

Conceiving, Designing, Implementing and Operating an EDI Engineering Employability Learning Toolkit to Aid Graduate Employment

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ABSTRACT

Society 5.0 strives to achieve UNESCO Sustainability Goals, addressing world wide society inequalities. However, both AI-driven and traditional recruitment systems have historically perpetuated biases that have resulted in the underrepresentation of women and GLOBAL MAJORITY individuals in the engineering industry. In response, Canterbury Christ Church University has established a new equality, diversity, and inclusive (EDI) engineering, design, and technology education provision and adopted CDIO framework. The engineering programmes seek to create an industry-ready stickable talent pipeline that addresses regional and international skills gaps. Therefore, develop engineers capabilities and competence and practice for in the workplace in developing EDI engineered solutions and EDI in their practice with colleagues. Consequently, there is a pressing need for an Employability (EL) Learning Toolkit with a focus on EDI; that supports engineering talent to develop their EDI in practice with colleagues; assist them in securing meaningful employment; educates the next generation of engineering recruiters in recruiting EDI talent to the workforce. This paper presents the findings of a quantitative research study conducted on employers' perceptions of the recruitment and employment process for graduates. The objective of this research is to inform the conception, design, implementation, and operation of a prototype Employability Learning Toolkit with an EDI engineering focus. This toolkit aims to build upon the previous research and development of the Canterbury Christ Church University's Future 360 initiative, demonstrating the university's dedication to fostering inclusivity in the engineering sector.

KEYWORDS

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Employer engagement, Graduate recruitment, Engineering Talent Pipeline, Standards: 2, 3, 9, 12, Optional Standard 4: Internationalization & mobility

INTRODUCTION

Society 5.0 aims to meet UNESCO Sustainability Goals, including achieving gender equality and reducing inequalities related to disability, socioeconomics, and ethnicity. Engineering plays a critical role in developing Society 5.0 by providing solutions to problems that affect the entire community. Doyle-Kent et al. (2019) highlight that true interdisciplinary and EDI (Equality, Diversity, and Inclusion) teams are needed to be effective in creating and engineering inclusive solutions to complex problems. Canterbury Christ Church University has established a new equality, diversity, and inclusive (EDI) engineering, design, and technology education provision. The curriculum adopts the Conceive Design Implement Operate (CDIO) Framework (Crawley et al., 2011) to offer an EDI 'industry-ready' talent pipeline, addressing regional skills gaps (Kent County Council, 2022; Southeast Local Enterprise Partnership, 2021). This initiative also supports regional economic growth, as diverse teams have been shown to achieve (Martins, 2020). The new engineering education provision aims to develop engineers' capabilities and competence and practice for in the workplace in developing equal, diversity and inclusive:

1. engineered solutions to problems
2. working practices with colleagues.
3. current and future engineering recruiters

The new engineering education curriculum implementation primarily will develop students in the items 1 and 2. However, there is a need for additional tool to the curriculum learning delivery to assist in developing students and employers in items 2 and 3, and enable students to successful secure graduate employment in engineering. However, disparities persist in engineering employment prospects for ethnic minorities, females, LGBTQ+, and low socioeconomic engineering students (McWhinnie and Peters, 2012; Mellors-Bourne, 2016; Nortcliffe et al., 2019; Engineering UK, 2019; Parutis et al., 2020). AI-driven recruitment systems encode minority and gender bias, exacerbating the issue (Njoto et al., 2022; Dastin, 2022), leading to the loss of female and Global Majority (Global Majority in Western Society is new term for BAME: Black, Asian, and Minority Ethnic) engineering talent to graduate roles outside the sector (Engineering UK, 2019). Hersh and Doyle-Kent (2023) recommend that engineering employers consider all aspects of EDI, including social, cultural, gender, and disability perspectives, when creating an EDI workplace. Therefore, the EDI engineering employability learning toolkit is to enhance the social capital and employability of female, Global Majority, and low socioeconomic students in engineering, enabling all students to secure meaningful engineering employment and educating the next generation of engineering recruiters in EDI recruitment and the creation of an EDI engineering working environment.

The EDI Employability toolkit will positively impact the CDIO curriculum implementation of Standard 2 in meeting employer stakeholders and student needs. Also, contributes to CDIO standard 3 in integrating the personal and interpersonal skills development in students within the curriculum. The toolkit will add to the faculty competence in developing personal and interpersonal skills (CDIO Standard 9).

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This paper presents results and analysis of a quantitative survey with engineering employers to understand employers' perceptions of the recruitment and employment of engineering graduates. The research with employers aims to inform the conception, design, implementation, and operation of a prototype EDI Employability Learning Toolkit for engineering students. The toolkit builds upon previous research and development of the Canterbury Christ Church University Future 360 Framework (Employment toolkit), incorporating the Graduate Capital Model (Tomlinson, 2017), the internship framework (Shawcross and Ridgman, 2014), and principles of social capital learning (Brown et al., 2014). This toolkit also demonstrates the university's dedication to fostering inclusivity in the engineering sector and developing an EDI talent pipeline to industry.

LITERATURE REVIEW

Mellors-Bourne (2016) found that only 40% of Global Majority engineering students secure engineering employment within six months of graduating. In fact, female and Global Majority graduates typically secure non-engineering employment, as reported by Engineering UK (2019), and female engineers' salaries are lower. The UK Higher Education is particularly failing to address the leak in the pipeline of women and Global Majority engineering students into graduate roles, resulting in fewer female and Global Majority graduates entering engineering employment than those entering university (McWhinnie and Peters, 2012). Nortcliffe et al. (2019) identified a similar issue with students securing placements, with only a significant number of Global Majority students not securing a placement. This placement gap contributes to the widening Global Majority degree attainment gap. Placement is critical to academic attainment, as Mandilaras (2004) demonstrated that students with placement experience achieve a higher degree classification than peers without placement experience. Nortcliffe et al. (2017) reported that peer-assisted learning (PAL) interventions within the first and second years of an engineering degree program can reduce the placement and degree attainment gap while increasing student belonging. Brown et al. (2005) highlighted that University Engineering Educators should not only develop technical competency but also enhance students' human and social capital for graduate employability. Students from low socioeconomic households lacking social capital may require tailored interventions (Parutis et al., 2020).

Enterprises require diverse employees for improved social and economic performance, and diverse engineering graduate employees contribute to the economic growth of engineering enterprises (Martins, 2020). To address the growing engineering skills shortage in the UK and globally, the engineering employment sector needs graduates who can seamlessly transition from higher education to industry. Learning interventions researched and developed by Shawcross and Ridgman (2014) have been shown to enhance engineering students' ability to be "industry placement ready," in terms of social capital and employability skills.

The current student pipeline to employers typically consists of Gen Z graduates. The current student population consists of Gen Z. Research by Mărginean (2022) highlighted that 85% of Gen Z students in Romania rated both "My work represents me" and "I like what they do on the job" as extremely or very important. Additionally, 61% want their job to have a positive impact. This aligns with Schroth's (2019) report on USA Gen Z, indicating they seek roles that are interesting and meaningful, with 91% believing everyone should be treated equally, despite limited or no internship experience. Meaningful employment is also a common theme for UK Gen Z (Parry and Battista, 2019). However, engineering employers may be employing more

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females and Global Majority individuals over the last ten years; however, retention of females remains a concern (Engineering UK, 2022). The engineering sector in the UK is struggling to retain employees since the pandemic (Kellie, 2022). Tushar and Sooraksa (2023) identified a mismatch between graduate skills and industry requirements, with the pandemic and post-pandemic accelerating the need for technologically enabled graduates. Additionally, iBid concluded that there is a need to further comprehend employment skills and strategies to smoothly transition graduates into employment. This paper presents quantitative research with employers to understand engineering employers' EDI and recruitment policy/strategy.

RESEARCH METHODOLOGY

To better understand employers' perspectives and requirements and to support the conception, design, implementation, and operation of the EDI EL Toolkit, the research approach aims to answer the following research questions:

- Q1 Do employers value EDI in practice in the workplace?
- Q2 Are employers' applicant recruitment shortlisting strategies inclusive?
- Q3 Are there opportunities for universities to enhance student development for applying for jobs?
- Q4 Are there opportunities for employers to enhance their recruitment processes to be more EDI?

A quantitative survey approach with both Likert scale and qualitative questions was proposed, following Cohen's (2017) active research approach. The survey was planned to be open from May to October 2023 and distributed to employers who attended events at Canterbury Christ Church University, including:

- Undergraduate engineering final year project poster event in May 2023,
- Postgraduate MSc research project poster event in September 2023,
- Kent Chamber of Commerce July 2023 business-to-business event with the School of Engineering, Technology, and Design.

Additionally, the survey was planned to be distributed to engineering employers listed in the University's and EqualEngineers's CRM (Customer Relations Management) System. The research approach received approval from the University ethics committee.

RESULTS AND DISCUSSION

The survey was completed by 100 employees working for industrial engineering employers, representing a proportionally equivalent range of organizations of different sizes:

- 30% Micro-enterprises (5 or fewer employees)
- 25% Small and Medium Enterprises (less than 50 employees and turnover less than £10M)

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- 20% Medium enterprises (less than 250 employees and turnover less than £50M)
- 25% Large Enterprises (more than 250 employees and turnover greater than £50M)

Fifty-five percent of the respondents are involved in recruiting graduates and placement students. The survey results comprehensively answer Q1. Employers value EDI by demonstrating that they have an EDI policy and that it is implemented in practice. Employees also recognize the need to recruit more diverse graduates to support a more diverse workforce (see Table 1). Additionally, Figure 1 highlights that employees in the industry recognize EDI as addressing broad inequalities in society, including gender, sex, age, socioeconomics, disability, and ethnicity. Thematic analysis of the qualitative responses under the "other" category in Figure 1 emphasized that EDI means fostering an inclusive culture and community.

Table 1: Survey questions respect to employer EDI Policy

Question to Industrial Employee	Strongly Agree	Agree	Disagree	Strongly Disagree
We have an Equality, Diversity and Inclusion policy that is core to the business	50%	40%	8%	2%
We have seen implementation of the Equality, Diversity and Inclusion policy in practice in the business	40%	50%	7%	3%
To meet our graduate recruitment targets we need to recruit a more diverse workforce	41%	44%	13%	2%

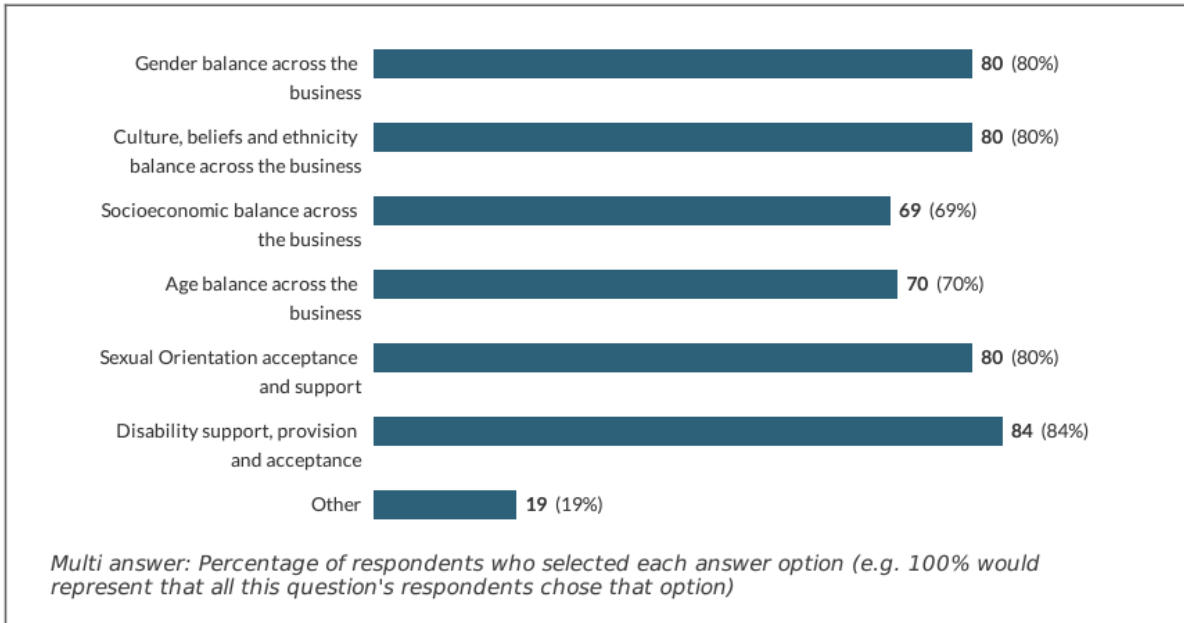


Figure 1: “What does Equality and Inclusion mean to you?”

Eighty-two percent of the respondents highlighted that the applicant recruitment screening process (shortlisting for an interview) is manual. Figure 2 highlights what employers consider critical information from applicants to support the screening process.

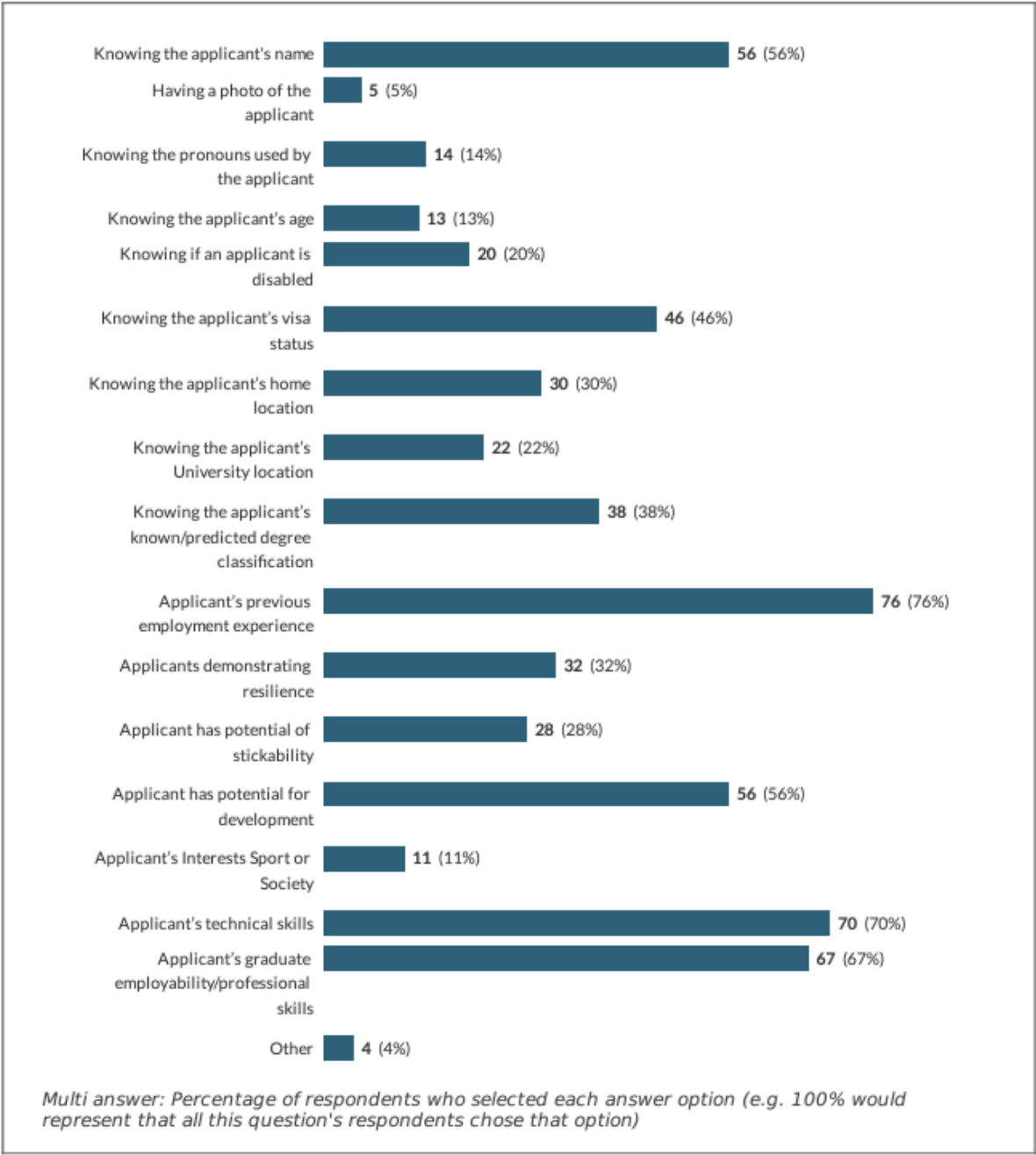


Figure 2: Survey multiple checkbox on the critical components of their employer's screening process

From an EDI recruitment strategy perspective in addressing Q2, the results in Figure 2 indicate the potential risk of bias during the shortlisting process. For instance, it could be argued that the applicant's name is not essential, as it has the potential to induce gender (Keiner-Kisin, 2012) and ethnicity bias (Derous and Ryan, 2019). Concerning declared visible disabilities, applicants face discrimination at the short-listing stage (Bendick, 2018), while the declaration of hidden disabilities has a positive impact on being short-listed (Spirito Dalgin, and Bellini, 2008). Similarly, knowing the applicant's visa status has been used as a legitimate basis for short-listing, supporting aversive racism (Shinnaoui and Narchal, 2010). However, it is noted that employers and potential international employees have to meet government visa employment requirements. Also, knowing a candidate's university can induce recruitment bias, with applicants from top-ranked UK universities more likely to be shortlisted than those from lower-ranked universities (Drydakis, 2016). It should be noted that employers may potentially miss out on diverse talent through university bias, as a higher proportion of Global Majority engineering students (Mellors-Bourne, 2016) and low socioeconomic students (Havergal, 2016) study at lower-ranked universities, known as Post-92 Universities.

Figure 2, however, does highlight the importance for education providers to offer opportunities for developing students' technical and employability skills, as well as opportunities for students to build a portfolio of work-based learning experiences such as placements or internships. Traditional year-long placements may not be inclusive if students have caring responsibilities, disabilities, or are from low socioeconomic backgrounds, especially when an internship requires travel or living away from home (considering affordability of accommodation, travel, public transport accessibility, etc.) (Brewester and Thompson, 2020). Thompson and Brewester (2023) emphasize taking an inclusive approach to creating meaningful placement experiences that benefit all stakeholders, indicating the need for universities and employers to co-create work-based learning experiences that are more inclusive.

The positive outcome of Figure 2 was other responses (open question) indicating candidates' who are leavers are being automatically shortlisted, and other respondents request visa information post-interview and job offer.

In response to Q3, a thematic analysis of the written qualitative answers indicates that universities need to develop students' understanding of:

- Career opportunities in engineering
- Workplace and corporate environment, including internships
- EDI in the workplace
- Employer recruitment processes, such as CVs, covering letters, applications, interviews, etc.

The thematic analysis of respondents' answers to their reflections on their organization's recruitment processes and practices regarding opportunities for enhancing processes to be more EDI (answering research question Q4) revealed:

- Challenges in completing EDI for small/micro organizations
- Room for improvement and further training
- The need to understand more about EDI recruitment processes
- Development and engagement in more EDI recruitment practices, such as anonymous shortlisting and structured interviews

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However, seven respondents believed the question was not applicable or that their processes do not need enhancing. The reality is that concerning EDI, it is an incremental societal process (Lutfiyya and Bartlett, 2020). We are all a work in progress, and everyone's processes need continuous improvement.

CONCLUSION

The research answered the research questions:

Q1 Do employers value EDI in practice in the workplace?

A1 Yes, in the UK, employees and employers from micro to large enterprises value EDI through the creation and implementation of their EDI policy.

Q2 Are employers' applicant recruitment shortlisting strategies inclusive?

A2 No, employers' practices have the potential to induce bias through knowing the applicant's name, visa status, and university:

- The name can indicate gender, leading to females typically being short-listed out (Keiner-Kisin, 2012).
- The name can indicate ethnicity, resulting in typical negative recruitment bias towards Global Majority applicants (Derous and Ryan, 2019).
- The applicant's visa status can introduce racial bias (Shinnaoui and Narchal, 2010).
- University bias towards higher-ranking universities exists (Drydakis, 2016), as Global Majority (Mellor-Bourne, 2016), and low socio-economic students (Havergal, 2016) typically attend lower-ranking universities.

Q3 Are there opportunities for Universities to enhance student development for applying for jobs?

A3 There is a greater need for engineering programs to collaborate with career services to develop student understanding of engineering careers, the world of work, and recruitment processes. Additionally, there is a need to co-create inclusive internships with all stakeholders.

Q4 Are there opportunities for employers to enhance their recruitment processes to be more EDI?

A4 Yes, employers have an appetite to understand, learn more, develop, and engage in EDI recruitment practices.

In conclusion, employers value EDI, and the majority recognize that EDI in practice is a work in progress, requiring incremental changes (Lutfiyya and Bartlett, 2020). At Canterbury Christ Church University, the Future 360 Framework (Employment toolkit) addresses students' understanding and learning of employer recruitment processes. Regarding employers' requirements for the EDI EL Toolkit, there is a need to develop students' understanding of:

- Engineering careers,

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- Corporate work environment,
- EDI in the workplace.

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BIOGRAPHICAL INFORMATION

Anne Nortcliffe is the founding Head of Engineering, Technology and Design at Canterbury Christ Church University and Professor of Inclusive Engineering and Technology. Anne Has PhD and MSc in Control Engineering and Degree in Chemistry. Anne Has industry and academic experience over 25 years of experience in educating the next generation of engineering graduates. Anne is an active engineering and computing education researcher, in particular addressing inequalities in higher education and strives to create equal, diverse and inclusive education facilities and experience for all stakeholders.

Claudius Fanusie is an Architect, Artist, Musician and founder of cross-disciplinary practice ArchiArtyMusicTects. The socio-political and historical contextualising of the practice's work is based around Fanusie's childhood memories growing up in Freetown, Sierra Leone; his Black British minority status; and the legacies of the Trans-Atlantic Slave Trade and colonisation. Fanusie uses both traditional and digital tools and one of the work he is currently developing is a playable experience using Virtual Reality to challenge deeply held views of the audience by exploring themes around racial capitalism and racism in contemporary British society. Fanusie brings all these very relevant experiences into the development of the EDI toolkit.

Gabbie Matei a devoted PhD student specializing in AI and Immersive Technologies for a Sustainable Economy, exemplifies a profound commitment to sustainability and innovation. Leading cross-functional teams and actively contributing to a significant European Regional Development Funded project in the past, she has demonstrated a unique blend of academic rigor and practical expertise. Her passion for crafting immersive experiences using emerging technologies is evident. In her role as the EDGE Hub Coordinator at Canterbury Christ Church University, Gabriela is actively contributing to the Equality, Diversity, and Inclusion toolkit project, seamlessly aligning her skills with the mission of fostering sustainability and inclusivity.

Mary Makinde is a Principal Lecturer in Forensic Investigation. Mary's practitioner background has been integral to the development of her approaches to curriculum design and research. Mary is the Closing Gap Strategic Lead in the University, working with colleagues and students across the university to provide a whole-institutional, holistic approach to addressing outcomes and experiences for Global Majority Students, aiming to make sustainable positive transformational change. It is through this role that Mary is making a significant contribution to the EDI Toolkit.

Susan Odev is Head of the Canterbury Christ Church University's Careers and Enterprise team managing the institution's employability and student enterprise education strategy. Susan is the architect of Future 360 - CCCU's Framework for Developing Enterprising, Professional Graduates (2019-2024) and her team has supported the wider university as it steadily improved its graduate employment outcomes. The university is currently ranked first in the UK for graduates in work. Susan is passionate about improving the graduate capital of our widening participation students having herself been a mature student at CCCU. Prior to joining CCCU, Susan banked over twenty years experience as a learning development specialist in the public and charitable sectors, managing diverse teams through times of organizational change and facilitating industry-leading professional development programmes.

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