts, however, the use of pseudonyms has been shown to increase contributions and significantly decrease such negative postings (Malinen, 2015).

Iriberry (2009) describes a life cycle view – *Inception, Creation, Growth, Maturity and Death* - of different types of online communities (e.g. gaming platform, interest group, support group) and highlights the success factors of each stage of the lifecycle. The first stage is *Inception*, where a need or vision is identified. At this stage, the success factors include having transparent goals, targeting of one group of users and establishing the codes of behaviour. The next stage is *Creation* where technological components are selected. Success factors include having a user-centred design, looking at interface usability, planning security and anonymity rules, and ensuring that reliability and performance are fit for purpose. At the *Growth* stage, the key is to attract and keep new members. Success factors here include that there is a growth management plan and that new users are supported into the community, and that the content is up to date and quality assured. *Maturity* is the stage where communities become more formal organisations. Success factors include moving users into administration roles as moderators or subgroup owners and recognising the contributions or loyalty of members. If a community does not maintain the *Maturity* phase it is likely to die. Determinants of *Death* of a community include an undersupply of content, poor participation and concerns over privacy and security (Iriberry and Leroy, 2009).

5. Leadership Development

Key findings

At the level of the Leadership Development training programme:

- An organisational, group or individual training needs analysis should be conducted and the subsequent programme should align with the identified needs.
- The programmes should have clearly defined and widely accepted leadership goals in order to be seen as worthwhile by participants and others within the organisation.
- Self-administered programmes are not as effective for learning as directed courses.
- Programmes delivered face to face are more effective at changing what participants do after their training than virtual (web-based) programmes.
- Multiple delivery methods (e.g. workshops, lectures, activities) lead to greater learning than when fewer delivery methods are used.
- The inclusion of both 'hard' (e.g. budget monitoring) and 'soft' (e.g. interpersonal relationships) skills in a leadership programme benefits both the individual and the organisation.
- Longer programmes with time between sessions lead to greater organisational outcomes, possibly due to increased knowledge transfer, time for multiple delivery methods or an increase in perceptions of the training programme's value.

At the level of the institution

- Improvements in Leadership Development are easier to maintain and track if someone has responsibility for it at an institution level.
- Organisations need to be more transparent in promotion criteria in order for any inequalities between groups to be seen and addressed.
- The organisation needs to consider workload distribution if inequalities between groups are to be seen and addressed e.g. via an equity audit.

Training can be considered to have impact on four areas: reactions (how people feel about the training); learning (what participants can do after training); transfer (what participants will do after training); and results (how the training benefits the organisation).

In their 2017 review, Lacerenza et al. found that leadership training tends to improve cognitive and skills-based outcomes for participants regardless of how it is designed, delivered and implemented (Lacerenza et al., 2017). However, they also identified factors that will improve the effectiveness of one or more aspects of the training. The following are recommendations from their report.

- A high quality programme starts with a needs analysis of the organisation, group and/or the individual depending on desired outcomes. Factors that could be considered in the analysis include identifying stakeholders, identifying what outcomes are desired and deciding which outcomes are the most important. The training can then be tailored to meet these needs.

- Mandatory training has more effect on organisational goals; this may be because it is perceived that the organisation is taking training seriously. Voluntary training had more effect on the transfer of skills and knowledge after the training.
- Programmes that allow time between sessions show a greater effect on transfer and results.
- Longer programmes have more impact on organisational outcomes than shorter.
- Using multiple delivery methods (information, demonstration, practice-based) is more effective than using one or two delivery methods; if only one delivery mechanism is used it should be practice-based.
- Self-administered programmes are not as effective as those led by others. This may be because fewer delivery methods are utilised. Both internal and external instructors can be effective.
- On-site training improves results more than off-site training; this may be because the training is more attuned to the organisation whilst off-site training may be more generic.
- Use of feedback increased effectiveness but there is a need for the feedback to be well designed.
- Programmes teaching business skills such as problem solving, data analysis or monitoring budgets are most effective for participants in terms of learning and implementation (learning and transfer aspects) but those incorporating soft skills such as leadership or interpersonal skills improved organisational outcomes.

Leadership programmes, which enhance the agency and thus careers of individuals, are useful in their own right. However, they can also be part of efforts to increase the presence of under-represented groups of staff at higher levels within an organisation by examining organisational factors that have led to such under-representation. Well-defined leadership goals for leadership programmes, alongside effective delivery structures and organizational processes are needed to help effect change in representation at higher levels of leadership (Sanchez et al., 2008) (Fisher et al., 2019). An audit of the staff workload including informal (but expected) tasks, and making standards applied to promotion (Terosky et al., 2014) or workload (Karanhxa et al., 2014) transparent will begin to focus the drive to increase the representation of under-represented groups at leadership levels. For these actions to be effective it is important that an individual or committee tasked with and held accountability for reducing inequality counters “organizational inertia and wilful resistance” (Williams et al., 2014).

In terms of programmes specifically aiming to address progression or retention of staff from under-represented groups, there are several examples of successful programmes in the literature, all of which contain multiple elements. These programmes include:

- A programme for early career researchers and PhD students from under-represented backgrounds in the University of Pittsburgh’s Institute for Clinical Research which provides mentoring, training in academic writing and presentation skills and possibilities for career development or grant funding. Over ten years, nearly everybody, from the 76 individuals from under-represented backgrounds who participated in the programme gained grants as Principal Investigator (PI) or joint PI (Rubio et al., 2018).
- A junior faculty development program in the University of California’s School of Medicine addressed the problem of retention of minority staff and provided counselling, academic preparation, introduction to institutional culture, workshops on pedagogy and grant writing and mentoring. Following this programme, the retention rate improved for all staff and was at an equal level for both minority and non-minority colleagues (Daley et al., 2006).
- A National Science Foundation ADVANCE funded programme, run in 19 universities in the USA, aimed to increase the number of women academics in science and engineering. The

programme involved sharing of ideas, resources and best practice as well as tracking numbers of women at each job level and evaluating the effectiveness of initiatives. All but one of the 13 universities where outcome data was available showed an increase in the number of women, particularly at Assistant Professor level. In five universities there was an increase of at least 50% in the number of women at that level (Bilimoria et al., 2008).

- A programme in an Australian university aimed to support women moving from Senior Lecturer to Associate Professor. The course involved mentoring, skills development, academic portfolio development, feedback and personal network development. The most praised aspect by participants were talks by guest speakers on aspects of the promotion process or by senior leaders in the university. The programme led to an increase in the number of women at higher levels in the university. The findings of the study show that a well-designed, women-only leadership course can have an impact on promotion levels and on women's view of themselves, but the authors acknowledged that leadership development needs to sit alongside more systematic change at an institutional level to create sustainable change. The university has recruited more diverse recruitment panels and has amended its strategic plan to include a focus on recruiting and supporting a diverse staff and student bodies with explicit targets (Parker et al., 2018).

6. Collaboration with Industry

Key findings

- University-Industry Collaboration (UIC) can be divided into stages: Pre-linkage, establishment, engagement, advancement, latent phase.
- The initial UIC contact may be through conferences, referrals from colleagues or more impersonal means, e.g. internet searches.
- Face-to-face contact at the beginning is a good way to learn about the needs and goals of partners and identify those with similar working styles.
- In the longer term, personal networks are important to facilitate future collaborations.
- Barriers to UIC include differing timescales of dissemination of results between industry and universities, and differing purpose of research for academics and industry.
- For a successful UIC there must be an acceptance of different social values, norms and cultures.
- Trust between partners is a necessary condition for collaboration to work.
- Successful partnerships have relationships at the personal as well as organisational level.

The need for innovation within business, and the drive to commercialise academic knowledge has encouraged an increased level of interest in recent years in University-Industry Collaborations (UICs). These may be formal or informal and may result in publications, co-operation, contacts and contracts (Yegros-Yegros et al., 2016).

There are five common stages in the life-cycle of a UIC. *Pre-linkage* is when the initial contacts are made. *Establishment* is when discussions of what collaborative work will take place will lead to a mutual agreement. *Engagement* happens when the partners work together on the project. *Advancement* takes place when a strategic and sustainable relationship is formed. Finally, a *Latent* phase takes place when the project has finished and no formal working relationship exists any longer. Plewa (2013) describes four drivers to a successful UIC and describes their features and success criteria as each stage of the life-cycle as shown below. (Plewa et al., 2013).

Phase	Drivers				Success Criteria
	Communication	Understanding	Trust	People	
Pre-linkage	Identifying potential research partners				
Establishment	Quality	Of partners' needs	In the reputation and credibility of partners	Based on similarity	Clear definition of the project goals and deliverables
Engagement	Open, two-way	Learning about the partner	In the individual	Development of personal relationships	Completion of deliverables
Advancement	Discussions beyond the project	Acting in an integrated way	In the relationship	Continuation of personal relationships	Continuing engagement
Latent	Opportunity for future collaborative work				

A factor that helps with a successful collaboration is to engage with collaborators early in any potential collaborative project. Agreement early in the collaboration on roles and responsibilities, data sharing and standardisation and definition of success alongside well-planned meetings can limit problems later in the collaborative process (Jones et al., 2017) (Amabile et al., 2001). Successful partnerships have relationships at both the individual and organisational level (Steinmo, 2015) and face-to-face contact at the beginning of a collaboration is important (Plewa et al., 2013). To cross the boundaries between academia and industry, dialogue is needed where motivation, interests and objectives are explored (Rajalo and Vadi, 2017) (Rybnicek and Königsgruber, 2019) (E. Proulx et al., 2014) and where personal interactions can help overcome the complexities of the collaborative research (Hoppe, 2001 cited in Plewa et al., 2013).

There are barriers to creating a successful UIC, including differences in timescales with the short-term orientation of industry research, timing of disclosure and topic of research between universities and industry. Perceptions of these can be mitigated by industrial work experience or collaborative experience with different partners (Tartari et al., 2012). Some difficulties arise where there is a lack of cultural understanding between academics and practitioners, a lack of understanding about issues related to the commitments and responsibilities of those involved, and a lack of common/overlapping knowledge about research (Amabile et al., 2001) (Porter and Birdi, 2018). A further challenge to UICs can be the difficulty of aligning universities' and industries' interests within long-term partnerships (EUA, 2009).

Transactional barriers can be created by the differing needs and style of administration in industry and university environments. However if universities can create the infrastructure to foster collaborations, this will aid academics who have not yet developed their own networks (Tartari et al., 2012).

Trust between partners within UICs is vital, with length of partnerships and frequency of repeated interactions being key in supporting collaborative relationships (Thune and Gulbrandsen, 2011).

7. Other Resources

The Guardian University award 2019 for advancing staff equality (Guardian, 2019) was presented to the University of South Wales for its Fair Play 30 project which provides the LGBT community with visible allies. Runners up were the University of Essex with a group to support trans staff and the University of Strathclyde who are supporting staff with caring responsibilities.

The Leadership Foundation for Higher Education (LFHE, 2019) runs programmes and publishes research in both Leadership and Equality and Diversity. The Equality Challenge Unit (ECU, 2019) has both the Athena SWAN Charter and the Race Equality Charter. The Leadership foundation for Higher Education and the Equality Challenge Unit have merged with the Higher Education Academy under the name AdvanceHE.

The Institute of Leadership and Management (ILM, 2019) works in the areas of Leadership and Coaching.

Stonewall <https://www.stonewall.org.uk/> campaigns on LGBT issues.

The leaky pipeline is discussed in a blog on the Society for Women Engineer's website https://alltogether.swe.org/2019/04/women-in-engineering-a-review-of-the-2018-literature/?utm_source=newsletter&utm_medium=email&utm_campaign=SEFI+Flash+News+and+Press+Review accessed 15th May 2019

Kings College London has work on equality and diversity. Their web pages are

<https://www.kcl.ac.uk/ioppn/diversity-inclusion/index.aspx>

<https://www.kcl.ac.uk/hr/diversity/index.aspx>

They also have a network funded by Wellcome Trust looking at inequalities in health and health service <https://heronnetwork.com/>

8. Appendix 1 – Methodology

General methodology – peer reviewed literature

Online databases were searched using the terms in Table 1. In the search wildcards were used. For example, to search for university or universities the term universit* was used. In addition, the references of selected articles were examined to identify further relevant articles. Citation metrics were used to identify further strands.

Table 1. Terms used in the literature search. Publication years 2000 - 2019

Theme	Search terms	Context	Type of reference	Hosting Organisations for academic libraries
Leadership	Diversity/Diverse	Higher education	Synthesis Review Meta-analysis Systematic Article	ACM ¹ EBSCO ² Google Scholar ³ IEEE ⁴ PubMed ⁵ Web of Science ⁶
	Minority/Minorities	University		
	Under represented			
	Leadership			
	Development			
	Programme			
Industry	Industry	Industry		
	Collaboration	Higher education		
	Under represented	University		
	Diversity/Diverse			
	Minority/Minorities			
	Under represented			
	Network			
On-line platform	Co-operation			
	Gender	Higher education		
	Disability	University		
	Online			
	Platform			
	Community			
	Social network			
Shared characteristic Mentoring	Mentor	Higher Education		
	Network	University		
	Staff			
Reciprocal Mentoring	Mentor	Higher Education		
	Two- way	University		
	Reciprocal			

¹ Association for Computing Machinery <https://www.acm.org/>

² <https://www.ebsco.com/>

³ <https://scholar.google.co.uk/>

⁴ Institute of Electrical and Electronics Engineers <https://www.ieee.org/>

⁵ <https://www.ncbi.nlm.nih.gov/pubmed/>

⁶ <https://wok.mimas.ac.uk/>

Publication year 2000 was chosen as the earliest date for the literature search as much of the landscape of EDI and of Higher Education has changed over the last 20 years. However, if a paper which was considered to be influential was published prior to this date, its inclusion was considered on a case by case basis.

Papers were identified by title and keywords, refined by reading of abstracts and further refined by reading of whole text.

Initial searches produced between 50 (online platform) and 5000 (shared characteristic mentoring) potential articles (plus additional articles based on citations or reference trails), which were reduced to the 15 -30 per topic which have been reported here.

General methodology – other literature

For other literature (e.g. reports, articles and web pages), there has not been a methodical search for resources. The team were alerted to the presence of such resources and these were examined and included where relevant. These resources are not always from peer-reviewed sources and are included for additional contextual information. These have been included in the Other Resources section.

9. Appendix 2 – Summary of Shared Characteristic Mentoring articles for screening

A scoping review of existing studies on Shared Characteristics Mentoring screened 2,200 abstracts leading to selection of 45 studies for detailed reading. The studies were further screened based on the quality of samples and research designs and 27 were further selected for some basic quality appraisal. The table below shows the summary of the 27 articles.

1.	Study	Target group	Design	Sample	Outcomes	Results	Quality of evidence
2.	(Lewis et al., 2016)	URM and women	RCT	150	Satisfaction with work and satisfaction need for mentors	No differences in satisfaction levels of different mentoring types	3
3.	(MacPhee et al., 2013)	Women/ low income groups	non-random selection of participant with pre-post comparison	175	Self-efficacy and performance	positive outcome of programme on women	2
4.	(Viets et al., 2009)	URM	non-random selection of participant, pre-post survey of mentees	9	Grant submission, publications, conference presentations	positive outcome	2
5.	(Wingard et al., 2008)	URM	Comparison URM with Non URM (Non-random)	26	Perceived effects of mentoring on career path, and research productivity, including publication and grant success.	positive outcome	2
6.	(Benson et al., 2002)	URM	Voluntary participation /selection of senior faculty by junior	18	Perceptions	Mentoring reported to be most useful	2
7.	(Beecroft et al., 2006)	Not URM	Non-random selection of nurses. Matched non-randomly	No details	Satisfaction with mentors/mentees	Not clear	1

8.	(Johnson et al., 1998)	URM ECR	non-random selection of URM	36	Retention of URM entrants	slight positive	1
9.	(Rust et al., 1998)	URM	non-random selection of participants, pre-post questionnaire	36	Skills in teaching, research, cultural competence, administrative skills	positive outcome	1
10	(Santos and Reigadas, 2002)	URM	non-random selection	No details	Self-efficacy and goal identification	matched on ethnicity showed more programme satisfaction	1
11	(Yager et al., 2007)	URM	non-random selection, pre-post self-reports	14	Grant funding, publications and promotions	Positive outcome	1
12	(Abernethy, 1999)	URM mentored by Non-URM	Non-random selection, no comparison	30 out of 42	Perception on satisfaction with mentoring programme	positive outcome	0
13	(Buchwald and Dick, 2011)	URM	non-random selection of participant, no baseline data, no comparison groups	29	Publications, grants, social connections	positive outcome	0
14	(Bussey-Jones et al., 2006) 674–679.	Women	volunteering women	5 women	Nothing	nothing	0
15	(Daley et al., 2006)	URM and Non-URM	non-random selection of participant, no baseline data on selected participants, cohort	114 after dropout N=112	Retention of junior URM and Non URM on 3 years before and after	positive outcome	0
16	(Enriquez et al., 2017)	URM	Non-random participants	164	Self-efficacy and satisfaction	Mentoring reported to be most useful	0

17	(Gasman and Nguyen, 2016)	URM in STEM education	Non- random selection of participation just interviews and self-reports	10	Not clear	Mentoring reported to be most useful	0
18	(Kosoko-Lasaki et al., 2006)	URM	non-random selection of women and ethnic minorities, no baseline data on selected participants	130	Retention, promotion	Positive outcome	0
19	(Lewellen-Williams et al., 2006)	URM	non-random selection of participant, no baseline data, no comparison groups	22	Skills for academic success	Positive outcome	0
20	(Marinac and Gerkovich, 2012)	ECR	non-random selection of participants, no baseline data, no comparison groups	55	Self-efficacy towards research, grants submitted and achieved, researchers money received	Positive outcome	0
21	(Sinkford et al., 2009)	URM	non-random selection of participant, no baseline data, no comparison groups	46	Perceived effectiveness of mentoring	Positive outcome	0
22	(Waitzkin et al., 2006)	URM	non-random selection of participant, no baseline data on selected participants, cohort	11	Progression in status, grant achievement	Positive outcome	0
23	(Abelson et al., 2018)	URM	Not clear	No details	Retention, promotion	URM less retention and promotion	0

24	(Abedin et al., 2012)	Not URM	Not clear	No details	stress reduction, ease of transition,	Peer mentoring is better than senior mentoring	0
25	(Altuntas, 2012)	Not URM	cross-section	No details	mapping mentoring types	Mentoring reported to be most useful	0
26	(Anderson et al., 2012)	Not URM	non-random-cross-section	No details	mentoring types and satisfaction levels	Mentoring reported to be most useful	0
27	(Bauman et al., 2014)	Women	non-random selection of participant, no baseline data on selected participants, cohort	No details	recruitment and retention, career satisfaction, and institutional climate	positive but not sure if it's the programme of institutional culture	0

10. References

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