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Developing Undergraduate Engineering Students' Soft Skills with Interdisciplinary Personal Development Planning Modules in Chinese Transnational Education: A Case Study

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Contents

Abstract

To be a competent engineer no longer only depends on knowledge; soft skills such as teamwork, critical problem solving, communication, and personal and social skills are required in the multifaceted, globalised world of engineering. However, it is widely reported that undergraduate engineering students leave university without the required soft skills to function effectively in the workplace (Beuret and Webb 1982, Riemer 2002, Idrus, Salleh and Lim Abdullah 2011, World Economic Forum 2020). To ensure engineering students leave higher education with the required skills means a revamp of engineering education. This case study follows one cohort of Chinese undergraduate engineering students at a joint education institute between the UK and China, in a transnational education setting. It explores the development of the students' soft skills when studying an interdisciplinary three-year set of personal development planning (PDP) modules. A mixed-method study featuring two questionnaires over a period of one calendar year (two academic years), 15 interviews and documentary analysis of the students' engineering logbook (a record of professional development) shows the benefit of these modules and the development of students' soft skills whilst studying using a project-based approach. It was found that students developed a range of soft skills relevant to engineering including project management, teamwork and problem-solving skills which helps them academically, professionally and in the workplace. Findings also showed that students saw the value of the PDP modules, especially for their next career steps and identified that the project-based interdisciplinary approach was important. Culture and self-efficacy were also found to be key in the development of soft skills. A model of PDP modules for undergraduate programme design is given explaining how PDP needs to feature discipline specific skills which are embedded into the degree programme, whilst using an innovation educational approach which is culturally appropriate for developing soft skills in engineering higher education.

Key words: Personal Development Planning (PDP), Transnational Education (TNE), soft skills, interdisciplinary, undergraduate engineering, China

List of Acronyms

BERA	British Educational Research Association
CDIO	Conceive Design Implement Operate
CL	Cover Letter
CPD	Continuous Professional Development
CS-MM	Case Study Mixed Methods
CSR	Corporate Social Responsibility
CV	Curriculum Vitae
FYP	Final Year Project
GDPR	General Data Protection Regulation
HE	Higher Education
ICT	Information Computer Technology
IET	Institute of Engineering Technology
ILO	Intended Learning Outcome
IOM3	Institution of Materials Minerals and Mining
JEI	Joint Education Institute
MM-CS	Mixed Methods-Case Study
MMR	Mixed Methods Research
NSS	National Student Survey
PBL	Problem Based Learning
PDP	Personal Development Planning
PESTLE	Political Economic Social Technological Legal Environmental
PjBL	Project Based Learning
PM	Project Management
RQ	Research Question
SSLC	Student-Staff Liaison Committee
STEM	Science Technology Engineering Maths
SWOT	Strengths Weaknesses Opportunities Threats
TEF	Teaching Excellence Framework
TNE	Transnational Education
UK-SPEC	UK-Standard for Professional Engineering Competence
VLE	Virtual Learning Environment
VR	Virtual Reality

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Chapter 1
Introduction

1.1 Introduction

'Chinese University 3.0', the latest stage in the development of Chinese Higher Education (HE), has led to educational internationalisation and China's need to remain competitive in a globalised world (Li, Jun 2016). This has led to joint ventures with overseas universities with the aim of knowledge and skill share, often known as Transnational Education (TNE).

Engineering has also developed its role in education through accreditation of HE programmes to "assure confidence that graduates have a solid educational foundation to enter critical STEM (science, technology, engineering, maths) fields in the global workforce" (ABET 2021, no p.). Graham (2018) reports the future of engineering education needing diversification, cross-disciplinary curriculum and global experiences. Without this, engineering education will fail to address key future trends of sustainability, the 4th industrial revolution and work readiness (Hadgraft and Kolmos 2020). The Engineering Council further substantiates this with its new Engineer 2030 flagship policy project (Royal Academy of Engineering 2024) which aims to, "develop a world-leading and truly inclusive engineering workforce…. and make systematic changes across education, skills, and employment".

This introductory chapter aims to understand the impact that integrated three-year Personal Development Planning (PDP) modules have on the academic, professional, and transferable soft skills of students in a university engineering programme.

The undergraduate Engineering Material Science and Engineering Polymer Material Science programmes are part of a Joint Education Institute (JEI) between two universities, Canal University, UK, and Mountain University, China. The JEI welcomed its first cohort of students in 2017. Students attend the China-based JEI for four years where they are taught a range of technical and core modules in English by academics from the UK and Chinese universities, as well as compulsory Chinese cultural and political modules.

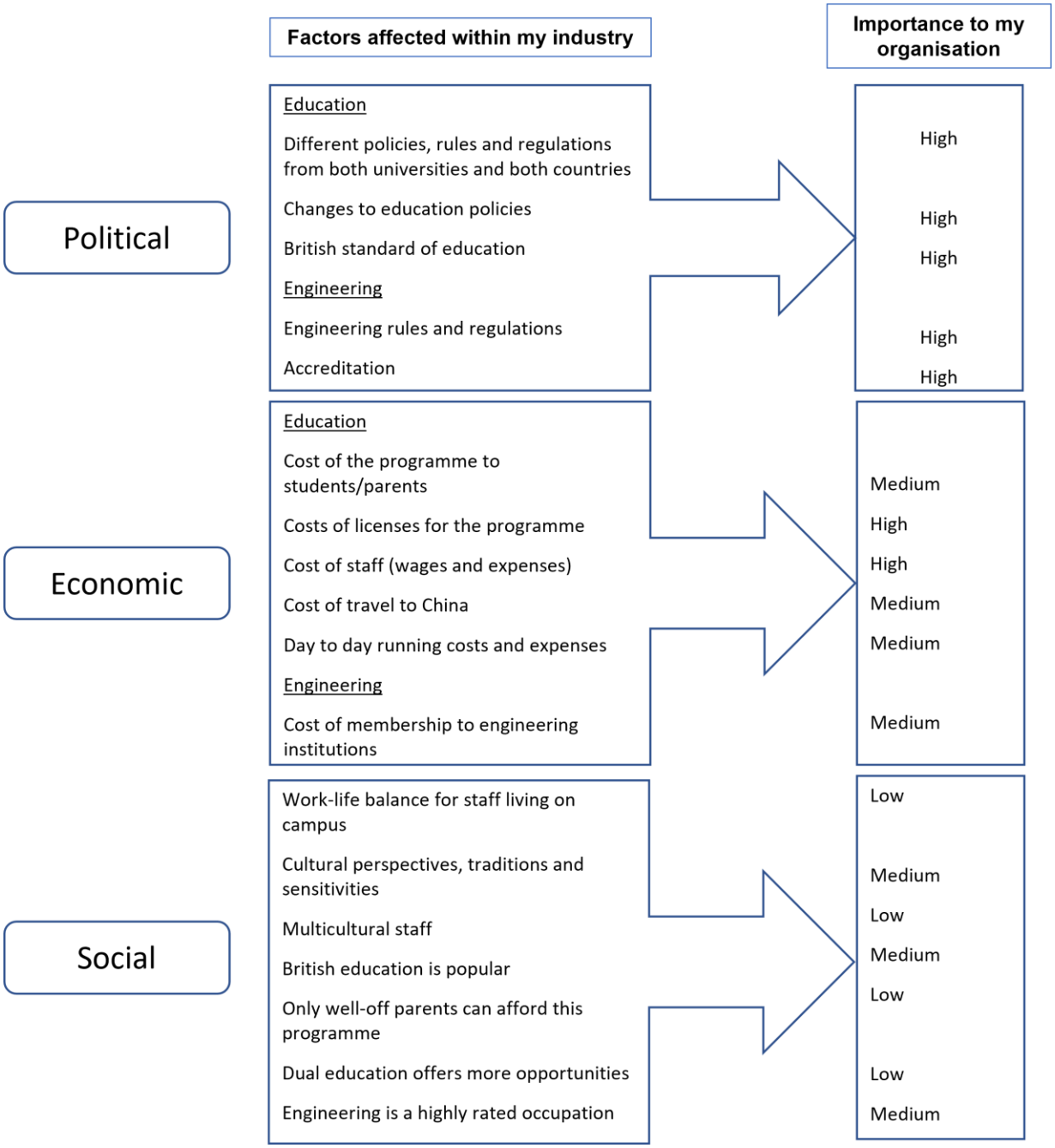
Each PDP module is classed as a 3.5-credit core technical module at Mountain University and a 0-credit core module at Canal University. Each PDP module spans the entire academic year and continues for the first three years of the degree programme. The PDP modules are progressive in nature, first focussing on academic skills, then moving on to employability and finally business skills, aiming to develop academically able students, as well as effective graduate engineers who could function well in a workplace.

As module organiser of the PDP modules, this researcher conceptualises, designs, creates and delivers all three modules to over 700 students in the JEI (see appendix 1). Within the JEI, interdisciplinary education is encouraged, so this researcher works closely with engineering colleagues to create meaningful PDP modules using assessed real-world tasks and projects, where the students develop skills useful to engineers. Interdisciplinary in this context means using the knowledge of language/skills specialists and engineers to create a tailored set of PDP modules that develop the soft skills of students by using engineering knowledge, concepts and projects.

1.2 Context

As the JEI is a joint venture between two universities in two different countries, and covers two industries (education and engineering), a range of issues arise. These two industries can create conflict and therefore issues surfacing need to be analysed and discussed to identify which factors are most important to each industry. This is done through a PESTLE analysis which helps analyse the ontology of the JEI.

A PESTLE analysis identifies external influences on an organisation by analysing six key factors: political, economic, social, technological, legal and environmental (Morrison 2020). In the case of the JEI, a PESTLE analysis as a tool helps as there are multiple partners involved, in terms of universities, countries and industries. The PESTLE analysis may help identify the major factors that are important to the JEI as well as where there are potential conflicts and opportunities. The PESTLE analysis for the JEI (Figure 1.1) identifies political and technology factors most relevant to PDP which will be further discussed below. For a full discussion of all factors, see appendix 2.


Factors affected within my industry
Importance to my organisation
Political
Education
Different policies, rules and regulations from both universities and both countries
Changes to education policies
British standard of education
Engineering
Engineering rules and regulations
Accreditation
High
High
High
High
High
Economic
Education
Cost of the programme to students/parents
Costs of licenses for the programme
Cost of staff (wages and expenses)
Cost of travel to China
Day to day running costs and expenses
Engineering
Cost of membership to engineering institutions
Medium
High
High
Medium
Medium
Medium
Social
Work-life balance for staff living on campus
Cultural perspectives, traditions and sensitivities
Multicultural staff
British education is popular
Only well-off parents can afford this programme
Dual education offers more opportunities
Engineering is a highly rated occupation
Low
Medium
Low
Medium
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Low
Medium

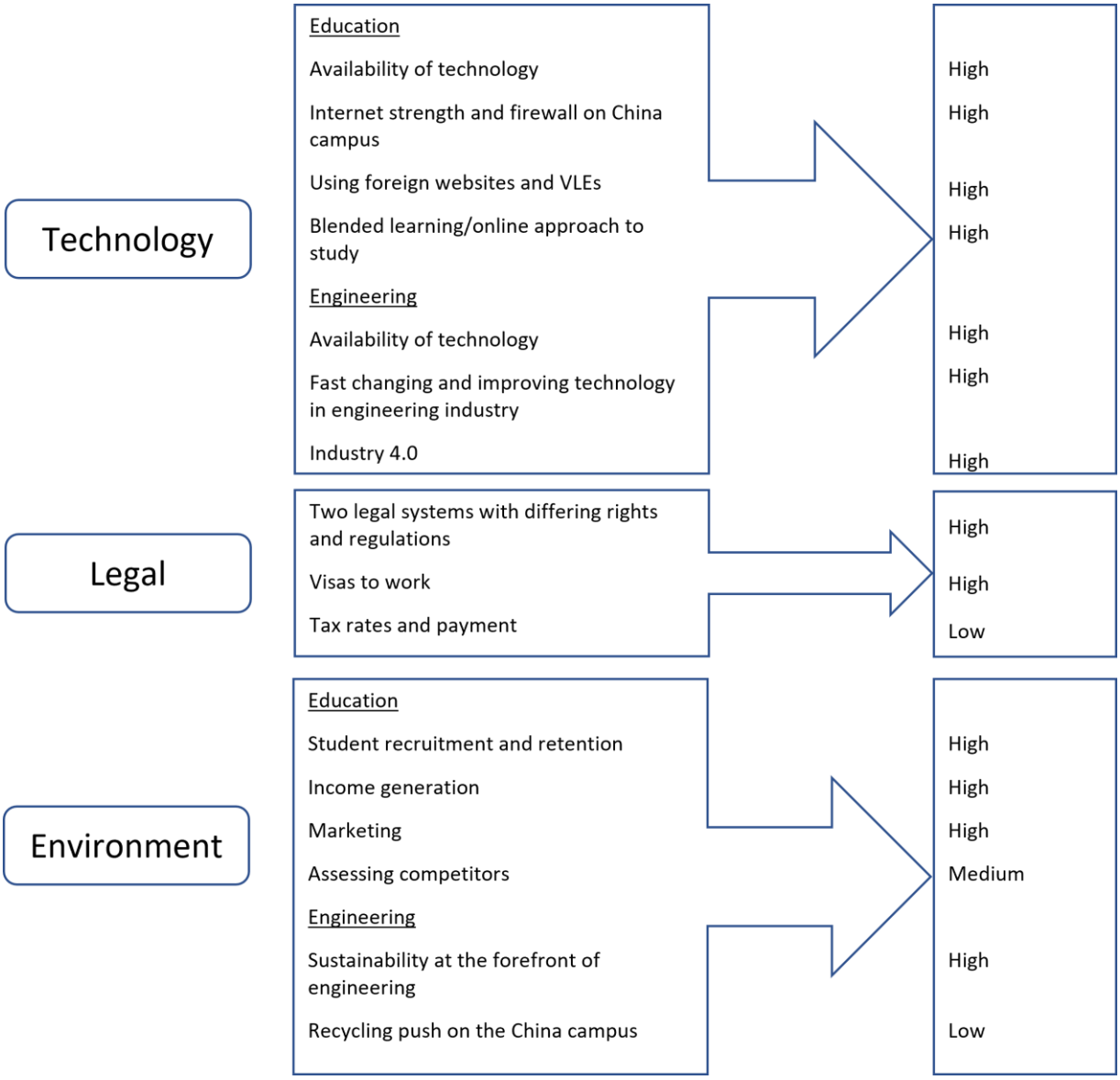

Figure 1.1: PESTLE analysis

From the PESTLE analysis, politically, at a local level, each university has their own policies, procedures and regulations which can sometimes be differing or conflicting causing complex procedures, confusion or even misunderstanding of policies between staff members and students. Trifiro (2018) found similar issues with transnational education agencies. At a university level, each university is subject to the education policies of each country and/or province from the appropriate education authorities. There can also be issues regarding the British standard of education and the academic rules and regulations that accompany this. This can be a problem as there are areas such as plagiarism that are viewed differently in China. Therefore, students must be taught the specific policies and procedures of the two education systems, including how to give feedback on modules through the Student-Staff Liaison Committee (SSLC).

From an engineering perspective, to gain accreditation from an established engineering body, for example The Institute of Materials, Minerals and Mining (IOM3), certain specifications must be met. Accreditation in the UK and China differ in terms of requirements and transferability. There are also codes of conduct that engineers must meet, especially when part of an engineering society. Codes of practice also differ between countries, but the expectation is that an engineer is trustworthy and always considers the public good (IOM3 2019).

Technology can be an issue especially the Internet and "Great Firewall" in China (Lee 2018). As the JEI uses a foreign virtual learning environment it can sometimes be difficult to access, especially at some locations on campus such as in the dormitory where internet signal is weak. Inside the School internet strength is better but access can still be slow. Additionally, during the COVID-19 pandemic, as blended learning has had to take place with the British university staff online and the students on campus, technology use has increased. This has been a learning opportunity for the JEI to create new and interactive ways of learning on a variety of different lecture platforms.

Technology constantly advances in the engineering sector and with Industry 4.0 and the rise in artificial intelligence it is important that students are computer and technology literate (Valeur 2020). This fast-changing industry means it is up to education staff to also keep abreast of change, so students are prepared for when they enter the workplace. The Global Competitiveness Report 2019 (WEF 2019, p. 156) also rates Chinese university graduates' skillset as 4.5 out of 7, placing China 35th out of 141 countries and the technical skills of the active population as 4.7 out of 7, placing China 45th out of 141 counties, and finally ease of finding skilled employees as 4.6 out of 7, placing China 41st out of 141 countries.

Based on the PESTLE analysis it is clear to see that there are Strengths, Weaknesses, Opportunities and Threats to the JEI as can be seen in the SWOT analysis below (Figure 1.2).

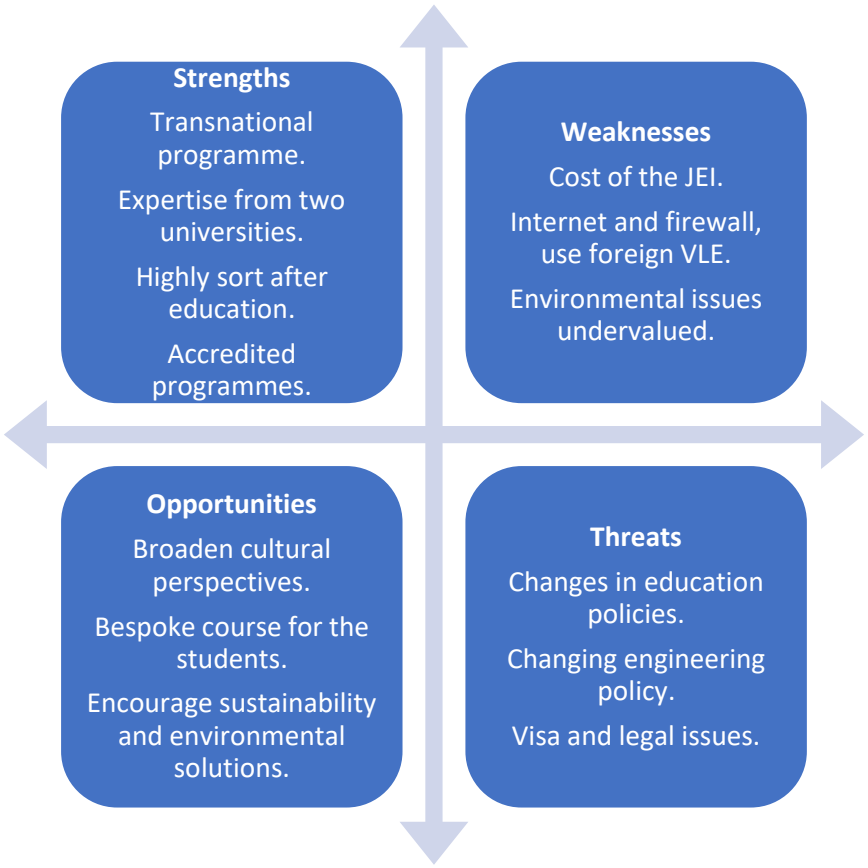

Figure 1.2: SWOT analysis of the JEI

From the PESTLE and SWOT analyses mentioned above, the most significant factors affecting the PDP modules are political, due to the education policy requirements from each university and country. This brings opportunities to develop the PDP modules to be bespoke for the JEI, therefore meeting the needs of the internal and external stakeholders and enhancing the environmental factor from the PESTLE. By creating a bespoke set of modules, a major strength is identified and providing the provision of PDP is deemed successful, it can be an excellent marketing tool for the JEI (environmental factor). However, PDP is an unknown to many, especially in China. These new modules can be seen as less useful to students as they contain less engineering technical subject knowledge than students expect from the university course. This can be a weakness of the course if the aims, objectives and benefits are not explicitly shown to the students.

Chapter 2
Literature Review

2.1 Introduction

This literature review chapter explores literature related to the research question: How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students? It is widely cited that graduates lack the soft skills required in the workplace and this has been and is still continuing, particularly in the multifaceted field of engineering (Beuret and Webb 1982, Riemer 2002, Idrus, Salleh and Lim Abdullah 2011, World Economic Forum 2020). Engineering as a globalised industry recruits from a global talent pool meaning graduates need strong communication skills, emotional intelligence, team working ability and cultural understanding to be able to work in diverse teams internationally. Additionally, Industry 4.0 has created a demand for technological and digital skills means a need to reskill the current workforce and ensure new employees have these skills (Valeur 2020). There has never been a greater need then for personal development planning and implementing this into university courses could solve the prominent issue of a lack of graduate skills. The following literature review identifies what PDP is at university, as well as in engineering and the TNE context. It then goes on to discuss what HE is offering in terms of employability, PDP and graduate attributes. The chapter continues by analysing the development of curriculum and assessment in terms of PDP before concluding with a discussion on the impact of COVID-19 on skills development, curriculum design and pedagogy.

2.2 Personal Development Planning at University

PDP is defined as:

> *"a structured and supported process undertaken by a learner to reflect upon their own learning, performance and/or achievement and to plan for their personal, educational and career development. It is an inclusive process, open to all learners, in all HE provision settings, and at all levels"* (The Quality Assurance Agency for Higher Education, (QAA) 2009, p. 5).

It is worth noting that PDP is a taught process that is successful if students are well supported (Hearn 2007) from staff or mentors who have been well trained and are willing to invest a significant amount of time into the process (Lafrance 2018). As a taught process, PDP in itself is a skill that can be mastered through a process of teaching and learning over time. Personal development plans are

often used as a reflection tool as well as being used as a mentoring device to provide career progression and career satisfaction (Woolnough and Fielden 2017).

The personal development plan is an action plan used to identify goals, strengths and weaknesses and is completed through a process of reflection to identify areas for improvement (Putter 2021). However, the need for a mentor here is significant as simply identifying needs is not enough; how to fulfil those needs is key. A personal development plan needs to be used as a 'feed forward tool' (Beausaert, et al. 2013) to take those identified needs and turn them into reality through training or certification. Without this, the plan simply becomes a feedback tool and therefore does not have a real purpose. If there is no clear purpose to this reflection, then the tool becomes redundant. This is why purpose and validity of PDP, the course content and the tools available are invaluable to the learner. To be an active participant in PDP, the validity and value needs to be clear. This all feeds into continuing professional development (CPD) which is part of any workplace. Developing employees through CPD is key to any successful business. The development of technology and new practices means that employees must be upskilled to keep the business competitive.

CPD needs to be developed as part of academia. In engineering, as discussed above, waiting for graduation to develop soft skills leaves a gap in the market, so it is imperative CPD starts at university (Ooi 2021). During university it is important to start the process of continually improving oneself. This is why students attend university in the first place. Whilst at university, students need to develop skills to enable them to be successful at university as well as engaging in the process of lifelong learning. These essential study skills include communication skills, teamwork skills, critical thinking and academic reading and writing skills. Additionally, Cottrell (2019) notes the fact that study skills take time to develop and evolve as one studies. She also says that by engaging in PDP, students at university then "gain more than just a degree" (p. 70). In fact, by going through the reflective and analytical process, students can gain skills and abilities to help them "compete and cope in the world" (p. 70). This, therefore, shows the benefit of engaging in the PDP process early and how it can help develop the skill of lifelong learning.

2.3 Engineering, Skills and Personal Development Planning

Engineers are required to have a number of hard and soft skills in order to be considered competent in their profession. Hard skills include knowledge whereas soft skills include communication, teamwork and critical thinking skills. The Engineering Council sets the standard for engineers to become professionally registered through the UK-SPEC (The UK Standard for Professional Engineering Competence) (Engineering Council 2020b). Section D of the UK-SPEC discusses the

communication and interpersonal skills that are required for professional registration. Across the three levels of registration, demonstration of teamwork, effective communication in English and personal and social skills are required. One way of demonstrating personal skills according to the UK-SPEC is, “knowing and managing own emotions, strengths and weaknesses” (p. 37). It is therefore important that personal development planning is integrated into university courses to ensure graduates are employable, meeting the standards of the Engineering Council and the needs of industry, as a critical element of PDP is reflection.

Reflection is the traditional form of PDP where individuals reflect on specific tasks or situations using a reflective model. However, reflection is a personal journey and therefore difficult to assess and is much more useful when it is placed into an engineering context. Therefore, having an Engineering Logbook is important for students. This is a reflective journal of continuing professional development which can be used to support professional registration. The logbook, which details the activity conducted including the date/time and audience, the learning objectives, a reflection of the activity and the outcome is created in PDP1 at the JEI and is used throughout the degree programme to develop the reflective, recording and CPD skills of undergraduate student engineers (Nightingale 2022). It encompasses the idea of ‘my career path‘ which is the Engineering Council’s online professional development system (Engineering Council 2020a), but also incorporates a more reflective approach using Gibbs’ reflective cycle (Gibbs 1998), which gives a more detailed approach to reflection. A similar approach was taken by Dube, Williams and Nwabunike (2021) but with master’s level systems engineering apprentices. This shows the importance of recording professional development for apprentices, but this researcher believes it is vital for all students, regardless of level of study.

Goodall (2017, p. 78) said that PDP does not have to be “a formal or rigid process in order to be of benefit”. Therefore, PDP can also encompass the skills required for engineers as the engineering industry diversifies. The Royal Academy of Engineering (2020) identifies six skills that engineers need in this evolving landscape: “systems thinking, problem solving, visualising, improving, creative problem-solving and adapting” (p. 10). This shows that engineering has progressed beyond teamwork and communication and so curriculum should be adapted to fit industry needs. Therefore, HE needs to address the issue of personal development and provide graduates with ‘job-ready’ skills as identified in the Global Competitiveness Report 2020 (Schwab and Zahidi 2021) in a more substantial way than it is currently.

In the 2017 Employer Skills Survey (a UK survey conducted with over 87,000 businesses) (Winterbotham, et al. 2018), ‘technical and practical skills’ and ‘people and personal skills’ were two

broad categories in which employers noted a lack of skills among applicants (pp. 46-48). Critically, 'Business Services' which features engineering, reported complex analytical skills as the largest lack (57%), significantly higher than all sectors (49%) (figure 2.1 'technical and practical skills'). Problem solving skills (key for engineering) feature in this group, a 41% lack. 45% of all skill-shortages lacked 'operational skills' which features 'knowledge of how the organisation works'. Finally, 33% of all skill-shortage vacancies were due to a lack of digital skills.

In 'people and personal skills', a lack of time management and task prioritisation accounted for 51% of all skill-shortages vacancies. Management of your own and other's feelings accounted for 37%. Management and leadership skills accounted for 50% which are important skills in teamwork and project management; both essential skills for engineers.

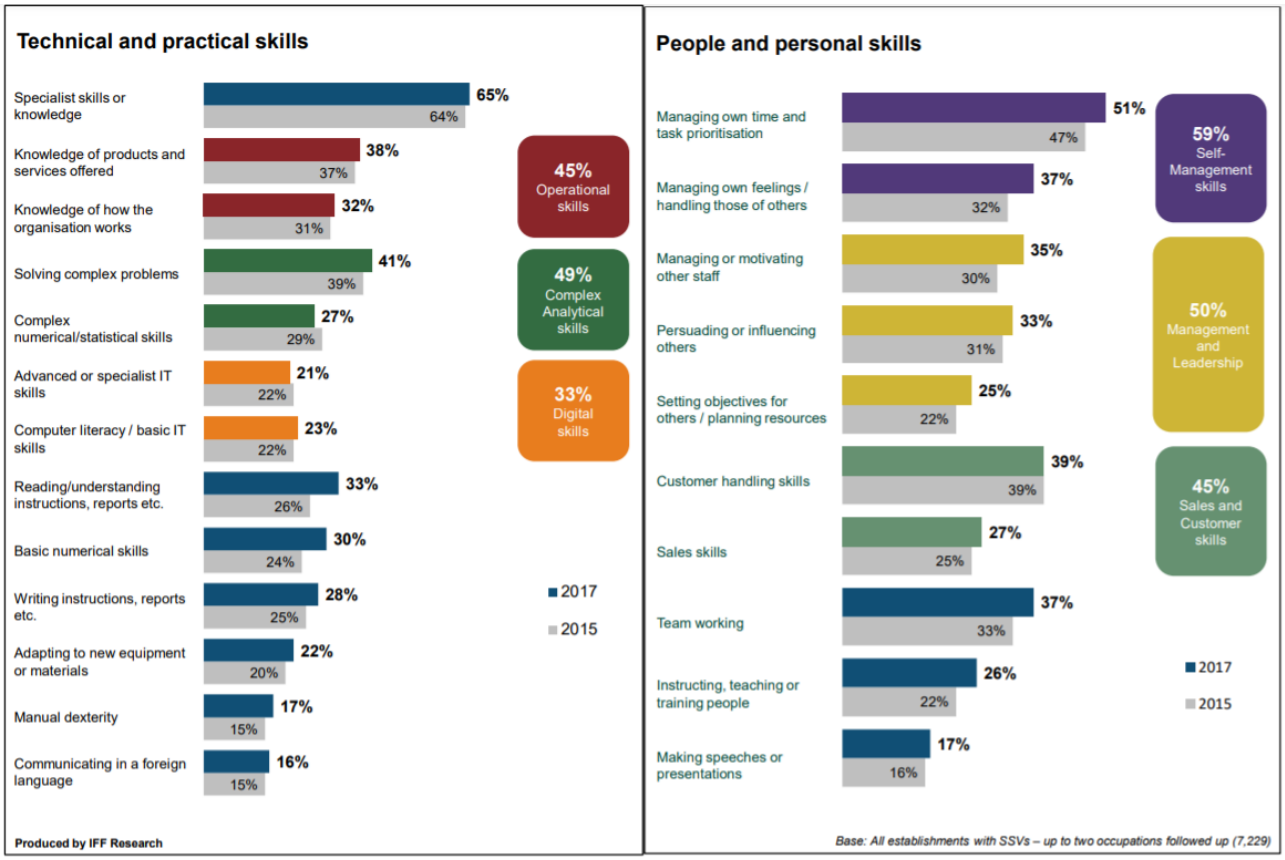

Figure 2.1: Skills needed in the workplace (Winterbotham, et al. 2018, p. 49)

The report (Winterbotham, et al. 2018, p. 52) also indicated that having these skills shortage vacancies meant there was a 'delay developing new products or services' (40%), 'difficulties introducing new working practices' (35%) and 'difficulties meeting quality standards' (34%). All of these are required aspects of engineering as engineers are required to always consider the public

good and stay ahead of current trends and developments in the market (Royal Academy of Engineering and Engineering Council 2017, IOM3 2019).

Finally, the 2017 Employer Skills survey (p. 84) also reported that 67% of companies wanted to increase employee training and spending to overcome skills gaps. However, increasing spending could lead the company into financial difficulty, especially if it is a small business. This is echoed by the Institute of Engineering and Technology's (IET) 2021 skills survey which states that whilst 50% of companies surveyed want to train their staff, they are under pressure to reduce company costs (p. 22), so 51% of companies believe the Government should be providing more support to train or reskill (p. 6) (The Institute of Engineering and Technology 2021b).

This demonstrates the need for graduates/employees to have the required skills before entering the workforce, which is where higher education has its' role, specifically with PDP. Having spent at least three years in higher education, students invest heavily in themselves through their time, money and personal sacrifice, so it is important that they find a course which meets industry needs and equips them with the key skills that are needed.

With the Higher Education Act (Harrison 2011) making changes to tuition fees and funding in England and Wales, universities increasingly became businesses with the student customer expecting more. This is especially important in TNE as fees are higher than the host country fees, but much less than international student fees in the foreign university (Fang and Wang 2014), so the TNE students could expect the same customer experience as in the UK. Failing to equip students with the key skills is a failure of the business and of customer service. Additionally, the high fees required of international students mean, as a business, a university needs to identify its corporate social responsibility (CSR) towards society, both local and global, which encompasses the students and the employers. CSR is defined as:

> *"a self-regulating business model that helps a company be socially accountable—to itself, its stakeholders, and the public. By practicing corporate social responsibility, companies can be conscious of the kind of impact they are having on all aspects of society, including economic, social, and environmental"* (Fernando 2021, no p.).

This shows that businesses are being failed by universities and universities are not effectively practicing their CSR. As stakeholders, businesses expect when they employ graduates, the initial training expenses are reduced, and companies can promote more in-house training to mould the graduates into company assets. However, according to IET 2021 skills survey, 96% of engineering

employees say that skills shortage among applicants affects their business (The Institute of Engineering and Technology 2021b).

Development of skills whilst at university will help reduce the graduate unemployment. Atkinson and Pennington (2012) reported that employers felt graduates were unable to apply their technical skills and knowledge into a workplace or business setting and therefore were unsuitable for roles. The authors also report that a third of unemployed graduates felt the provision of careers input and support to understand employers' requirements were lacking in university courses. However, Kornelakis and Petrakaki (2020) argue that embedding skills into the curriculum does not guarantee employment but instead helps with the "transition from education to employment" (p. 291). Advance HE also highlights that embedding employability helps transition but goes further by saying this transition, "benefits them, the economy and their communities" (Norton and Tibby 2020). This is an important distinction here as Advance HE is looking towards the benefits to society rather than benefits to just oneself in seeking and finding employment. Therefore, embedding employability into HE is beneficial to society, industries and the economy overall, which will then be beneficial to the individual. So, it could be said that developing employability skills in university is keeping business competitive and industry thriving which in terms of the engineering sector is vital for the UK economy as engineering contributed 21.4% of the UK's overall turnover in 2018 (Engineering 2019).

Overall, the engineering industry has clear skills requirements which universities should be providing to its' graduates. This can be achieved through PDP modules which are developed to meet the needs of industry. A reimagination of PDP to not only focus on soft skills but also develop hard skills in an innovative way by including both educators and industry experts is a key recommendation from the IET 2021 skills survey (The Institute of Engineering and Technology 2021a) and will be discussed later.

2.4 Transnational Education

Engineering previously meant choosing from local suppliers, but now, acquiring materials, workforce and doing business across the globe has led to a breakdown of barriers and a need for soft skills and linguistic acumen in addition to hard skills. HE now attracts many overseas students, so students are also drivers as well as industry and employers. Companies need graduates with communication skills, intercultural skills, empathy and social awareness (Bourn and Neal 2008), which are more often found in students with international experience (Archer and Davison 2008). This was also echoed in research by Lockett and Feng (2019) who identified that employers were looking for graduates with soft skills who were returning to China from studies abroad which shows the need

for higher levels of social skills. Walther, Miller and Sochacka (2017) proposed a model for teaching empathy to engineering students as they believe this teachable skill is vital in today's engineering society where engineers have to engage in empathy with varying stakeholders. This would also align with engineers considering the public good, a main focal point of being in the industry. Therefore, TNE programmes are paramount to give student the global perspective, develop cultural skills and help remove barriers to industry.

TNE has a range of definitions and is often used to cover a multitude of programme types where teaching and learning is delivered 'offshore' (Mellors-Bourne, Jones and Woodfield 2015). For the joint venture between Canal University in the UK and Mountain University in China (the focus of this study) the following definition will be used: *"Award- or credit-bearing learning undertaken by students who are based in a different country from that of the awarding institution"* (O'Mahony 2014, p. 8).

TNE programmes offer students the oversees learning experience from their home country, which can be beneficial as students are not losing their social networks and future business contacts in China. However, it has been seen as 'second best' to actually studying abroad (Fang and Wang 2014). It is therefore important that the programme provides the quality of education that UK HE is renowned for. Additionally, there needs to be preparation for the workplace. If students are looking for that overseas degree, but staying in their home country, then they are likely to continue to stay and work in their home country (Fang and Wang 2014). This is often the case for the Canal and Mountain JEI students in China. With an incredibly competitive job market awaiting Chinese graduates, and students and parents willing to spend more money on education (Cen 2017), this could be one of the reasons for the rise in TNE and joint programmes between UK and China universities. Additionally, TNE students in China often pursue a master's degree abroad (Fang and Wang 2014), meaning they will be expected to have the soft skills required to be successful in this. It therefore means that programmes need to cater for professional and workplace skills both internationally and in China, so cultural awareness is important.

This further emphasises the need for PDP modules so students can become self-aware (identifying their own social and cultural barriers) and be able to identify their own needs for the future, whether for further study or their career. However, PDP or developing soft skills is an unfamiliar concept for Chinese students who prefer mastering technical skills (Lockett and Feng 2019), so showing validity of these modules is essential. Connections with the programme major, future employers and industry is key to ensuring the success of PDP. Chinese companies also report a lack of soft skills (Chan, J., Goh and Prest 2015, Yan and Kongjit 2020) with graduates from both home

and those who studied abroad unable to meet market demand (JP Morgan 2016). Soft skills are reported as important to keep graduates competitive in the job market (Cao 2022). However, the rote style of learning or 'teach-to-test' method (Lu, R., Goodale and Guo 2014) that Chinese undergraduates are accustomed to means they have difficulties in acquiring the skills required in the workplace as well as the teaching approaches used in a JEI. Teaching methods and approaches used in TNE programmes often mirror those used in UK HE such a problem-based learning, task-based learning, student-centred approach, communicative approach and a flipped classroom. More critical thinking skills, communication skills and autonomy are also required in UK HE and these are often skills that Chinese students find the most difficult.

Chinese students are often generalised as being passive or surface learners and preferring memorisation and repetition (Burrows 2016). It is also said that peer learning is not valued, only the teacher's opinion, which of course is opposite to UK HE (Burrows 2016). UK HE focuses on the learners being active, challenging concepts and ideas and deep learning (Burrows 2016). This therefore poses a challenge for both Chinese learners and UK HE to ensure that learning takes place, and learners develop the skills needed to be successful at university. PDP can bridge this gap and will discuss how in the following sections.

2.5 Higher Education and Approaches to Employability and Personal Development Planning

Approaches to employability

There are three approaches to employability in universities: embedded, bolt-on and parallel (Cranmer 2006). This means students are either unaware of learning skills as they are hidden within context, explicitly aware of learning skills in isolation, or a mixture of both approaches. Table 1 shows the extent to which employability skills can be embedded into university courses and who should be teaching these areas.

Table 1: Methods of delivering employability skills in HE curriculum (Cranmer 2006, p. 172)

Delivered by subject lecturers (mandatory)				Delivered by Careers and Employability Unit personnel (optional)	
Total embedding of employability skills	Explicit embedding and integration	Bolt-on 'Professional Skills'	Bolt-on 'Generic Skills'	Parallel development Study Skills	Parallel development Generic Skills
Employability skills	Employability skills	Specific modules aimed at enhancing study and generic skills	Specific modules aimed at enhancing generic skills, developed by Careers and Employability Unit personnel, integrated into mainstream	Developing writing Creative thinking Using web resources	CV writing Career guidance Making effective job applications
Lose skills without trace Skills disappear in context No explicit assessment Low impact on curriculum	Visible skills Skills in context Explicit assessment High impact on curriculum	Visible skills (Study and generic skills) in context Explicit assessment High impact on curriculum	Visible skills (Generic) skills in context Explicit assessment High impact on curriculum	Bolt-on development Limited contextualisation Separate assessment Low impact on curriculum	Bolt-on development Limited contextualisation Separate assessment Low impact on curriculum

Cranmer (2006) does raise concerns regarding the impact of universities/lecturers teaching employability skills. She does highlight the issue again in later research suggesting that employer involvement in course design and sandwich years have a positive impact on graduate employment, but there is limited research into the effect of teaching of employability skills at university (Mason, Williams and Cranmer 2009).

Approaches to PDP

The three approaches to employability in universities that Cranmer suggests above, reflect the three models of PDP developed by Clegg and Bradley (2006). Clegg and Bradley discuss the professional, employment and academic models of PDP. The professional model is similar to the bolt-on professional skills discussed in table 1. This relates to specific skills being taught for a specific career and having evidence (through assessment) to demonstrate these skills. The employment model focuses more on generic workplace skills which aim for longer term career development or short-term employment needs. This would align with the bolt-on generic skills and the parallel

development generic skills identified in table 1. Crucially though, both of these skill sets can be taught by the careers centre. Finally, the academic model enhances student skills in order to successfully complete their degree and this would align with parallel study skills and embedding and integration, because the academic model acknowledges the importance of these skills being discipline specific. This researcher would argue that none of these approaches are appropriate in isolation if the careers centre is teaching employment and professional skills, it is unlikely that they would have much involvement with the specialists related to each student's degree programme. This would mean that only generic skills are being taught, which is not aiding employers in different industries as they would still need to spend money on training. Additionally, if the academic model only focuses on study skills, this as well does not provide the skills needed for students. Furthermore, study skills are again often taught in isolation, by specified places within a university such as the library, or as a self-study activity. This again is not linking soft skills to the degree, the employer or the industry and this researcher would argue, this does not aid students in any way. It is important to have integrated PDP modules to support learners throughout their university journey; undergraduate or postgraduate.

Baker, Perkins and Comber (2014) discuss the relationship of PDP and taught postgraduate international students at UK universities. They found that Clegg and Bradley's (2006) employment model resonated with their findings due to postgraduates' motivation for careers and therefore showed PDP as valuable for international taught postgraduates.

A study using of e-portfolios based on each of models of PDP also found positive results (Frith 2010). Each model was studied in a different subject, with physics being studied for the academic model. Whilst there was enthusiasm to engage in PDP, adapting it into the physics curriculum was difficult as academic staff were not confident in assessing reflective tasks and so e-portfolios were not fully introduced. However, the relevance of being discipline specific was recognised as significant which is key to PDP validity as well as pedagogical and curriculum development.

Interestingly, the embedded, bolt-on and parallel approaches discussed above seem to be what most PDP courses/activities follow. Audunsson, Matthiasdottir and Fridgeirsson (2020) discuss a project called 'Disaster Days' which using a real-life engineering scenario to develop the teamwork, networking and creative thinking skills of undergraduate engineering students. This project correlates with the parallel approach of Cranmer (2006) because students receive a talk on teamwork and its importance. Without this lecture on teamwork, this project would align with the embedded approach.

An example of total embedding of skills is discussed by Reedy, et al. (2020). In their elective 8-week problem orientation/project-based course, Reedy, et al. discuss how they assessed the course but did not explicitly assess teamwork and creativity as they wanted these skills to remain implicit. This aligns with total embedding of employability skills and no explicit assessment as seen in table 1. Additionally, Reedy, et al. discuss the use of industry experts in the creation of their project. This is of key importance as noted above in the IET 2021 survey as one of their key recommendations of educators and employers working together.

Finally, examples of bolt-on PDP can be found in a career planning course over one semester (14 weeks) (Dorazio 2020) and in a four-year course developed by Goodliffe (2005). Dorazio's course focussed solely on career planning skills such as interviews and applying for jobs which aligns with the bolt-on generic skills because the students were fully aware of what they were learning. This is similar to Goodliffe's courses, but they also focus on study skills as the first-year course discusses learning strategies and thinking skills needed for higher education. Whilst Goodliffe's courses do have an element of engineering related to them, and so an attempt to embed the courses more into context, this fails as she does not get buy-in from the university lecturers.

Again, this raises the issue of curriculum design in relation to integration and involvement from subject specialists/experts. In three further studies, two of which looked at skills-based PDP, Singh, R., et al. (2019) suggest changing teaching pedagogy and Andreea and Bucur (2020) discuss rewriting or developing the curriculum to better identify skills needed in engineering. Power, et al. (2005) also discussed collaboration between subject specialists and mapping of skills to develop the academic literacies of first year undergraduate industrial design engineers. Curriculum design and pedagogy will be more fully discussed in later sections. However, what all of these examples show is that there is no continued, integrated approach to PDP which is not aiding learners to be successful. Whilst these activities are positive, they are short lived, which is why this researcher proposes the idea of PDP modules throughout the university degree.

2.6 Graduate Attributes

UK Higher Education has shifted its focus to equipping students with skills needed to gain employability after graduation (Wong, et al. 2021). However, Wong, et al. note the development of skills and career planning is limited, particularly in the UK. 'Graduate attributes' feature highly with universities when developing modules, courses or programmes, especially as it is one of the key contributors to UK universities gaining Teaching Excellence Framework status (TEF), through the measurement of student outcomes and learning gains. The TEF states that students should be able

to gain, “acquisition of attributes such as lifelong learning skills... skills and attributes necessary to compete for a graduate level job” (Department of Education 2017, p. 24). As universities are keen to gain TEF status (bronze, silver or gold), graduate attributes have become a hot topic and more of a focus for institutions, especially those aiming for gold status, like Canal university.

Graduate attributes are not new, but in the age where universities need to show the value of obtaining a degree, graduate attributes can be seen as another form of ranking and how universities are distinguished from each other (Mahon 2022). This can be supported by the National Student Survey (NSS) that recently added the question, “How has your course developed your knowledge and skills that you think you will need for your future?” to their survey (Office for Students 2023). Lists of graduate attributes vary between institutions and are influenced by a variety or internal and external factors like noted above (Mahon 2022), but, like the NSS question above, are very loose in terms of what they actually mean and how one should develop them (Wong, et al. 2022) as they are not an integrated part of the degree programme, but something a learner should be learning themselves as they progress through their degree (Barrie 2012). This demonstrates the need for integrated PDP modules into the degree programme to meet the needs of all stakeholders. It also shows that the development of soft skills needs to be highlighted so learners recognise that they are being learned and developed. There are two main issues highlighted in the review of literature regarding graduate attributes, firstly the use of the term ‘generic’ and secondly, the fact that learning relies on the individual. PDP is often thought to be the development of generic soft skills which can be transferable into different situations. However, this researcher believes that in order to develop soft skills, they need to be taught within a specific context; namely that of the degree programme. This is to help learners develop the ‘job ready’ skills they need as discussed above. This means developing curriculum based the needs of all stakeholders which will be discussed further later.

In terms of learning relying on the individual, there is discussion in the literature regarding how to assess graduate attributes and reflection is named as one of the ways. This would align with social constructivism and further exacerbates the need for PDP as reflection is a key theme in personal development. The idea of oneself means that each individual develops their own reality which will be discussed later in the literature review and further in the methodology section.

HE institutes have careers departments that support graduates in finding employment. However, students need to actively seek out support from the careers department, which many students do not. According to the Strada-Gallup Alumni Survey (Strada and Gallup 2018), only 22% of US

undergraduate graduates sought advice from the career's office (p. 9). Compared to their Chinese counterparts, American business students sought more STEM careers advise due to more career choices and less STEM preparedness (Rezayat and Sheu 2019). Bradley, Quigley and Bailey (2021) reported that in their UK-based study, less than 50% of students studied attended careers events. This shows that very few students are actively pursuing help with career and personal development. Therefore, actively embedding careers and personal development into the curriculum is necessary to enhance the knowledge of undergraduates and to aid careers choices. Furthermore, the Strada-Gallup report (2018) stated that students seek careers advice from faculty or staff members, not related to the careers service, and 49% found the advice helpful or very helpful and 32% found the advice somewhat helpful (p. 11). This shows that students are more likely to seek advice from those they have a more personal relationship with. Therefore, embedding careers advice and PDP modules into the curriculum from trusted teachers will have a more beneficial effect for students.

Wong, et al. (2022) mapped graduate attributes within UK universities into the several themes, summarised in table 2.

Table 2: Graduate Attribute Themes in UK Universities (Wong, et al. 2022)

Graduate Attributes Theme	% of UK universities	Soft skills
Self-awareness and lifelong learning	89%	self-awareness, emotional intelligence, adaptability, effective communication, organisation and time management
Employability and personal development	75%	working effectively with others in groups and teams, demonstrating leadership by inspiring shared organisational goals, managing conflict and building strong rapports with colleagues; and utilising specialist knowledge and commercial awareness
Global Citizenship and engagement	70%	taking social and civic responsibility, equality, diversity and inclusion on local and international levels, networking, language skills
Academic and Research Literacy	66%	Academic literacy (EAP), academic expression, research literacy (critical thinking, evaluating evidence, contributing new knowledge or ideas, forming conclusions), ethical responsibility and sustainability

What is worthy to note from Wong's study is that academic skills are listed last, whereas the idea of self and employability are mentioned most frequently by universities. This suggests that academia is not the most important aspect of being at university, but developing oneself and soft skills is. This therefore shows the need for PDP modules as the soft skills mentioned in the table are those which are developed during PDP. In addition to self-awareness, lifelong learning appears at the top of the table which will be discussed in relation to PDP now.

2.7 Personal Development Planning and Lifelong Learning

Lifelong learning is defined as, *"the provision or use of both formal and informal learning opportunities throughout people's lives in order to foster the continuous development and improvement of the knowledge and skills needed for employment and personal fulfilment"* (Collins 2022). This definition indicates that there are two reasons for pursuing lifelong learning: professional development and personal development. As mentioned above, CPD is often the main form of professional development which is used to advance in one's chosen career or help to seek out new employment opportunities. Therefore, having the necessary skills to advance is key. Soft skills are important for this as many people often combine work and study, by taking part-time courses as part of their job or in addition to their job. This requires skills such as time management, organisation and motivation. In terms of personal development, lifelong learning enhances the perception of oneself and develops personal growth. Someone who has the desire to improve themselves either personally or professionally can be described as having a growth mindset. A person with a growth mindset is concerned with learning and has skills such as persistence, finding inspiration from others and embracing challenges in order to achieve high levels of achievement. On the other hand, someone with a fixed mindset tries to reinforce looking smart and often achieves less than their full potential as they may plateau as they give up easily, see effort as pointless or feel threatened by other people's success (Dweck 2016). Each person can experience both a fixed or a growth mindset in different areas of their lives or through their beliefs, but those who engage with lifelong learning and seek out opportunities to improve will increase this growth mindset which helps the person develop both personally and professionally. Paul, et al. (2020) discuss the importance of developing resilience as part of a growth mindset with engineering students as this helps with lifelong learning. Resilience is a key skill that has been developed as a result of the COVID-19 pandemic from engineering students (Brennan, et al. 2023) and by engineers (Padilha, et al. 2021) and something which PDP needs to develop in individuals to assist with lifelong learning.

In terms of educational research, there is no consensus as to a theory for lifelong learning, but one of the most common concepts is lifelong learning skills along with the types of lifelong learning (formal, nonformal and informal) (Thwe and Kálmán 2023). PDP covers these concepts as it teaches common lifelong learning skills and in the case of this research, a formal way by means of a three-year interdisciplinary set of PDP modules. Taranto and Buchanan (2020) discuss the use of self-regulated learning theory and its need to develop lifelong learning. This would align with PDP as it is a personal endeavour and relies heavily upon self-evaluation and reflection. Therefore, this would support a constructivist point of view which will be discussed further in the next section.

Chinese learners and lifelong learning

Thinking specifically about Chinese students, lifelong learning is now becoming invaluable as there is a move into the 4th industrial revolution. Woetzel, et al. (2021) discuss the need for a workforce upskill in China and an education reform to develop lifelong learning as digitalisation and automation become more prevalent. China is perfectly capable of reforming education as it has done previously. Li (2016) discussed Chinese HE entering what was coined 'Chinese University 3.0' to keep up with the demands of a globalised world. This is where the need for lifelong learning sits. Woetzel, et al. (2021) estimate that the skills needed by 2030 could amount to an additional 236 billion hours or 40 extra days per worker. The authors discuss the need for "high cognition skills (critical thinking and decision making), social and emotional skills (interpersonal and leadership) and technical skills (advanced data analysis)" (p. 47), which calls for more vocational education. "Vocational education and training prepares people for work and develops citizens' skills to remain employable and respond to the needs of the economy" (European Commission, N.D.). There is a call in the 'Reskilling China' report (Woetzel, et al. 2021) for a move away from the traditional textbook style teaching, commonplace in China, to a more vocational style with hands-on and internship experience. For workers already in employment a new pedagogy may be difficult for them to adapt to as they will be older and so used to the traditional teaching methods, so vocational education may be a new phenomenon and difficult to instil. Woetzel, et al. highlighted a survey where only 21% of workers saw developing vocational skills as urgent, instead favouring language, certification and education degree (p. 54). The belief is that with more vocational education and a new more hands-on pedagogy, lifelong learning will be developed in Chinese students, thus making them more competitive in the workforce and market.

2.8 Curriculum Development

A constructivist approach

Biggs (1996) discusses the notion of constructive alignment which brings together constructivist psychology and curriculum theory and is an outcome-based theory. He discusses the need for teachers to really identify what they want students to learn and gain input from students as well through reflection as to how well they felt they had met the learning objectives. Again, this relates well to PDP as reflection is a key part of development, but also ontologically speaking (Waring 2021), reflection creates multiple realities, so analysis through a constructivist lens is appropriate. Biggs (1996) argues that there are three points of contact where constructivism should be implemented with instructional design: learning objectives, teaching methods and assessment. He suggests a

hierarchical approach to learning objectives to show the development of the student, an embedded approach to teaching and learning activities, and a portfolio of assessment where students are able to choose assignments that showcase their development in relation to the learning objectives. Practically speaking this approach fits with the student-centred approach of HE and hierarchical outcomes would align with progression though university, which is a feature of UK HE.

Even though Biggs considers the students are vital in the constructive alignment curriculum, Hailikari, et al. (2021) claim that often students' perspectives are not taken into account. Consequently, in their study, Hailikari, et al. researched the effect constructive alignment has on student learning. They found that deep learning occurred when there was active teaching and learning, the opposite of traditional lectures, so high engagement activities made the students do more. However, students' own motivation can encourage engagement in low active environments. As a result, it can be seen here that even in a traditional setting, deep learning can occur, but only if student motivation is high. This is problematic when students have little or no interest in the course or programme but are simply attending due to cultural family pressures which is prevalent in China (Bodycott and Lai 2017) or when students are only attending a JEI as a way to access a prestigious Chinese University which may be out of their reach (Wang and Fang 2014).

Stages and considerations of curriculum development

Curriculum development is clearly the defining factor when it comes to ensuring undergraduate students leave university with the hard/technical and soft/non-technical skills required for the workplace and successful completion of their university degree. Curriculum development goes through a series of stages (planning, implementation, evaluation) to be ready to teach and a diverse group is required in this process including, the lecturers, the students, the university, industry and the employers. Focussing on this through a business lens, the stakeholders (the university and the employers/industry) often have the biggest impact on development as they are the ones providing funding, resources and potentially jobs. It is important that they are satisfied that the customers' needs (i.e., the students) are being met and are therefore happy to continue investing in this area, i.e., their education via university tuition fees.

The first stage in developing the curriculum is to complete a needs analysis. A needs analysis assesses what each group involved in the course requires. The needs, wants and desires of each are assessed and the feasibility of these are evaluated based on resources, knowledge and available staff. A needs analysis is conducted as it is rare to have a homogenous group of learners. Each

learner will have different experiences, backgrounds, levels of knowledge and so on, so it is important to consider this when building a course. It is also important to distinguish between needs which several authors have attempted to do. Previous work on needs analysis was able to separate needs into various categories addressing each stakeholder (Hutchinson and Waters 1987, Berwick 1989, Brindley 1989) with Brindley also discussing how learning is carried out and the final outcome of that learning. Whilst needs analysis is commonly used for English Language teaching, it can also be used to identify developmental needs of educators (Erdoğan and Gürol 2021), to develop pedagogy to motivate learners (Sieglová 2019), or to identify the needs to improve in a technical subject like chemistry (Lee, T. T., Sharif and Rahim 2018). However needs are identified, it is clear that needs are complex, wide ranging and it is difficult to satisfy everyone involved. However, needs analysis can help a course designer try to address these different perspectives to create a suitable course which has validity and purpose for all.

A needs analysis can be conducted in a variety of ways including non-expert intuitions and expert practitioner intuitions, interviews, surveys and questionnaires, observations, text-based analysis and diaries, logs and journals (Huhta, et al. 2013). All of these methods have their advantages and disadvantages, so Huhta, et al. advocate the use of a triangulation approach to needs analysis, drawing from a variety of sources in order to gain the most insight. By gaining insight from a variety of sources, including from the stakeholders as mentioned above, this is the most viable way to try to achieve a well-rounded course that is suitable for everyone involved.

Student voice is nowadays also a highlight of university courses. Learners are often seen as partners in the education process, so gaining their perspective is a key part of developing curriculum after the initial needs analysis has taken place (Basilio and Presto-Dabu 2024). Collecting student voice can be done though the SSLC in the programmes, but this only becomes effective when there is an outcome from this, i.e. a change happens in the curriculum, otherwise learners cannot see value in this. Mpuangnan and Ntombela (2024) discussed the need for community voice and cultural considerations when it came to developing a curriculum. This shows the need to involve all stakeholders in the education process to ensure that all needs are met, so learners can learn effectively and develop the hard and soft skills that they need to gain a job and become an effective member of the workforce and the local community. More on cultural considerations will now be discussed.

Cultural considerations

A homogenous group of Chinese learners often have the same learning strengths and difficulties, so the curriculum can be bespoke for them. However, cultural appropriacy needs to be considered. Additionally, the way these students view engineering, engineering tasks and view engineering in relation to their culture and society is important. Jordan, et al. (2019) investigate the relationship between culture and engineering in Native American Navajo society and suggest implementing a border-crossing lens when it comes to engineering education which looks at a way to connect engineering to students' culture which can be achieved through appropriate cultural pedagogy.

Given the differences between Chinese and British education and the skills involved, Courtney and Du (2015) have a book dedicated to developing study skills especially for Chinese students. Interestingly, when it comes to academic skills Courtney and Du identify plagiarism and academic misconduct as the first concern of Chinese students under the title 'becoming a responsible learner'. This could be identified as a problem for Chinese learners developing as lifelong learners because they need to become responsible in the trusted engineering profession and plagiarism would not be tolerated within engineering ethics. Additionally, to meet the UK-SPEC standards and the codes of professional practice, honesty is a key identifier of an engineer (IOM3 2019), so learning academic responsibility will develop lifelong learning, ethical and professional decision making. Courtney and Du (2015) then discuss learner autonomy and expectations of students in lectures and seminars. Finally, skills such as groupwork, organisation, communication and critical thinking are discussed. It is clear that plagiarism is a clear concern for Chinese study as mentioned by several authors (Yang and Lin 2009, Bikowski and Gui 2018), however, it is interesting that critical thinking is something which is tackled last in the chapter considering that Chinese students also struggle to question knowledge and think critically due to the Confusion idea of believing what experts say as the truth or the idea of a standard answer (James, Miller and Wyckoff 2019). However, Li and Flowerdew (2018) argue that plagiarism is discouraged in Chinese history, and it is in fact the fault of universities for the prevalence of plagiarism in Chinese higher education due to ineffective pedagogy. This shows that it is not only culture that needs to be considered, but also pedagogy when assessing the needs of students and designing a curriculum. Additionally, Holmes (2004) argues that perhaps the onus is not fully on Chinese students to change, but also the teachers. She suggests a more open-minded approach with more cultural understanding. This therefore shows how curriculum should be designed for the specific needs of students, programmes or disciplines, because then individual differences can be more supported leading to more student success and meeting of the learning outcomes.

Internationalising the curriculum is also a valued approach to improving cultural understanding, the skills of the students and improving pedagogy (Zeng 2008, Jin, et al. 2011, Cheng, et al. 2018). Trying to ensure students become global citizens is important for employment prospects as well as fulfilling the goals of UK HE. Singh and Fan (2021) discussed the advantages and disadvantages of international study for Chinese students, identifying that while international study was beneficial in terms of human, cultural, psychological and identity capital, social capital suffered. Social capital is the ability to network and build relationships with employers, so studying abroad reduced this ability. This shows that JEIs and internationalising the curriculum could have the biggest benefit for Chinese students as they are able to gain international benefits but also keep the benefits they need to succeed in Chinese society.

Approaches and pedagogy in curriculum design for engineers

There are different approaches to curriculum design which can reflect what the university bases the students' needs on during the implementation stage of curriculum development. Berzina, et al. (2019) advocate the use of adaptive learning methods for engineers to develop a personalised programme which could lead to greater skills development and lifelong learning. Grebski, et al. (2020) analyse the similarities and differences between two mechanical engineering foundation years programmes based in the US and Poland. They identify that the American course is more theoretical based, and the Polish course is designed to ensure students are ready for work and do not require on the job training. Arguably, it is important that student engineers have up to date information on what is current and trending in their field, as this does make them employable; therefore, the Polish course helps with this as it gives a wider range of specialised courses to ensure graduates have a breadth of knowledge. However, something that this course lacks is the soft skills that are transferable to the workplace. For example, there is no communication course or technical writing course like there is in the American course. Thus, whilst the Polish university may be more forward thinking in terms of their approach to ensuring students are work-ready, this researcher would argue that students are not work-ready. Whilst they may not require on the job training for the technical side, graduates may not have team working skills or the ability to write engineering reports, which may require training. The limiting factor of this study is it is not possible to identify what pedagogy is used for teaching as it has used a 'desk research method' where is looks at documentation only. Therefore, a clear understanding of pedagogy would help determine the viability to create a fully rounded curriculum of technical and soft skills, by which including PDP modules could be the answer.

Problem-based learning

Problem-based learning (PBL) features highly in engineering pedagogy to reflect the real-life situations engineers face and act as an 'authentic scaffold' (Lindsay and Morgan 2021). It gives students the opportunity to act like real engineers and demonstrate their skills, both technical knowledge and soft skills. Universities often want to distance themselves from traditional lectures to try and meet the needs of students as well as meeting the university strategy and PBL may be one way to do that. Hammond (2013) however argues that PBL is not suitable in the early years of undergraduate study, but lecture-style methods are better. Even though he highlights the advantages of PBL like developing some soft skills and student satisfaction from a stimulating and enjoyable way of learning, he details three major disadvantages. Firstly, knowing the fundamentals of engineering knowledge, secondly the cost of changing the pedagogy due to large class sizes and thirdly that the students do not possess confidence for self-directed learning. Whilst knowing the fundamental theory of science and engineering is key, this researcher disagrees with the fact that it has to be delivered in a lecture format. In fact, lecture formats prevent other skills such as communication skills, critical thinking and leadership from developing (Choudhury 2019). Flipping the classroom is an increasingly popular method often implemented in the Canal and Mountain JEI to encourage students to research and discover their own answers, with the lecturer helping them with concepts they are unfamiliar with (Bergmann and Sams 2012). This has helped students at the JEI connect with the material and feel more confident to ask questions as evidenced anecdotally but has not made them fully autonomous.

Lindsay and Morgan (2021) discuss their use of PBL within their engineering model for an engineering programme at a university in Australia. They use four challenges that student engineers complete in the first three semesters at university. The aim is to develop the knowledge and skills of these student engineers in a real-life context. This is because after the PBL stage, student engineers move on to workplace learning where they take part in four one-year paid work placements. Lindsay and Morgan found that organisations that employed the student engineers were very happy as students were well prepared and settled into work quickly. They also found that organisations often wanted to keep the student engineers for subsequent placements. It stands to reason that students were well prepared because the purpose of PBL is to provide that real-life foundation of transferability into the workplace. The other interesting part of the model proposed by Lindsay and Morgan is the theoretical component. Students are required to be self-directed learners and access the theoretical course online and whilst they are on work placements. The on-demand topic tree curriculum provides students with an overview of the entire curriculum and can be fully accessed by all student engineers, at all times. The authors found that because of today's social media culture,

student engineers tended to 'binge' topics on the topic tree and complete them all at once. This has shown that students become engaged and want to find out more and so develop that self-directed learning.

Admission to the programme is based on interview rather than grades as Lindsay and Morgan want to admit students based on their ability to be autonomous and motivation to learn on their own. This raises the feasibility aspect of this kind of admission, similarly uttered by Hammond (2013). Whilst this sense of self-direction would be suitable in an ideal world, when you start to look at programme viability through student numbers, the low numbers that are admitted to this programme (29 students for the first year and lower the subsequent years (Lindsay and Morgan 2021)) would not make this programme sustainable in the long run, despite the academic validity of it. Furthermore, most universities do not have the opportunity to vet the students entering to identify their learning attitude. Therefore, this makes it impossible to implement this type of self-directed learning on a large scale, especially if students are not autonomous and so it is the responsibility of the university to train students to become autonomous and this is the role of PDP. In a JEI programme like the one between Canal and Mountain universities, this type of pedagogy would fit with the philosophy of the programme, but cultural differences would be problematic with this approach as the learning style of Chinese learners vastly differ from this Western approach. Additionally, rote-learning style which is heavily relied upon in Chinese education would also not suit the pass/fail approach to assessment portfolios discussed in this study. Therefore, this model of engineering education would be more suited to Western HE systems that have a small student intake.

Interdisciplinary project-based learning

Intrapersonal communication is discussed by Deveci and Nunn (2018) which would fit well with PDP modules as it involves reflecting on oneself. Being able to reflect on yourself also requires emotional intelligence (awareness of our own and other's emotions) and having emotional intelligence would help develop teamwork skills, managing others and leadership as getting the best out of others. This would lead to more team success which in business could translate to project success. A set of PDP modules therefore based on project-based learning (PjBL) would help develop both intrapersonal skills and emotional intelligence. PjBL appeared popular in developing lifelong learning, especially in terms of Turkish engineering students' communication skills (Kapusuz and Can 2014).

A collaborative curriculum can also aid with accreditation. For an engineering programme to be professionally accredited, it needs to meet certain learning outcomes which cover a range of skills including technical knowledge and soft skills. When a programme gains accreditation, graduates can be sure that they have gained knowledge that can be used in their professional registration (IOM3 2022) and the programme meets the standard of the engineering profession (Engineering Council 2022a). The Engineering Council identifies six areas of learning that any degree must meet to be accredited and those are: science and mathematics, engineering analysis, design, economic, legal, social, ethical and environmental context, engineering practice and additional general skills (Engineering Council 2022b). Simply from looking at this list of areas, it can be seen that they cover different disciplines so would require expertise from a variety of backgrounds. Therefore, having a collaborative curriculum developed at programme level can help meet professional accreditation guidelines, including proving those through assessment.

Murray, Hendry and McQuade (2020) discuss the use of their project-based co-curricular activity for civil engineering students and found positive results. They concluded that the workshops conducted with engineering professional enabled development of skills, lifelong learning and readiness for the workplace. Their project also gained professional accreditation showing that interdisciplinary project-based activities are beneficial for students and the development of soft skills.

Curriculum development and lifelong learning

Stowe and Huh (2018) study the role that the curriculum has on lifelong learning. Stow and Huh use Knapper and Cropley's (2000) lifelong learning characteristics (set goals, apply appropriate knowledge and skills, engage in self-direction and self-evaluation, locate information beyond the classroom and, adapt to new learning situations) which they believe, if included in the curriculum, will develop students' ability to learn. The study of an engineering and computer science programme concluded that the pedagogical practice and way instructors taught played a key role in the development of the learners. This aligns with the need to mentor or coach students (Heinrich, Bhattacharya and Rayudu 2007). They also found that if the five lifelong learning characteristics were purposefully and consistently included in the curriculum, this would promote lifelong learning with student engineers. Therefore, by developing the curriculum specifically for the target students, HE institutions would be developing graduate engineers with a key soft skill that would assist them in their CPD and therefore start to address the issue of a lack of graduate skills.

Considering the literature above from the Royal Academy of Engineering, Engineering Council and the Employer Skills Survey, it is clear that to create an effective curriculum you have to consider skills and adding PDP modules to the curriculum can develop this. Additionally, pedagogy and teaching methods used, collaboration involving industry professionals and appropriacy of curriculum design are key to designing specific engineering course curriculum for students. However, to ensure a tailor-made curriculum, culture must be considered as well as the perceptions of all stakeholders through needs analysis.

2.9 Assessment

Assessment is a key part of any curriculum design as there is a need to test the abilities of a student. Assessment is seen as the way to check understanding, learning and the curriculum itself both though formative and summative assessment, individually or as a group. Depending on the learning outcomes and pedagogical approach determines the type of assessment used. Formative assessment has been shown to improve student learning and the way in which students recall the information they need for formative assessment also shows learning (Finelli and Froyd 2019). Traditionally however, to test theoretical knowledge, exams are used as a large part of engineering course assessment. There is a growing body of literature though that is looking to test the students' knowledge through problem solving activities (Lindsay and Morgan 2021) or conceptual learning activities (Hurwitz, et al. 2014). COVID-19 has also promoted a shift away from exams (Motogna, Marcus and Molnar 2020) and this has shown an increase in student attainment (DeMara, Tian and Howard 2019). Other ways to assess include through coursework such as reports, experiments, presentations or even portfolios. This also links with formative assessment where students are showing that they are achieving the learning objectives and applying their learning in different ways.

Assessing soft skills though remains up for discussion. Mahon (2022) discusses the need for soft skills to be assessed in order for students to take them seriously. Assessment of soft skills usually involves self-reporting and reflection which some students may not feel are an acceptable form of assessment. Whilst this researcher can see the value in reflection as an aspect of assessment, assessing soft skills through authentic engineering assessment would be more appropriate. Devedzic, et al. (2018) discuss the use of levelled badges (bronze, silver and gold) to assess soft skills through teacher assessment and peer evaluation during project-based learning in computer programmers. This is a good way to show attainment of skills, but in the context of this study, a numerical grade is needed as part of the Mountain degree which causes issues in the assessment of the PDP modules.

Assessment in engineering

The first step in assessment design is deciding which learning objectives will be assessed. Universities have strategic objectives that they wish to meet, programmes have programme objectives, courses have individual learning objectives and accreditors also have outcomes that a programme must meet to gain important accreditation. Professional registration competencies are also key in engineering (Engineering Council 2020b). It is therefore important to align those learning objectives from the university, programme and course with the accreditation and registration learning outcomes. Secondly, the form of assessment is important. In an engineering context, it is unlikely that engineers would be taking formal exams in their day-to-day work to show their knowledge. In fact, applying their knowledge is more important so students should be given an opportunity to demonstrate their knowledge in a variety of ways (QAA 2019, Engineering Council 2020b). Finally, grading is an important issue. Grades are traditionally on a numerical scale of 0-100, but there are also professional qualifications that work on a pass/fail basis. In fact, the more educated you become, the fewer concrete the marks you receive. Considering all this, all learning objectives need to be considered both from academic and professional perspectives.

Carracedo, et al. (2018) and Naqvi, et al. (2019) both developed a methodology (Carracedo, et al.) or framework (Naqvi, et al.) to assess professional skills in engineering students' final year projects (FYP) at university. Carracedo, et al. distinguish a set of indicators that students should achieve at each of the three milestones in their FYP. Naqvi, et al. identify a set of learning objectives that are mapped to the programme outcomes and in line with professional standards expected of engineers. Interestingly, Carracedo, et al. do not mention any mapping of objectives, however they did say that a design procedure comprising of six stages to assess FYP was written in a project funded by the Spanish Ministry of Science and Education to try to show a more transparent process and grading for student projects.

Both sets of authors' work have weighed outcomes, but Carracedo, et al. have equal weighting, whereas Naqvi, et al. weight their objectives based on the relevance to the completion of the FYP. Additionally, according to Carracedo, et al. their methodology is not transferable to technical skills as it only concerns professional skills. Therefore, if a student was to give a poor presentation, they would still be able to pass the FYP based on technical knowledge. This is a major flaw of the methodology and leads to questioning of whether they can claim that this methodology is fit for purpose, or if it is actually an approach and not a methodology. It should not be possible for a student to pass with only technical knowledge if a key indicator the authors want to achieve is to assess professional skills. This, as can be seen from the employability literature would not satisfy

employers and would therefore lead to these graduates being unemployed. Whilst this methodology lacks transferability, Naqvi, et al. claim that their framework is transferable to any engineering programme with minor modifications. This makes their framework much more viable.

One of the benefits of Carracedo, et al.'s methodology though is that there are three milestones at which the students are assessed (initial, follow-up, final) which relate to project stages, as opposed to Naqvi, et al.'s one final assessment. Additionally, the methodology objectives can appear in multiple stages, thus giving the student an opportunity to further develop their professional skills as they progress through the FYP. This seems to follow Biggs' (1996) idea of hierarchical objectives, as students will be able to develop and show the connections between each objective.

The issue with both the methodology and the framework is that they lack industrial experience and rely solely on academics to formulate and assess the projects. Naqvi, et al.'s framework seems viable, but that industrial lens would strengthen their objectives. Whilst the authors do use the programme learning outcomes from the Washington Accord (an organisation within the International Engineering Alliance that "is concerned with engineering education and competence across the whole spectrum of engineering" (International Engineering Alliance 2014, p. 4)) and therefore does have some industrial benchmarking, however, it is vital that any learning outcomes are developed with all stakeholders or through accreditation shows the validation of the engineering accrediting body.

Therefore, to create valid assessment, learning objectives need to be decided and assessment designed related to real-world situations that would meet the needs of employers. This means being more innovative with assessment and essentially curriculum design.

2.10 The Impact of COVID-19 on Skills Development, Curriculum Design and Pedagogy

The COVID-19 pandemic has had a profound effect on education around the world. With lockdowns and the inability to travel, JEI programmes have been unable to continue teaching as normal. This has affected the skills of the students, curriculum design and pedagogy.

From a teacher perspective, the constant changing landscape of COVID-19 has meant that pedagogy has needed to develop to fully teach students online. This has enabled teachers to become more creative and develop further, encouraging CPD even when at home. In the JEI in China, students have been individually online and together in the classroom, but teachers remained online until April 2023 and were broadcast into the rooms which has led to pedagogical challenges as well as skills

challenges. Developing new activities and gamifying concepts has helped developed the skills of students as well as engage them in a teacher-less classroom. An example of this is using an online escape room to develop transferable skills (Nightingale 2021) which shows the use of innovative pedagogy to ensure students are still practicing and developing the soft skills needed in academia and later in the workplace.

Digital skills were identified as lacking in graduates as mentioned in figure 2.1, but they are also needed for the future of education (Education for Engineering 2017), especially in HE to meet the demands of the of the students and Industry 4.0 (Rodríguez-Abitia and Bribiesca-Correa 2021). It is noted that UK university students identify as digital citizens (and digital natives) who come to university with digital skills which are honed into a more professional usage (Blaj-Ward and Winter 2019). From the article, it can be deduced that a digital citizen is someone who takes place in a conversation online and has the skills and abilities to construct an online identify to take part in this online world. This is different for Chinese students who similarly identify as digital citizens but have a mediocre level of computer skills (Ke and Xu 2017). From personal experience, the digital abilities of Chinese students have increased during the COVID-19 pandemic due to the reliance of online lectures and the distance of the teacher. This has also shown the resilience of students which has previously been reported as a problem (Gray 2015). This means students are much more employable because of this digital skills development and the need to adapt. Therefore, HE could develop curriculum to include more digital skills using blended learning for which PDP modules would be the ideal platform for this. Giving a blended learning approach could also prove effective in helping students develop basic technology skills relevant for Industry 4.0 with face-to-face experiences developing the exact technical and digital skills graduate engineers need to become employable and a fully collaborative digital citizen.

In a study of software engineers in Ireland however, Brennan, et al. (2023) reported that students who had simply lived through the pandemic and the rapid transition to learning online had developed resilience. However, other research from the pandemic has shown that giving support and coping strategies to students can help their academic success, as students who can think positively engage better with the learning process (Ainiyah, et al. 2021). PDP modules would be useful for this because students need support to make transitions into new scenarios.

In addition to the development of digital skills and resilience, Brennan, et al. (2023) also reported that 50% of respondents stated an improvement in time management skills and 40% reported better organisational skills. Whilst this study surveyed both undergraduate and postgraduate students, masters' students only responded slightly higher to the development of time management and

organisational skills than undergraduates. This shows that undergraduates are capable of developing skills and it should not be left until postgraduate level to develop soft skills. Additionally, the development of time management and organisational skills in Brennan, et al.'s study is positive as it aligns with the skills engineers need to develop in figure 2.1. Accordingly, the pandemic has been positive, but being in this situation means students develop soft skills, so pedagogically, educators need to develop real-life authentic situations for students to experience to develop these skills. This is why project-based learning is important in the classroom as it can replicate authentic engineering situations, thus developing soft skills which was also shown by Konings and Legg (2020) in an undergraduate engineering programme in New Zealand.

2.11 Summary

This literature review has shown the immediate need to address the lack of graduate engineers' skills and how PDP modules can develop these. The literature review consulted the main stakeholders and key educational outcomes that are important for this study. Figure 2.2 shows how these concepts are aligned and interconnected.

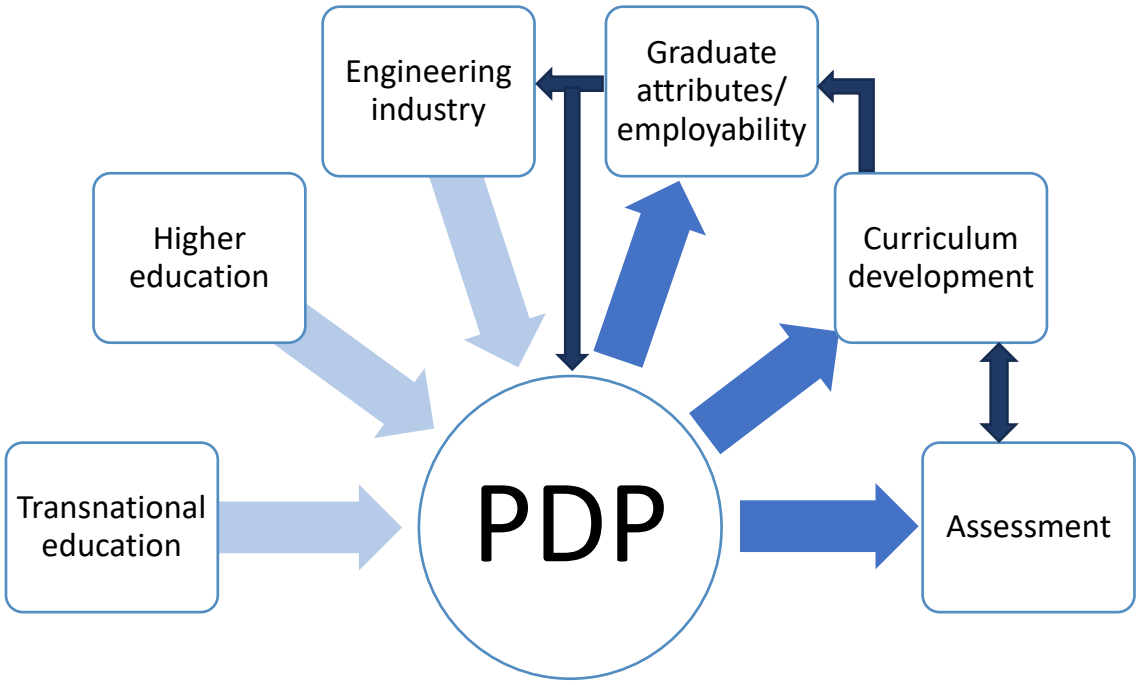

Figure 2.2: Literature review conceptual framework

What can be seen from figure 2.2 is that PDP has a number of influences. Much like a needs analysis, the various stakeholders must be considered alongside any context specifications. This figure shows that the main stakeholders are higher education and the engineering industry, with transnational

education featuring heavily due to the context of this study. These have the biggest influence on PDP modules. Therefore, PDP addresses the needs of the stakeholders through curriculum development and assessment (which are interconnected), which then develops the graduate attributes and employability skills students need to become employed in the engineering industry. These soft skills are welcomed by the engineering industry as the skills gap has been closed, showing the need for and importance of PDP modules.

The literature showed that according to industry, there are wide skills gaps when it comes to graduates, not only in terms of hard skills, but more commonly, soft skills. The Employer Skills survey identifies that engineering is suffering from a 41% lack of problem-solving skills, 51% lack in time management and task prioritisation and 37% lack of teamwork skills (Winterbotham, et al. 2018). The UK-SPEC shows that professional registration requires candidates to show their personal skills such as teamwork, communication skills and interpersonal skills (Engineering Council 2020b), which is clearly shown as lacking from the data above. The Royal Academy of Engineering also notes six additional skills that go beyond the basic communication and teamwork abilities, which include adaptability, problem solving and creativity (The Royal Academy of Engineering 2020), also identified a lacking in graduates. This shows the major gap in skills that could be lessened with the implementation of PDP modules at university.

Importantly when it comes to engineering and business, a lack of required soft skills means higher unemployment as businesses do not want to spend increased amounts on training graduates when they could employ others. It is noted in the literature that whilst companies do want to increase training and spending, cost cutting reduces this ability. Therefore, PDP at university could help reduce the costs of training and unemployment as money could be spent upskilling in areas such as new technology, for example, AI.

In terms of higher education, it is clear that universities are not providing the required services to industry or to its students. Universities should be practicing higher levels of CSR to meet the needs of its customers. In terms of PDP provision, the literature review discusses the approaches taken to provide PDP to students in an embedded, bolt-on or parallel approach (Cranmer 2006). The literature review details universities' PDP activities through projects (Audunsson, Matthiasdottir and Fridgeirsson 2020), short courses (Reedy, et al. 2020) or semester-long courses (Dorazio 2020).

Additional key points to show are that there is limited continual PDP support throughout degree programmes and that PDP is often left until a postgraduate stage (Baker, Perkins and Comber 2014) which is not an inclusive educational approach that universities should be aiming for. This also links to transnational education.

In the context of this study, consideration of transnational education is key. The participants of this study are studying in their home country, but through a joint education institute which offers a UK degree. Therefore, international students may not be familiar with the idea of soft skills and the importance of these towards their degree programme as well as their future careers. In addition, pedagogical and cultural differences are evident. This means that students in this programme are mostly likely to only be familiar with a Chinese pedagogy as this is what they have grown up with. This is similar for other transnational programmes but could also be extended to any overseas students going to study in the UK as there are often pedagogical differences. To be successful at university, students often study in a student-centred approach with group work and discussion being at the forefront. This means that students need soft skills to be able to succeed in this environment. However, in contexts where a 'teach-to-test' method (Lu, R., Goodale and Guo 2014) is used, this will be completely unfamiliar to students leading to an inability to participate adequately. Therefore, PDP modules are clearly needed to help these students and develop an inclusive environment.

Figure 2.2 also notes three areas of output to develop PDP modules which are curriculum development and assessment (which are interlinked), with successful design and assessment leading to attainment of graduate attributes and employability. This then links back to ensuring graduates have the required soft skills to meet industry stakeholder needs, therefore showing the need for PDP modules.

Curriculum development therefore has to be carefully considered in order to make sure the intended learning outcomes and graduate attributes are being met. Again, this aligns with the needs analysis approach of the literature review. Curricula should be developed through a constructivist lens according to Biggs (1996) who notes that learning objectives, pedagogy and assessment should be developed using this approach. Assessment of PDP can be a difficult concept, as PDP is often associated with reflection, and as reflection is personal, it can be argued that it therefore cannot be assessed. However, as examined in the literature review, PDP is more than reflection, it is using a constructivist lens to develop what skills the students need to develop and those can be assessed. Additionally, as with this study, context is key and so assessment may well be needed to meet the requirements of the university. However, students can be assessed in creative ways, such as by awarding badges (Devedzic, et al. 2018). Learning objectives should also be assessed and so by being clear about what soft skills should be developed, coherent assessment can be developed. The pedagogy as discussed in the literature review should focus on problem-based learning as this is most appropriate for engineers. However, engineers also work on projects, so project-based learning is also appropriate. Additionally, project-based learning is appropriate for developing soft skills as it

develops both intrapersonal skills and emotional intelligence which was show in studies by Kapusuz and Can (2014), and Murray, Hendry and McQuade (2020).

Graduate attributes are discussed widely within higher education and there has been a shift to focus on these and therefore the employability of the graduates, which can be seen through HE organisations such as the Office for Students who added a skills question to the national student survey. However, it can be argued that whilst this is a step in the right direction, graduate attributes are still not being specifically taught in the courses, only sometimes highlighted, which again shows the need for taught PDP modules within an undergraduate degree. Wong et al. (2022) discusses four themes for graduate attributes: self-awareness and lifelong learning, employability and personal development, global citizenship and engagement and academic and research literacy. It is interesting to note that academic skills are seemingly the least important skills for universities according to the research, but lifelong learning is featured highly. It is vital then then students develop the lifelong learning skills they need for the workplace as technological developments cause the need for reskilling (as mentioned in the literature) and therefore, employees need those skills which they should be developed in university, to meet the stakeholder needs. This along with global citizenship links with TNE shows how valuable this study of undergraduate soft skills development in a Chinese context is and therefore the need for PDP modules.

The literature review has shown an analysis of inputs and outputs that were discussed in relation to PDP modules. Through assessing given models of PDP and employability, it can be seen that no course currently fully develops the transferable skills needed for the engineering industry. Curriculum design and pedagogy play a vital role in development of courses to meet the learning outcomes identified by multiple stakeholders. Additionally, in this study, culture is an important component when considering skills, curriculum design and pedagogy. The next chapter will discuss the methods and methodologies that will be used in this study to investigate the affect a three-year set of PDP modules has on the skills of Chinese undergraduate engineering students.

Chapter 3
Research Methods

3.1 Introduction

This chapter discusses the methodology (case study, mixed methods and documentary analysis) and methods (questionnaires and semi-structured interviews) used in the study of undergraduate engineering students developing soft skills through a three-year set of personal development planning (PDP) modules and why these were chosen.

The literature review showed that there is a critical lack of development of soft skills in engineers which stems from a lack of soft skills implemented within the university curriculum. This is something which needs to be addressed, and engineering employers currently do this through training and development, which they are unsatisfied with. The literature showed that support for development of soft skills can be found through professional engineering organisations such as the Engineering Council and the Institute of Materials, Minerals and Mining and to become professionally registered, the development of soft skills as well as the record of these is required (Engineering Council 2020). It was identified that curriculum development is essential to meet the needs of all stakeholders and pedagogy also plays a vital role in skills development. Universities do not currently run continued, integrated PDP modules which is where this study finds a gap and shows a clear need for research.

The aim of this chapter is to discuss the options available to investigate the issues identified in the literature review. The chapter will consider the cross-cultural environment that the study takes place in and will also look at the researcher's position and views within it. Discussions regarding the research paradigm, methodology, methods, sampling and ethics will then follow with clear reasoning being given for the choices made relevant to this study. However, to begin with the research questions will be discussed which form the basis of this chapter. The choices made as the researcher seeks to design the study in order to collect quality, reliable and valid data to answer these research questions are then examined.

3.2 Research Questions

The aim of this research is to identify the extent to which soft skills are developed in engineering undergraduate students who take an interdisciplinary set of personal development planning modules in China. Therefore, this study will aim to answer the following research questions:

1. How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students?
2. What impact, if any, does the interdisciplinary aspect have on preparing students for the workplace?
3. What soft skills do students develop?
4. How might these skills benefit students academically, professionally and in the workplace?

3.3 Research Paradigm

A researcher needs to understand the relationship between ontology, epistemology, methodology and methods (Waring 2021). Cohen, Manion and Morrison (2018) also discuss axiology and praxeology in relationship to educational research. This section aims to discuss each of these in relation to the researcher, educational research and this study.

Ontology is how a person views the world, epistemology is how a person knows about it (Waring 2021), axiology is a person's values and praxeology is the everyday use of those views (Cohen, Manion and Morrison 2018). Each of these will be discussed next.

The nature of this study focusses on the personal development of skills over time, with the key words being personal and time. Therefore, multiple realities exist based on each person's view of the world (Waring 2021), so this researcher's ontological position would fall under constructivism as PDP is personal and reflective. However, there is also the pragmatist view that reality is constantly renegotiated over time, and this is explicitly linked with mixed methods research (Coe 2021). Coe also suggests pragmatism supports the idea that research is conducted for a particular reason, based on the researcher's values which is an axiological view. It is also emphasised that pragmatism is against paradigms and rejects traditional ontology. This means the researcher is constructing the research to answer certain questions and so different methods are used based on what the researcher deems necessary for the research. Therefore, both the researcher and the participants are going to hold different ontological positions. This stems from characteristics such as age, culture, education and life experiences which means that in a cross-cultural piece of research such as this, study participants may feel they have similar world views because of their similar demographics. This may lead to a lack of depth in the data, meaning it is key for the researcher to develop appropriate methods of data collection that will ensure rich data that does have multiple realities to align with the constructivist ontological position.

In terms of educational research and ontology, Akkerman, Bakker and Penuel (2021) discuss the notion of "ontology in motion" which poses the idea that people act in a position with a particular

self-defined purpose and with future potential. Therefore, as education moves forward, it is the people that are constructing it through their learning and therefore motion. With the JEI being a partnership as this study shows, this helps with educational development as the educational output is mixed, i.e., British education in a Chinese setting. This therefore helps students develop and move them forward with different pedagogic teaching methods. This aligns with the idea of constructivism and the aim of this study as with different perspectives of education, such as developing interdisciplinary PDP modules within the undergraduate degree through task based real-life learning, learning is constructed, new ideas are formulated, and learners actively process new knowledge and skills.

Knowledge of a subject or its epistemology can be acquired through social channels in education and through individuals themselves (Watson 2016). When considering the context of this research within engineering education, Figueiredo (2008) discusses four dimensions to decode what it means to be an engineer and gain engineering knowledge; engineer as 'a sociologist, scientist, designer and doer' (p. 94). He continues to argue that a transdisciplinary approach is needed with epistemologies being both positivist and constructivist, with constructivist supporting a pragmatist approach. Again, it is clear to see here the link to multiple realities in different aspects to engineering education as discussed by Figueirdo above. This aligns with this study with its interdisciplinary approach which has been developed through the researcher's experience in the JEI. Additionally, the need for PDP is highlighted by Cosgrove and O'Reilly (2020) who discuss the need for reflection and Conceive-Design-Implement-Operate (CDIO) in their epistemological ideas of engineering education. CDIO discusses the need for professional skills development and project-based learning in engineering education (Crawley, et al. 2007). Thus, this research will address the epistemology of engineering education by the research questions and context of this study and analyse the need for PDP as discussed by the aforementioned authors.

The axiological stance taken by this researcher is to be as unbiased as possible because it is important when it comes to ethical decisions as they are made related to the research paradigm. Thus, values and ethics need to be balanced (Killam 2013). Research could be deemed as biased if too much of the own researcher's values are inputted, which could have been an issue in this study, due to the researcher's proximity to the study and participants, which will be discussed later. However, a good researcher is able to separate themselves from the context to ensure that valued judgements (Rothbard 1976) can made by the researcher to align with the chosen research paradigm and therefore increase the reliability and validity of the research. Personal values need to be dismissed, and ethical decisions made clearly in relation to the research questions and research paradigm, deciding on what is the most suitable for the context of this study.

Continuing with the theme of what is appropriate for the context, this researcher views praxeology as action based on values and understanding. You need to understand a situation to make a change (Rigg 2014). This is useful because in education, pedagogy is based on the development of teaching practices. This means that as an educator, you learn what works in your context and apply more of the same to meet the learning objectives or similarly remove strategies that are incompatible in the learning context. So, this research will lead the researcher to continue developing educational practice for skills development. Biesta (2015) discusses education praxeology and how education cannot be practiced judgement free. This is because educational practice is not fixed, and social situations change. This aligns well with PDP and its ontological position of multiple realities. If praxeology deals with the use of our own views, then depending on the person, the view will be different. In the case of this researcher, as mentioned above, the proximity to the research area means that a methodology can be chosen based on pragmatism or what is right for the context (Cohen, Manion and Morrison 2018). This leads to the choose of mixed methods research which will be discussed next.

3.4 Methodology

Educational research can be classified in a number of ways, with competing methodologies (Hammersley 2012). For example, qualitative verses quantitative, positivist verses interpretive or for three approaches, adding critical research. When undertaking qualitative research, methodologies such as grounded theory, phenomenology, ethnography, narrative research and case studies can be considered (Creswell and Poth 2016). Whilst phenomenology could have been a methodological choice in this research, the researcher is not focussed on the understanding of the lived experience of the participants but instead focussed on looking specifically at the effect of PDP modules on a group of undergraduates in a TNE setting, therefore meaning case study research is most relevant, which will now be discussed.

Case study research

Case studies are often used in all aspects of life, not just for research. Simons (2014) discusses how case studies are used as part of everyday life to tell stories as they are part of a lived experience. They are also used across countries and very often in teaching to show best practise and so it is appropriate to use case study research for this study of PDP.

Simons (2009) gives the following definition of case study research:

> *"Case study is an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution or system in a "real-life" context. It is research based, inclusive of different methods and is evidence-led"* (p. 21).

This definition aptly explains why case study research is used in this study as it links with PDP being personal and the need to gain multiple perspectives on the effectiveness of these modules. This can only be done by using different and multiple methods to gain a deep understanding of the unique context of the JEI (being in China with a joint British-Chinese education).

This study is a clear case study as it researches PDP in a specific context of a transnational education JEI, therefore showing clear boundaries around the case. Yin (2014) discusses the need for a case study to be bounded by people, time and space and he argues that individuals, small groups, organisations and partnerships create more concrete case studies than communities, relationships, decisions and projects (p. 33). The case study in this research shows clear boundaries as it is one group of students from the same year group, who started the programme at the same time being studied; these students are all Chinese, of a similar age and from a similar educational background; the study takes place in China in the JEI and it takes place over a specific time, studying the PDP modules over 3 years. This shows a clear bounded case study and according to Yin would be a concrete example of a case study.

This researcher believes that even though this is a clear, bounded case study, there is an element of generalisability for several reasons. Firstly, as the participants in the study are all similar (although there were multiple perspectives), they could be treated as one entity (Kumar 2019). It would be true to say that the sample used in this study is typical (all Chinese, all similar age and all with similar educational backgrounds) and if another group of students were chosen from the JEI, results could be similar. This means that results could be generalised for the JEI. However, this researcher believes that generalisability could go further than just this JEI as the research could be relevant to other TNE programmes in China or even into other international programmes with a large Chinese student population. Finally, the results could be generalised towards the subject area, e.g. engineering. As the PDP courses are specific to an engineering degree, the results could be implemented in other engineering degree programmes.

To conduct case study research Kumar (2019) suggests getting to know your sample population before collecting information. In this study, the sample population have been studying in the JEI for more than two years, so already have a good rapport with the researcher. Kumar also identifies an important aspect of a case study is multiple methods to collect data which aligns with the methods in this study.

Mixed Methods Research

Guetterman and Fetters (2018) discuss the use of case study and Mixed Methods Research (MMR) in a variety of scenarios. They detail two designs of integrating case study research and MMR: Case Study-mixed methods design (CS-MM) and Mixed Methods-Case Study design (MM-CS). CS-MM takes a particular case and implements a qualitative and a quantitative component into it, whereas MM-CS employs mixed methods study and embeds a qualitative case study. In this study, CS-MM is used. The case study used in this study is single case study, which is intrinsic in nature and has holistic analysis (Yin 2014). The case study is intrinsic because as identified in the literature review, interdisciplinary three-year sets of PDP modules do not exist, so this makes the case unique and therefore of primary interest. It will also have holistic analysis because, according to Yin, the case study is from a programme in a school and therefore a global view of the results is needed, i.e. how the research can be applied to other areas within the school.

Mixed Methods Research can be seen as its own methodology or even a new paradigm (Johnson, Onwuegbuzie and Turner 2007). MMR is not new, having developed from triangulation (Biesta 2021) which could mean more accuracy and therefore, less bias. MMR is seen as more appropriate in today's mixed world (Cohen, Manion and Morrison 2018) as using both qualitative and quantitative research can give a more well-rounded, in-depth view in research, that aims "to generate a more accurate and adequate understanding of social phenomena" (Biesta 2021, p. 186). MMR therefore is seen as giving a sense of 'completeness' (Creswell and Plano Clark 2018).

MMR is most useful for this study because personal development and development of skills is dependent on each person and their self-perceived abilities. Using a quantitative methodology on its own would provide an insight to the overall population of this study, but it would not be able to give in-depth reasoning for the skills development. Similarly, in qualitative research the size of the cohort taking PDP modules (235 students in this study's cohort) in the JEI would require a significant investment of time to analyse any results to find themes. Therefore, it is more logical to use MMR to get a complete picture in order to answer the research questions thoroughly and be able to build a picture of generalisability and causality.

Creamer (2018) mentions the importance of mixed methods, not just being used in data analysis, but throughout the entire research process. To this end, ensuring there is a grounding in methodology, but choosing from different standpoints is key. This means that there is no one 'right way' of conducting research or choosing a particular methodology. For PDP this is significant, as mentioned before, each person constructs their own reality and this changes depending on experiences and interactions. Therefore, being fluid in methodology and approaches to methods , data collection and

analysis is vital in order to be able to understand the data from a range of different sources and participants. This is also relatable to educational practice and pedagogy in university as mentioned above in praxeology, as understanding the context and making a judgement on how to achieve the learning outcomes is crucial. Therefore, choosing mixed methods makes the research positioned clearly in the context, meaning there is a better opportunity to gather data that answers the research questions.

Documentary analysis

Documentary analysis is used in this study via the participants' reflective engineering logbooks. O'Connor (2019) identifies document analysis as part of discourse analysis and therefore finding social meanings in text.

Morgan (2022) discusses the use of preexisting texts aiding with triangulation of data, which is a feature of MMR and also aids in the validity of qualitative research. To be able to use the engineering logbook will aid the researcher in uncovering themes that participants may not have remembered or discussed during the interview. However, Morgan identifies one limitation of using documents is the potential for limited data. As the engineering logbook is a personal, CPD document, the length will vary between participants but should not be fewer than 30 entries (the base requirement for submission) which this researcher believes will be sufficient data. Another issue that may arise is the quality of reflection in the documents which will be where the main themes are drawn from. Participants are required to reflect on the activity recorded and reflect on themselves and their skills development. However, reflections as a skill can take some time to master, meaning some early logbook entries may contain more summary of the activity rather than the reflection of oneself. This could therefore reduce the amount and quality of the data. The engineering logbook will be more fully explained in the methods.

Validity, reliability and generalisability

Kumar (2019) discusses three types of validity in quantitative research: face and content validity, concurrent and predictive validity, and construct validity. Face validity increases when objectives are clearly linked to the research instrument (e.g., a questionnaire) and content validity shows the extent to which the research instrument covers the research area. Predictive validity, as the name suggests, assesses how well the instrument can predict an outcome and concurrent validity occurs

when the findings of your instrument match with those of another. Finally, if the instrument being used measures what it is intended to measure, it has construct validity.

However, when validity in qualitative research is discussed, due to the less restrictive and fluid concept of answers, it is traditionally approached as internal and external validity, reliability and objectivity. Guba and Lincoln (1994) suggested a framework of four criteria for validity and reliability in qualitative research that better aligns with a constructivism paradigm which are: credibility, transferability, dependability and confirmability. Comparing to qualitative research, credibility is similar to internal validity, transferability aligns with external validity, dependability is similar to reliability and conformability aligns with objectivity. This model suggests the possibility of having validity and reliability in qualitative research, but data collection and methods used should be the same. This researcher believes that using case study research may help alleviate this issue as replicating qualitative methods in a similar case study may increase the validity and reliability of results. This could also increase the replicability of methods and the application of the results.

Generalisability is often considered important in scientific study. However, Burchett, et al. (2020) discuss the idea that generalisability should be focussed on the effectiveness of an action. Therefore, instead of identifying similarities or differences between populations, assessing the effect PDP had would help assess the generalisability. This researcher believes that PDP can be generalised as everyone needs to develop soft skills for employability and therefore, whilst the sample of the study can influence PDP in terms of the PESTLE analysis as discussed in the introduction chapter, the idea of needing and developing skills is important for everyone, no matter the situation. In terms of case study research, Yin (2014) discusses how case study helps develop a theory. Generalisation can occur in various forms and in this study, generalisation could come from a number of characteristics of the case study. For example, TNE, higher education, Chinese students, undergraduates or engineering could all experiment with this theory to identify its uselessness in their context. Thomas and Myres (2015) and Pring (2015) note that generalisability does not need to conform to the scientific notion but can influence understanding be used in other situations.

The validity and reliability of each of the methods for data collection will be discussed in the next section.

3.5 Methods

Mixed methods were used to collect data in this study and so includes both quantitative methods to identify facts through statistical analysis and qualitative methods to understand the behaviour of participants through thematic analysis.

When using qualitative and quantitative methods, they can be 'concurrent or sequential' (Biesta 2021). This means both methods are being used in the same study (concurrent) or alternating (sequential). As mentioned previously, MMR was developed from triangulation and in addition to this, there are four other reasons for mixed methods: complementarity, initiation, development and expansion (Biesta 2021). In this study, "complementary- seeking elaboration, enhancement, illustration and classification of the results from one method with results from the other method" and "development- using the findings from one method to inform the other method" (Biesta 2021, p. 186) are the two important factors in this research design as the qualitative questionnaires were used to develop the direction of the interviews and by using both the quantitative then qualitative methods sequentially, these were complementary in producing full ideas from the participants. Therefore, this study uses a sequential-explanatory design.

Overview of data collection: project and methods

As the PDP modules span three years, data was collected at two key milestones in the PDP modules during this longitudinal study; firstly, after completing the Materials Library Project which the students participate in in year 2 and secondly at the end of year 3 when students' Engineering Logbooks are submitted for summative assessment. The Materials Library was chosen as a data collection point as it is a project-based assessment where students need to showcase their soft skills. This was chosen as a case study because it was important to follow one cohort of students to see their development during the PDP modules to help answer RQ1. Questionnaires and interviews were used to understand which skills were developed then see reasoning for these. More interviews could have been conducted instead of the questionnaires with a stronger documentary analysis if there were stronger reflections in the engineering logbook.

As PDP1 focusses on soft skills introduction, the Materials Library project is the first time in PDP that students will have to showcase their soft skills over a sustained period of time, in this case, one semester: the duration of this project. It was also chosen as it is a project revisited in a technical module in year 3, where students can self-reflect, evaluate and revise their original work (as discussed further below). This aids the longitudinal approach to skills development. The Engineering Logbook project was also chosen as this is a longitudinal piece of assessment where the students show their CPD in a personal and reflective piece that has been developed whilst taking the three-year set of PDP modules.

Due to the different data points addressing development of students over time, this is a longitudinal study which will be further discussed later.

In year 2 the Materials Library is created as part of the PDP2 module and is divided into three stages: a poster, a recruitment fair and a website as can be seen in figure 3.1 and explained further below. The students work on this project for the entire second semester (16 weeks) in year 2.

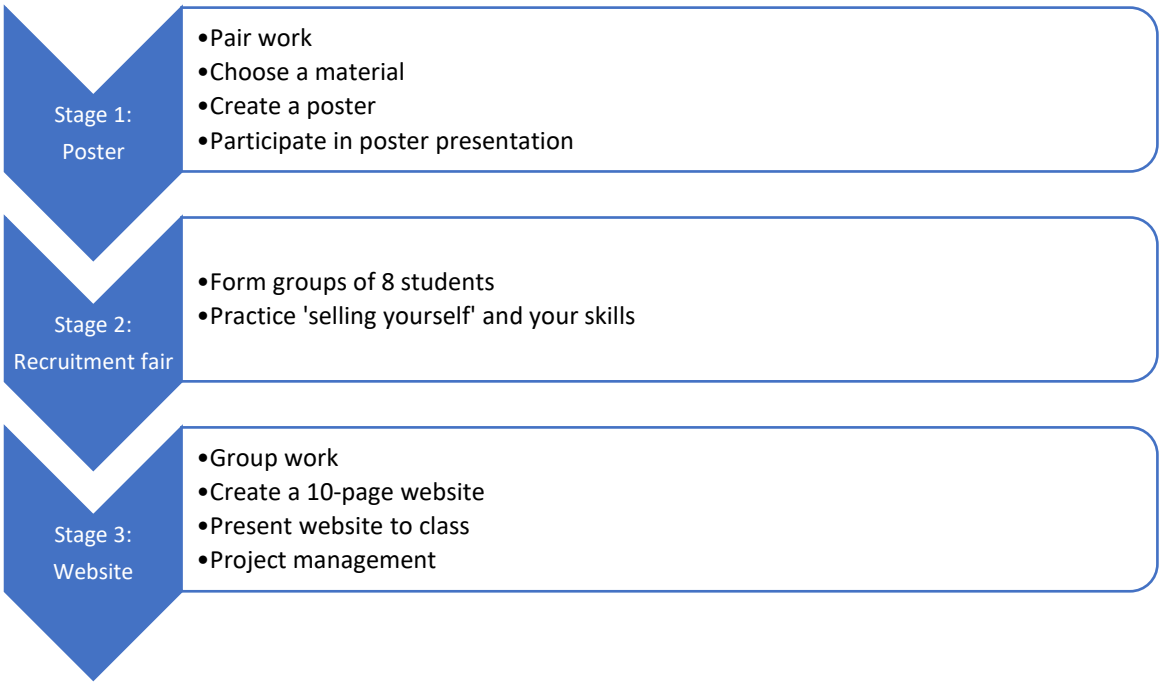

Figure 3.1 Stages of Materials Library Project

Stage 1 (poster) involves the students working in pairs to create a poster about a material they have chosen. This poster includes an abstract, literature review, manufacturing/processing, applications, property profile and safety data sheet. Once completed, the students take part in a poster presentation session to display and discuss their work. A poster was chosen as creating and presenting a poster is a key skill that students need as this is a common form of presenting data and research for undergraduate and postgraduate students. Therefore, it is integrated into PDP to develop the academic skills that students need. Approximately 230 students with 115 posters take part in the presentation each year. During the poster presentation, students evaluate each other's work and vote on their favourite posters. The top 30 (approximately) are chosen to be developed into websites. During this stage of the project, the intended learning outcome (ILO) is to develop the skills listed in table 3 below.

Table 3: Intended learning outcomes for skills developed in stage 1 of the materials library project

Academic Skills	Employability Skills	Professional Skills
Poster making Research skills Academic reading	Technical knowledge Networking	Time management Teamwork (small group) Communication Creativity Negotiation Analytical

Stage 2 involves students forming groups through a recruitment fair. The winning poster pairs are approached by the remaining students who must sell themselves and their skills in order to be chosen to work on that team. Students can visit multiple poster winners to try to secure themselves a team. Students use the interview techniques they practiced in the previous semester's 'Entering the Workplace' project to help them complete this stage. The poster winners then choose an additional 6 people to join their teams, making teams of around 8 (dependant on student numbers). During this stage of the project, the ILO is to develop the skills listed in table 4 below.

Table 4: Intended learning outcomes for skills developed in stage 2 of the materials library project

Academic Skills	Employability Skills	Professional Skills
N/A	Self-promotion skills Interview skills Networking	Teamwork Critical thinking Communication Negotiation

Stage 3 then asks the teams of 8 to create a 10-page website for their material and a reflective document. Students are given technical guidance on how to create the website as well as a brief with the requirements for each page. After the websites are complete, the students present their work to other groups in a short 5-minute presentation. Developing digital skills is a key component that employers require yet is often missing from employees as discussed in the literature review (The Institute of Engineering and Technology 2021b). Therefore, including the creation of a website gives the students an opportunity to develop digital skills such as using new software, but also allows them to think about the way they present information so that it is suitable and comprehensible for

the audience. Students are also asked to record their management of the project via project management meeting forms. This enables all group members as well as the instructor to track the status of the project and help develop key engineering skills. During this stage of the project, the ILO is to develop the skills listed in table 5 below.

Table 5: Intended learning outcomes for skills developed in stage 3 of the materials library project

Academic Skills	Employability Skills	Professional Skills
Academic writing Academic reading Researching Presentation skills	Digital skills Technical knowledge	Teamwork (large group) Communication Conflict resolution Project management Leadership Problem solving Creativity

In year 3, the Materials Library project is further developed in the technical Materials Characterisation module. The students use the material from their year 2 project conduct characterisation testing and add a page to their website. This adds an interdisciplinary and developmental aspects to this project as students can make changes and develop their website as they see fit. The interdisciplinary nature of this project along with developing skills required by the workplace as mentioned previously, means the Materials Library project directly supports answering research question 2 (What impact, if any, does the interdisciplinary aspect have on preparing students for the workplace?). This should then be recorded in the engineering logbook as part of lab experiments and written assessment to form a reflection and therefore become part of the data.

The engineering logbook is submitted as summative assessment as part of PDP3. The logbook is a record of the student's professional development since the beginning of their time at the JEI. The logbook aims to instil the professional values and capabilities that engineers have in their professional careers. Having a record of professional development is key in demonstrating competency for professional registration (Engineering Council 2020b). It can also be used to assist students when writing postgraduate application forms, CVs, or personal statements. The logbook contains a range of tasks including giving presentations, work experience and training records. It also contains records of lab experiments and engineering design which can help protect intellectual

property. It finally advocates the use of reflection, a key PDP skill. Twice per year, at the end of each semester, students are required to complete an engineering logbook work record form which shows the development of the logbook over the semester. This work record form includes tasks identified for record by the instructor and also leaves a space for the student to detail their own identified tasks.

The work record form is key to ensure students are continually adding to their logbook as it is a summative piece of assessment and to help them develop that sense of professional development. The aim is to add a minimum of 10 entries per year with half of the CPD opportunities being identified by the instructor and half by the students. As undergraduate students they may not fully comprehend professional development or the importance of developing these skills, so it is the instructors' responsibility to guide them. As the logbook is developed from year one, it shows the development of the students' skills and abilities over time which can be recognised from the reflections. Using these reflections can therefore help answer research question 1 (How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students?) as it is concerned with the soft skills developed over the three-year period of PDP.

Longitudinal Research

Figure 3.2 shows a timeline of the PDP modules and data collection points to illustrate this study as a longitudinal piece of research.

Figure 3.2: Timeline of PDP modules and data collection points

As this is a longitudinal piece of research, having multiple data collection points will help track the variables and therefore answer the research questions. It gives students the opportunity to reflect on their work and their skills over a period of time. It may be argued that collecting data within a year, may not be seen as longitudinal. However, this researcher disagrees. As a longitudinal study, it is looking to "determine the pattern of change in relation to time" (Kumar 2019, p. 176). Therefore, even though the data collection points are within a year, students are asked to look back over three years and therefore, this researcher argues that this makes the study longitudinal. One study researching a career development programme lasted a year yet called itself longitudinal (McIlveen, Morgan and Bimrose 2012) and another study investigating self-regulated learning (using a personal development plan) in postgraduate professional education identified itself as longitudinal even though it was only a 9-month study (Endedijk, et al. 2014). Therefore, as long as there are multiple collection points, a study can be called longitudinal, no matter the length. It is important to consider when data is collected and if it is looking forward or backwards.

Data collection was retrospective-prospective (Kumar 2019) as it asked students to recall information from Material Library project they completed at the end of year 2 (which created a baseline) and then subsequently asking how the PDP programmes have improved their skills as part of their Engineering Logbook (end of year 3). Neale (2020) discusses the importance of incorporating both retrospective and prospective approaches into a study and by incorporating elements of a prospective approach, it will help answer research question 4 (How might these skills benefit students academically, professionally and in the workplace?). He also further makes an interesting point regarding the use of time in longitudinal research as he says it gives, "the potential to 'think dynamically' in creative, flexible and innovative ways" (p. 103). This is important as PDP asks students to think differently and using the logbook to record their professional development also asks students to look for opportunities to show skills development throughout university tasks. The logbook is there a key element in identifying the skills that have been developed by students, thus answering research question 3 (What soft skills do students develop?). For professional engineering registration, E4 discusses the need for "undertaking reviews of your development needs" (Engineering Council 2020b, p. 39) which means being able to identify the skills you have or lack in relation to continual professional development, which again supports the need for the logbook and research question 3.

Data was collected through four methods: two questionnaires (one conducted after the Materials Library project and one conducted after the submission of the Engineering Logbook), semi-structured interviews and documentary analysis. The questionnaires, interviews and documentary analysis will now be discussed.

Questionnaires

In mixed methods research, qualitative research is usually conducted prior to quantitative methods to gain ideas of what to include in quantitative questionnaires. However, in this case based on prior knowledge of the learning outcomes of the PDP modules and the skills students should be learning, this researcher already has adequate knowledge to form questions. It is in fact the two questionnaires being administered that will inform the qualitative methods being used in this study. Similarly, Thompson, et al. (2013) used a related method in their mixed methods study where they used questionnaires to provide context for the interviews. However, in this research study, the context is well known, so questionnaires are needed to provide a base for further investigation through qualitative measures.

Questionnaires are a useful tool to gain an overall impression of the thoughts of a large group (Tymms 2021) which is useful in this study as the entire year group (235 students) were invited to complete the questionnaires. The questionnaires were designed to be taken online (due to unavailability of travel because of the COVID-19 pandemic), taking little time to answer and being straight-forward to complete (Cohen, Manion and Morrison 2018). Technical considerations like the software that was used was also considered. Due to China's firewall (Zhang, C. 2020), certain software is not available, so in this study, Microsoft Forms was used as it is accessible to the students, and they are already familiar with using it through peer feedback tasks and other questionnaires that have been administered within the JEI programme.

One of the biggest disadvantages of questionnaires is the questions themselves. It is important that the questions are clear and concise (Choi and Pak 2005) and can only be interpreted in the way the researcher intends. This is why piloting questionnaires is important in any research (Marshall 2005). If the participants give answers that are confusing or do not contain enough information for the researcher, then this can be a wasted opportunity. Additionally, questionnaire fatigue (Choi and Pak 2005) can be a problem for students, especially if they are frequently asked to complete questionnaires, which does happen in the JEI with mid-term and end of term evaluations for each module.

As mentioned above, it is important to create clear questions for the participant. Additionally, there are different question types that can be chosen such as multiple choice, Likert-scale, rating questions, open-ended short or long answer questions. Choosing appropriate question types is key for the questionnaire to be a successful tool and gain useful information that answers the researcher's research questions.

Maietta (2013) used a quantitative questionnaire in her study regarding the correlation of career planning courses and self-efficacy. Whilst there was positive correlation in her results, Maietta noted that the compulsory nature of the courses could have led to the students showing high participation in the courses. This shows that quantitative data is not enough to show the reasons behind students' decisions. Whilst questionnaires are useful to give an overview, they do not give enough detail as to the reasoning.

A more detailed use of questionnaires was used in a study analysing the use of e-portfolios in PDP (McKenna, Baxter and Hainey 2017). In this study, the authors used two questionnaires using ranking, Likert-style questions to answer their three research questions. One questionnaire surveyed students, whilst the second surveyed teaching staff. Moreover, as the staff questionnaire focussed on how e-portfolios and PDP support could be improved, on some questions, one of the options on the Likert-scale was 'other (please specify)', which enabled staff to give a more details. The 'other' option was not available to students which this researcher finds interesting as the authors state that they asked staff their views to 'reduce bias'. However, this researcher believes that not giving students the 'other' option increases bias as there is no option for students to express or clarify their views. This is why mixed methods is useful when researching the impact of PDP. Interestingly, McKenna, Baxter and Hainey used Cottrell's (2021) work on PDP priorities as the basis for their questionnaires. Cottrell is seen as an authority in PDP and her work on skills in used in other author's work (Monks, Conway and Dhuigneain 2006, Bryson 2011, Jorge, et al. 2017) and so using her ideas on skills and PDP in a research instrument is reliable. Therefore, Cottrell features in one of the questionnaires in this study, as discussed next.

The questionnaires in this study

Two questionnaires were administered in this study with the aim of predominantly answering research questions 1 and 3. Before administering the questionnaires, a pilot of the questionnaires was completed by 8 fourth year students who has previously completed all PDP modules and associated projects. They piloted the questionnaires for ease of understanding and readability. Small changes to wording were made or additional information added based on the feedback. For example, question 13 in questionnaire 1, 'networking' was changed to, 'networking (communicating with companies)' (see appendix 3).

Questionnaire 1 was administered after students have completed the Materials Library project in year 2. There were 5 questions that participants were asked to answer. However, as the questionnaire was conducted online, information regarding the participant information sheet and

consent forms were included as question numbers, but actual questions started from number 13 (see appendix 3).

Research question 3 asks what soft skill students develop, so questions 13 and 14 focussed on identification of skills developed during the Materials Library project. Questions 13 used a multi answer question where participants could choose between 15 skills, plus an 'other' option to reduce bias as noted above. Question 14 then asked participants to specify the skill or skills if they chose this option. The skills chosen were linked to the ILOs of the project and included academic skills (e.g. academic writing and presentation skills), workplace skills (e.g. teamwork and communication skills) and professional skills (e.g. project management and problem solving). These areas align with the models of PDP discussed in the literature review (Clegg and Bradley 2006). Question 17 asked participants to reflect on which skills they believe they needed to develop. This was included to identify participants' self-perception (did they choose one of the skills given in question 13 or choose something different) and a similar question is additionally asked in the subsequent questionnaire to identify any changes in development over time, which helps answer research question 1.

To help identify the impact that PDP1 and 2 have had on this project (research question 1), Likert-scale questions were asked to show the extent of agreement. Question 15 used the same 15 skills as noted in question 13 to identify the extent to which PDP1 and PDP2 helped develop each skill. Question 16 lists 6 statements to elicit agreement or disagreement on the impact of the PDP courses. To answer these questions, a 6-point scale was used with increases validity (Chomeya 2010). Normally, a 5-point scale is used, however, this includes a neutral answer. This researcher believes when identifying the extent of skill development, the participant needs to choose either the negative side, or the positive side of the scale, showing discrimination (Chomeya 2010). This is because a neutral answer cannot exist; skills are either developed or not developed on a sliding scale. Additionally, Lee, J.W., et al. (2002) found that the midpoint in a 5-point Likert scale is cultural significant as Chinese people tend to use this to when they have a positive inclination. However, in terms of data analysis, the use of the neutral mid-point could be misleading, which is why a 6-point scale is more useful. Chyung, et al. (2017) also identify the mid-point as a "dumping ground" (p. 17) when there is uncertainty about the question or when it is socially undesirable, which aligns with Confucianist thought of staying with the group (Lee, J. W., et al. 2002). This again shows the need for a forced choice, 6-point scale. The midpoint can also be removed when participants are familiar with the topic (Chyung, et al. 2017), which in this study the participants are as they have taken part in the activities, which means there should be no ambiguity regarding the questions.

Questionnaire 2 was administered to the same participants that completed questionnaire 1 after they submitted their engineering logbooks in year 3. This was to be able to compare the development of skills. There were 14 questions in total comprehensively covering all areas of research questions 1 and 3, but again due to consent, starts at question 5. Questionnaire 2 was more reflective in nature, asking participants to consider their skills development based on the three years of PDP they received.

The questionnaire was based on the questionnaire Monks, Conway and Dhuigneain (2006) used in their study of skills development. It used elements of these questionnaires, namely the structure of the sections, but it is more specific for the context of this study and to answer the research questions. In the original questionnaire by Monks, Conway and Dhuigneain, they used 5 sections: section 1 personal development, section 2 motivation for degree programme and believes about abilities, section 3 approach to tasks, section 4 dealing with people and section 5 demographics. As mentioned above, Cottrell is the key author on PDP and her ideas of skills and skills development were the core focus of the questionnaire and indeed the PDP course proposed by Monks, Conway and Dhuigneain and so using parts of this will increase the concurrent validity of the questionnaires in this study. It was decided to use the section 1 of Monks, Conway and Dhuigneain's questionnaire as it had the most relevance to this study. The part of section 2 regarding motivation for the degree was irrelevant due to the cultural considerations mentioned in chapter 1, but the abilities theme was referenced in some of the interview questions. Sections 3 and 4 were too specific on the skills they were researching and so would not gain an overview of skills which is the focus of this study. Finally, demographics are not a factor in this study, so this was dismissed. The questionnaire was divided into 3 sections: own personal abilities, my skills and PDP courses.

The 'my personal abilities section' (question 5) has similarities to the Monks, Conway and Dhuigneain (2006) questionnaire which is based on Cotrell and contains 18 statements on the participants abilities on a 6-point Likert scale. It was chosen as this researcher believes it includes statements related to the models of PDP. It was slightly tailored to remove some statements and link to the skills and abilities identified in questionnaire 1.

'My skills' section questions 6 and 7 are the same as questions 13 and 14 in questionnaire 1. This was designed for participants to retrospectively reflect on the Materials Library project after completing characterisation on their material and updating their project work. Similarly to questionnaire 1, question 8 asks participants to identify the helpfulness of PDP 3 in the development of 16 skills which are specific to the skills from the ILOs in PDP3. Questions 9, 10 and 12 ask participants to reflect on their soft skills development through open-ended questions. The use of

open-ended questions is intended to aid the development of the interviews that followed the administration of the questionnaires (Harland and Holey 2011). Open-ended questions also avoid bias and increase spontaneity from participants (Reja, et al. 2003). Because of this freedom to answer and share their own thoughts, the participants' personal ontology will be revealed here and thus support the construction of PDP and multiple realities. However, this leads to an endless possibility of thoughts and ideas, which is a disadvantage of open-ended questions (Reja, et al. 2003). Nevertheless, it is necessary to find real answers to the research questions and align with the choice of MMR methodology to gain a full picture.

The final section on 'PDP courses' again use 6-point Likert-style questions to gauge agreement of disagreement in the impact of the PDP modules (question 13) to help answer research question 1 as well research question 2 regarding the interdisciplinary aspect of the PDP modules. There is also an element of reflection on skills development and what has not been developed or covered in the courses (questions 15 and 16). Finally, this section asks for final comments on the courses (question 18) from the participants.

Semi-structured interviews

Interviews are quite a common qualitative method used to discuss PDP and so were used in this study. Baker, Perkins and Comber (2014) conducted qualitative research using semi-structured interviews to discover international postgraduate students' opinions on PDP at UK universities. It seems that interviews were conducted because of the personal journey of PDP which aligns with constructivism as mentioned previously. From their research, Baker, Perkins and Comber were able to draw conclusions in three thematic areas which is consistent with qualitative research practices and data analysis.

Interviews, however, are perhaps one of the most complex qualitative tools used in research. Cohen, Manion and Morrison (2018) identify 10 stages involved in conducting interviews which could be categorised into pre-interview, interview and post-interview stages. In this researcher's interpretation of the 10 interview stages of Cohen, Manion and Morrison, in the pre-interview stage, the design and theme of the interview are important, as well as the design, comprehension and responses of the actual questions, but not forgetting the logistics of the interview as well. The interview stage is not just simply asking questions and recording the answers. In fact, it involves considering the language used in the interview as well as non-verbal responses and body language. Bias can be shown through body language as nodding or making minimal responses can be seen as

the ‘correct’ answer for the participant, making them think this is what the researcher wants to hear. Therefore, it can provide skewed data. In the final post-interview stages, transcribing, verification and dissemination need to be considered.

This study used 15 semi-structured interviews which aimed to answer research questions 1, 2 and 4. The main theme of this interview was reflection and participants using their own reflective practice to investigate their progress throughout the three years of PDP modules. The interviews took place at the beginning of fourth academic year and prior to the interview, participants were asked to read their reflective engineering logbook as well as reflect on their answers to the two questionnaires.

Semi-structured interviews are beneficial for this process because there needs to be structure to ensure the research questions are being answered, but also, because of the reflective aspect, space needs to be given for participants to develop their own thoughts, ideas and feelings towards the topic of personal development. This means participants can discuss what they deem to be most important (Wisker 2008). The open-ended question answers from the questionnaire 2 were also used to form questions and delve deeper into the thoughts participants gave.

The case of unstructured interview questions and validity was discussed by Zhang and Kausel (2022) who found that overconfidence led to poor question creation. They added that by giving a list of questions to interviewers who then chose ones to ask, this created higher validity. This shows that semi-structured interviews have higher levels of reliability, validity and a higher chance of attaining appropriate data to answer the research questions.

As mentioned above, interviews pose a logistical challenge, especially in the context of this study, which is one of the disadvantages. Students are extremely busy with tightly controlled timetables, so were asked to participate in their precious little free time. Furthermore, online interviews were conducted to facilitate the participants and researcher.

As this study takes place in China, an understanding of culture is vital. Chinese students can sometimes be reluctant to share their opinions due to cultural reasons such as Guanxi and face (Ding, et al. 2017). Eckhardt and Bengtsson (2010) discuss the use of naturalistic interview technique for Chinese participants where you gain data from natural conversation. It is important that the participant feels comfortable with the interviewer, so having a teacher-student relationship with the research participants over the last two years will help with the level of comfort as the participant knows the researcher well. Lee (2016) discusses the idea of inside/outsider dichotomy with cross-cultural interviewing. She offers a middle ground of ‘relationalism’ where trust and rapport between researcher and participants bridges the cultural gap. This idea supports this researcher’s position

because there is a rapport with the participants which outweighs the power dynamic issues, because without the trust and rapport, it is clear that in this context, gaining a true insight into the thoughts of the participants may not be possible.

The first 6 participants were asked 13 questions (see appendix 4). However, what became clear was the need for a question regarding the impact of COVID-19, so the remaining 9 participants were asked a further question "Do you think the COVID-19 pandemic had any impact on your experience with the PDP modules? "(Q14) plus any other clarification to assess the effect of the COVID-19 pandemic on their development of soft skills as the majority of their PDP modules were taught online.

The first question asked participants to identify the skills they had developed from taking the three PDP modules, but it also asked them to identify if these were hard or soft skills. It was chosen to ask participants to identify if the skills they mentioned were hard or soft to ensure they knew what soft skills were, as this was a term used in later questions.

As the interviews aimed to answer research questions 1 (How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students?) and 2 (What impact, if any, does the interdisciplinary aspect have on preparing students for the workplace?) on the interdisciplinary aspect of the PDP modules, questions 2-3 and 5-7 discussed the usefulness of the PDP modules with skills development and in technical modules. Question 3 (3. Do you think you could have developed the soft skills that you need in your technical modules only? Why/why not?) was added based on a statement from questionnaire 2 as it produced an answer in the questionnaire that needed clarification in the interviews. Questions 11 and 12 were added to address the overall development in the undergraduate participants (RQ1) in their soft skills and future plans.

To help answer research question 4 (How might these skills benefit students academically, professionally and in the workplace?) questions 4 and 8-10 were asked to cover each of the three areas.

Engineering logbook document analysis

The documentary analysis is key in providing discussion in the interviews. Guerra (2017) used similar data collection by analysing engineering curriculum to inform semi-structured interviews. The logbooks used in this study were those of the participants in the interviews. Not only did the participants refer to their engineering logbooks as a reflective practice prior to the interviews, the

logbooks provided a valuable resource for the researcher to identify themes of soft skills development throughout the PDP modules. The aim of using the logbooks was the help answer research question 2 (What impact, if any, does the interdisciplinary aspect have on preparing students for the workplace?) as the logbook is a reflective document, but based on their professional development as an engineer.

The logbooks were analysed by first identifying themes from interview question 10, 'How do you think completing an engineering logbook has prepared you for the workplace?'. Each logbook was then read regarding the answers given to this interview question to identify support for each of those themes and to try to analyse and give reasons for those answers.

Next the limitations of each of the methods will be discussed.

3.6 Limitations

As with any method used, there can be some limitations identified. One of the limitations in both the questionnaires and the interviews was the use of the words 'professionally' and 'workplace' as students were unfamiliar with these terms in the context of the PDP modules as they had never worked previously and perhaps were not able to identify the difference between these two words. Therefore, further explanation was given and perhaps adding a definition may have been more relevant to the participants.

It was found that the logbooks provided limited data for this study for two reasons. Firstly, the reflections written focussed heavily on retelling of facts rather than analysis of skills. This was improved slightly in the later years of the logbook, but there was not a deep enough reflection to yield very telling results. Secondly, with regards to the workplace, only few participants had included entries that were related to the workplace such as internship experience or volunteering. This therefore limited the inference of the development of skills for the workplace.

Each of the methods discussed above require participants who will need to be carefully chosen as a sample, which will be discussed next.

3.7 Sampling

When selecting a sample, consideration of the methodology used is key. For quantitative research, sample size is dependent on what you want to achieve with the data, whereas for qualitative research, sample size is less important; instead, data collection is halted when no more can be gained from participants (Kumar 2019).

For this research, non-probability samples were used as this research aims to target one specific group of students. This type of sample aligns with case study research (Cohen, Manion and Morrison 2018) which this study is. Within non-probability, there are a range of sample types, with purposive and convenience samples being used in this study.

Purposive samples are chosen because they meet a specific need (Cohen, Manion and Morrison 2018). In this case the need is that the participants are taking the PDP modules at the JEI. Additionally, the year group is important as they must have completed the Materials Library project in order to complete the first questionnaire and be in the process of completing the third PDP module. However, because this study focusses on development of skills, anyone within the specific year group above is eligible to take part. Therefore, the sample can also be classed as a convenience sample. This means whoever says they want to participate can as long as they meet the inclusion and exclusion criteria. Therefore, recruitment works on a first come, first served basis with the aim of recruiting as many participants as possible.

A summary of the participants can be seen in table 6 with further explanation of the sample for each data collection method after.

Table 6: Summary of sample data

Data collection method	**Number of participants**	**Participant details**	**Date of data collection**	**Type of sample**
Questionnaire 1	41	2020 cohort	September 2022	Convenience
Questionnaire 2	27	Participants that completed questionnaire 1	June 2023	Purposive
Semi-structured interviews	15	Participants that completed both questionnaires	October 2023	Purposive
Documentary analysis	15	Same as interview participants	July 2023	Purposive

For the questionnaires, as many responses as possible was aimed for. Aiken and Hutton (2022) surveyed first year university science students on skills development and PDP and received a response rate of 18%. McKenna, Baxter and Hainey (2017) also surveyed university students regarding PDP and received 11.9% response rate from the School of Engineering and Computing. Therefore, whilst aiming for as many as possible, it was difficult to recruit participants to answer the questionnaires in the study due to the difficulty of contact during the pandemic. Additionally, the students were asked to participate in their free time and as this was not related to their grades, it was difficult to convert students to participants. For questionnaire 1, there was a response rate (from 235 students) of 17.4% and 11.4% for questionnaire 2 which was similar to the authors above. Furthermore, the purpose of the questionnaires were to gain overall or general ideas of skills development, but the interviews were the tool that provided more detail reasoning of the reasons behind the questionnaire answers.

Fifteen participants were interviewed as this provided sufficient data. After this point, this researcher believes data saturation was reached because of the limited heterogeneity of the sample (Kumar 2019). The participants of this study were all Chinese, around a similar age and had had a similar educational upbringing which will have contributed to similarity of answers given. The participants of this study, especially the ones in the interviews this researcher would class as the more motivated students in the JEI because they took the time to take part in the research. These are students who like to make a difference to the JEI as could be seen from the engineering logbook as some were student representatives.

As mentioned previously, the main inclusion criterion is that participants must have completed the Materials Library project and have completed PDP3 and submitted the engineering logbook. However, the take part in the interviews there were exclusion criteria. Firstly, the participant must have completed both questionnaires as they were asked to reflect on these, so participants could only be recruited from the questionnaire sample. Secondly, the participant must have completed the engineering logbook submission and have read and accessed it.

3.8 Ethics

Axiologically, ethics always need to be considered and are particularly important in this study as it takes place internationally, in a cross-cultural environment. It is also important to remember that in the engineering profession, engineers are required to adhere to codes of conduct which include ethics as they are responsible for the public good (IOM3 2019). Cohen, Manion and Morrison (2018)

note that contextual social, political, institutional, cultural and personal issues should be used as a basis for making ethical decisions.

The following will highlight the ethical issues within this study and whether, in the research context they are social political, institutional, cultural or personal in nature.

The research project

When conducting a research project, the first ethical issue to consider is establishing an appropriate research area and deciding on appropriate research questions, design, methodology, data collection and analysis. These are cultural and political contextual considerations which are needed to ensure the research is carried out reliably with validity and with all involved parties and any sensitivities are considered.

Secondly, following codes of practice and conduct from engineering and educational standpoints is important as in different fields of study, ethics might differ. This is an institutional perspective. For example, in healthcare there are a multitude of responsibilities and priorities that professional must follow as they deal hands on with human patients who need medical intervention (Runciman, Merry and Walton 2017). However, engineers' interactions with the public are secondary. So, if designing a new product for public use, there are multiple stages where safety can be considered and changes made, unlike in medicine, which can prevent harm to the user. Educational ethics in this study follows the British Educational Research Association guidelines as the research is being conducted as part of a UK university but also has renowned international association (British Educational Research Association 2018).

Linked with this is gaining ethical approval from the parties involved. Ethical approval would be considered as political, institutional and cultural and depending on the stakeholders, each ethical process could be different. For example, in this study, ethical approval was obtained in the UK but was not necessary in China. However, a letter signed by the Dean of the JEI was enough to continue with data collection because of gaining ethical approval in the UK.

Finally, as this is international research, it was important that all ethical documentation (participant information sheet and consent form) was available, accurately translated into Mandarin to adhere to social and cultural considerations. This enabled all participants to fully understand what the research involved and what was expected of them. This was important as the level of participant's English may differ and use of specific, educational, technical vocabulary may not be understood. It could be argued that using a translator could reduce the validity of the research. However, as a translator is

only translating the ethical documentation, this researcher rejects this and in fact argues that ensuring participants understand the research means protecting them from harm, which is the main aim of having ethical documentation. It is also part of BERA's ethical guidelines to consider participants' understanding when researching in another culture (British Educational Research Association 2018). Therefore, when dealing with participants before, during or after the data collection, plain English was used to avoid misunderstanding. This was also important when considering data collection to ensure the reliability of the data.

The participants and researcher

Ethically, it is important to note the researcher-teacher issue that might be biased. The participants have been previously taught by the researcher for two years which may cause a power struggle and lead to unauthentic answers (Banegas and Consoli 2020). This is personal, social and institutional considerations. It is unethical for the researcher to view the data through a biased lens (Kumar 2019), so is something that must be controlled. Although in this study, the researcher taught the students for two years, that teaching was online due to the COVID-19 pandemic. This has prevented a more personal relationship forming as the researcher has only interacted via a computer screen and without the face-to-face interaction, it could be argued that the researcher has limited knowledge of the participants. Additionally, the majority of data collection was conducted in the third year of study, in which the researcher does not teach the students, therefore increasing the distance and reducing the bias. Romano, et al. (2021) discuss bias in software engineering experiments and suggest blind data extraction. They suggest an external party extract data, or if this is not possible, identifiers should be removed, which is linked with confidentiality.

For those that do participate, it is important to protect their identity which will be done through anonymisation and pseudo-anonymisation (e.g. interviewee 1). Additionally, it is important to protect the universities in this study as there are sensitivities in the portrayal of China, Chinese students and the JEI as well as disclosure of public and private knowledge. These are cultural, political, social and institutional considerations. Privacy will be discussed in the data section and will be applicable here.

Linked to both of the above is a duty of care towards the participants and ensuring they understand participation in the study is voluntary and they can withdraw without consequence. This study also does not have any bearing on their study or grades which are important in this context as social, personal and cultural issues come into play here. Informed consent is therefore key. Participants need to know what information is needed, the purpose of that data and how they are expected to

participate (Kumar 2019). This information can be found in the participant information sheet, which as discussed above, needed to be accessible an understandable to all.

The data

When collecting data, an important ethical question relates to who has access to that data and how is it stored. It is vital to ensure encrypted, safe and secure data storage using two-factor authentication. This has personal, social, political and institutional implications. On 1st November 2021, China introduced its' new Personal Information Protection Law which is similar to GDPR (Calzada 2022), showing how data protection is taken seriously across the world. Therefore, in this study, it is of utmost importance to keep data safe and ensure that data is disseminate truthfully through the appropriate academic channels.

3.9 Summary

The research methods chapter has shown that when designing research, it is important to know your own position as a researcher. Once that position is known, you are then able to make informed choices regarding the way to design and conduct your research project. It is however key to always remember the context which you are operating in and the participants.

This chapter has shown that as PDP is a personal journey, multiple realities will exist, and this must be considered when designing the research study. It was important to capture the views of the many, so a mixed methods approach was appropriate in this context. From the chapter it can be seen that using only quantitative or qualitative data collection would not have been appropriate for the researcher's position or the study context's culture. Therefore, questionnaires, semi-structured interviews and document analysis have been chosen and a consideration of the culture taken when deciding how to implement this data collection. The sample of participants was also carefully considered based on other author's studies in similar fields. This ensured a reasonable response rate for questionnaires, which is important for quantitative research. Qualitative sampling is much more flexible and using the researcher's opinions as well as other studies has settled on a sufficient number of participants. Finally, ethical considerations were discussed in relation to the cross-cultural nature of this study.

The next chapter will analyse the data for the questionnaires used in this study and discuss reasons for how studying an interdisciplinary three-year set of PDP modules develops the soft skills of undergraduate engineering students.

Chapter 4
Findings Part 1

4.1 Introduction

This chapter discusses the findings from the two questionnaires that were conducted with participants from a joint education institute (JEI) between Canal and Mountain universities who had been taking the three personal development planning (PDP) modules as part of their degree programme.

As discussed in the methodology and methods chapter, questionnaire 1 was conducted after completing the PDP2 module and questionnaire 2 was conducted a year later at the end of PDP3. The questionnaires administered aimed to answer research question 1, *How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students?* and research question 3, *what soft skills do students develop?*

Questionnaire 1 aimed to understand the skills that participants felt they had developed as part of the second year Materials Library project and throughout the first 2 years of PDP. It also aimed to identify how much they believed the PDP modules helped them to develop those skills. The first question asked participants to consider the skills they developed in the Materials Library project. There were 15 options given and the skills listed were the skills that the Materials Library project aimed to develop through the intended learning outcome (ILO). There was also an 'other' option which gave participants an opportunity to detail any other skills they believe they developed. The next question asked participants to consider how much PDP1 and 2 had helped them develop the skills from the previous question and the same skills were added as these aligned to the module ILO. The third question asked participants to consider the pedagogy and aims of the PDP modules. The statements chosen were based on reading from the literature review and the pedagogy that is used to deliver the PDP modules. Finally, participants were asked to reflect and write down any skills that they still needed to develop. This was to encourage reflection, which is part of the PDP process, but also to compare to questionnaire 2 the following year. Questionnaire 1 was completed by 41 participants.

Questionnaire 2 followed a similar pattern with skills identification but further asked participants to reflect more deeply on their skills and evaluate the PDP modules. The questionnaire was divided into three sections. Section 1 is entitled 'own personal abilities' and is based on the work of Monks, Conway and Dhuigneain (2006) where participants need to identify their abilities in relation to employability and skills. Section 2 asked participants to identify the skills they developed in the

characterisation aspect of the Materials Library project. The same 15 skills and 'other' option that were used in questionnaire 1 were used so a comparison could be made. Similarly to questionnaire 1, the next question asked about the relationship between these skills and PDP3. The skills detailed in this question followed the ILOs of the module and also the skills that the Engineering Council require of engineers, especially for those who which to become chartered. In the following four questions, participants were asked to reflect on their skills by looking at their engineering logbooks and identifying which skills were their top and bottom skills and if they believed they have seen a change in their skill development and why they believed that was. The final section asked participants to evaluate the PDP modules in terms of how they developed their skills, if PDP prepared them for the workplace and the recommendation of PDP modules to others. Participants were also asked for final comments on the PDP modules. These questions were asked aimed to answer the overarching research question of this project. Questionnaire 2 was answered by 27 participants. A copy of the questionnaires can be found in appendix 3.

The aim of this chapter is the analyse the findings from the two questionnaires conducted in this study and discuss reasons for these findings. Reasons and some initial recommendations will also be given based on literature and personal conclusions.

4.2 Personal Abilities and the Need for Personal Development Planning

The personal abilities section of the questionnaire was adapted from Monks, Conway and Dhuigneain (2006) section 1 PDP questionnaire, which drew from Cotrell (2003) and 'the need for PDP'. This was chosen to be added as the first part of questionnaire 2 to identify the extent to which, after three years of PDP, students still had a need for PDP in certain areas and if the PDP modules had developed the skills the engineering industry require of graduates. It is being analysed first as it links skills development and the PDP modules together by asking participants, after three years of PDP are they confident in their own abilities. This section of the second questionnaire also helps to answer the overarching research question, 'How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students?' as the statements shown in figure 4.1 can be categorised into groups: self-reflection and evaluation, employability, interdisciplinary, skills and metacognitive strategies, which are key aspects of answering the research question.

Q5. Please read each statement and indicate the extent to which you agree or disagree by choosing the appropriate answer.

Figure 4.1: Questionnaire 2, question 5- Own personal abilities

Figure 4.1 shows that in terms of reflection, 83% of participants strongly agreed or agreed that they were very clear about the importance of reflection in professional life. Additionally, 47.8% of participants agreed or strongly agreed that they had a clear understanding of how to rate they own performance, and 65.2% agreed or strongly agreed that they were confident on how to improve their performance. Finally, 62.5% of participants also agreed or strongly agreed that they knew how to make best use of their mind.

When thinking about employability, 65.2% of participants agreed or strongly agreed that they knew what skill employers were looking for, but only 47.8% of participants agreed or strongly agreed that they were confident they had the skills employers were looking for. However, 69.6% of participants agreed or strongly agreed that they were confident about making a competence-based job application.

Interdisciplinary abilities were highlighted in three statements. Firstly, 65.2% of participants agreed or strongly agreed that they knew how to apply their expertise in a different field. Next, 56.5% of participants agreed or strongly agreed that they could see clearly how their skills applied in a wide range of situations. Finally, 52.5% of participants agreed or strongly agreed that they were confident that they could use their skills in new situations.

Skills such as teamwork and problem solving were addressed in some statements to meet basic workplace requirements and skills needed for engineering. 69.5% of participants agreed or strongly agreed that they were aware of the best roles for them to fill in teamwork. 56.5% of participants agreed or strongly agreed that they were confident at problem solving, and they will take a creative approach to problem solving. 60.9% of participants agreed or strongly agreed that they were very clear about the skills they were developing.

Finally, in terms of metacognition, 52.2% of participants agreed or strongly agreed that they were confident they could develop an effective strategy in most circumstances. 65.2% were confident that is things went wrong they would be able to fix them and 60.9% of participants agreed or strongly agreed that if things did not go to plan, they would have the determination to carry on. Lastly, 56.5% of participants agreed or strongly agreed that they were confident that when they had a plan, they could make it a reality.

What can be seen from the results above is that the PDP modules were perceived by respondents as developing their abilities. These results correlate with Monks, Conway and Dhuigneain (2006) who similarly asked these questions to one group of students who had received PDP classes and one group that had not. Therefore, this shows the importance of having PDP modules as there is a clear

need for PDP to ensure students develop crucial soft skills. The results do show though that there is room for improvement. Clearly understanding how to rate one's performance and confidence in having the skills employers wants had the least level of strong agreement. Rating your own performance can be quite an abstract concept, which is something Chinese learners have difficulty with because of the level of critical thinking required and the lack of hard knowledge (Chan, N., Ho and Ku 2011). Additionally, having little experience with employers and the workplace, participants might therefore be unsure if they have the skills required. Whilst PDP2 does cover applying for jobs where real job adverts are analysed and researching requirements for postgraduate study are addressed in PDP3, without having contact with employers or a professional network, being certain about the skill employers want can be difficult. Therefore, undergraduates having a professional network is vital for employability and graduate attributes (Badoer, Hollings and Chester 2021).

4.3 Skills Developed During the Personal Development Planning Modules

Questionnaires 1 and 2 asked the students to identify then skills that they developed during the three PDP modules in order to answer research question 3, "what soft skills do students develop?".

Figure 4.2 shows the skills that participants believed they developed from the Materials Library project in questionnaires 1 and 2. The figure shows that academic writing is rated as the highest, followed by teamwork, then critical thinking skills for both questionnaires. However, for questionnaire 1, communication skills and creativity were rated jointly next, followed by analytical skills then leadership and project management. In questionnaire 2 though, problem solving skills and communication skills followed the three top answers.

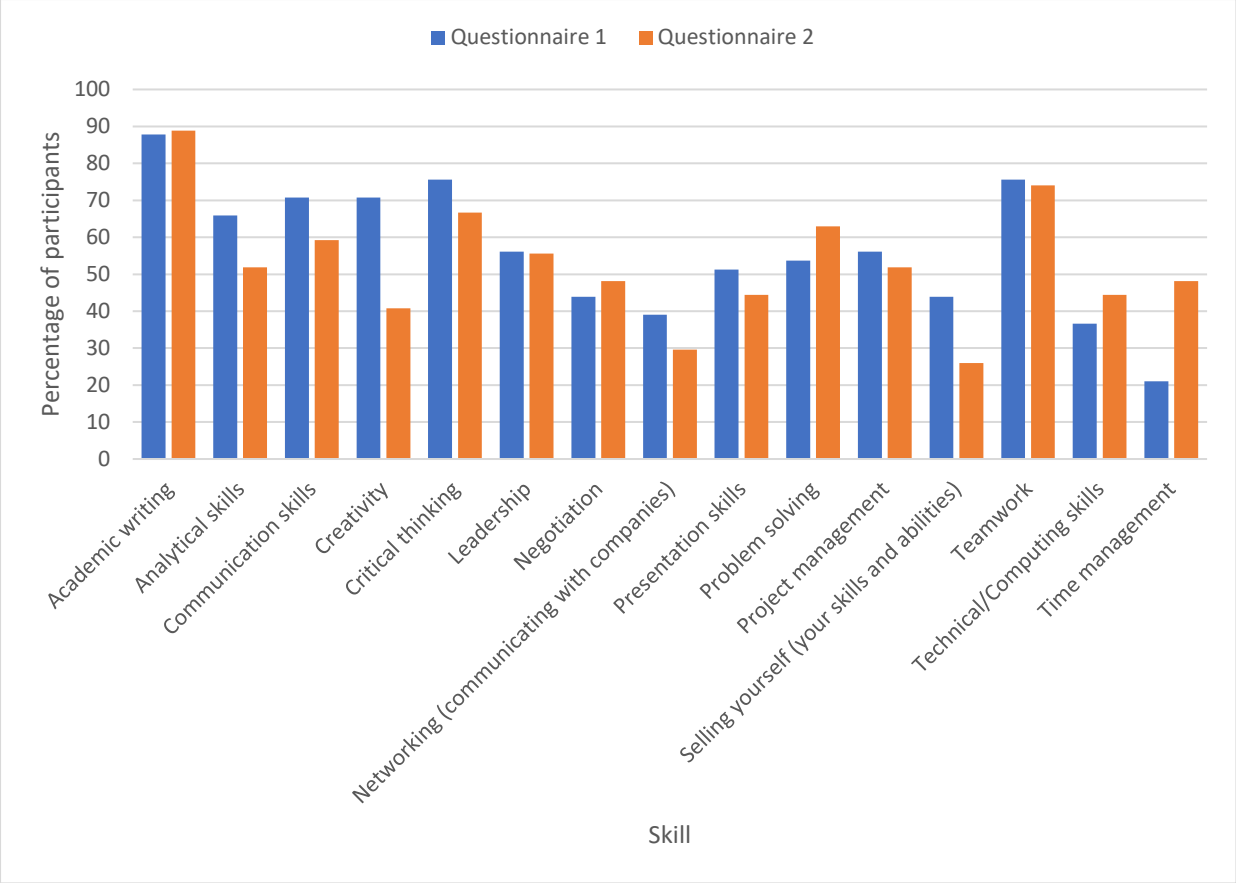

Figure 4.2: Questionnaires 1 and 2- skills developed after Materials Library Project

Interestingly, there is a large disparity in creativity between questionnaires 1 and 2 with 71% of participants rating this as a developed skill in questionnaire 1, but only 41% identified this in questionnaire 2. Similarly, there was an 18% difference in selling yourself between questionnaires 1 and 2 and a 14% difference in analytical skills, with questionnaire 1 scoring higher on these skills. The only large difference was in time management skills where 27% more participants rated this skill higher in questionnaire 2. Perhaps this is due to the focus of PDP2 and PDP3 follows these skills and therefore participants recognise where there is active content to develop these skills.

Table 7: Comparison of Material Library skills (between questionnaires 1 and 2)

Skill	Position Questionnaire 1	Position Questionnaire 2	Promotion (↑)/ demotion (↓)/same (-)
Academic writing	1	1	-
Teamwork	2	2	-
Critical thinking	2	3	↓ 1
Communication skills	3	5	↓2
Creativity	3	10	↓7
Analytical skills	4	7	↓3
Leadership	5	6	↓1
Project management	5	7	↓2
Problem solving	6	4	↑ 2
Presentation skills	7	9	↓2
Time management	7	8	↓1
Negotiation	8	8	-
Selling yourself	8	11	↓3
Networking	9	12	↓3
Technical/computing skills	10	9	↑1

Table 7 shows the comparison of the skills rated for the Materials Library project one year apart. What is clear to see from this table is that in questionnaire 2, the participants have more clearly defined the order of the skills in which they have developed. This would be expected as participants have grown, matured and developed their thinking in the year between questionnaires. Participants should have a clearer idea of their skills, especially at the end of three years of PDP and reflecting using their engineering logbook which was submitted as assessment. Therefore, they should have a more clearly defined idea of what they perceive their skills to be.

The table also shows that the 4 out of the top 5 skills remained the same (academic writing, teamwork, critical thinking and communication), however, problem solving skills moved from 6th to 4th position. This could be for two reasons. Firstly, the second part of the Materials Library project focusses on characterisation of materials which needs more problem solving skills. Secondly, the participants have developed those skills in the original Materials Library project and have now realised the significance of them once having time to reflect. Reflection through the engineering

logbook may have given them the opportunity to understand the soft skills they have developed during the Materials Library project. Having this engineering logbook has given students the opportunity to 'audit' their skills and identify strengths and weaknesses which is an important workplace skill (Mello and Wattret 2021).

Academic writing would be the top skill developed as this is a project-based task where participants were required to create a website consisting of multiple pages with a significant amount of text and applying project-based learning can improve academic writing skills (Hasani, Hendrayana and Senjaya 2017). Academic writing is not a skill specifically taught in the PDP modules, elements of scientific written presentation are though, such as interpretation of figures and data and correctly expressing those as it is important for an engineer to be able to do this as well as to be able to write reports and other technical documents for a range of audiences.

At the end of questionnaire 1 participants were asked to identify a skill or skills that they thought they still needed to develop (question 17). Communication skills were identified by 10 participants (which included communication with tutors and other students, and speaking fluent English), academic writing was mentioned by 5 participants, presentation skills by 4 participants and interestingly, 'none' was written by 7 participants. Whilst most of the answers given correlated with the skills mentioned in questionnaire 1, confidence and self-discipline were also mentioned once as was career planning. This shows self-awareness in developing personal skills and lifelong learning.

A year later, in questionnaire 2, participants were asked to identify their top 3 soft skills (question 9) and 3 soft skills that still needed improvement (question 10). For the top 3 skills, in terms of thinking skills, these were mentioned 11 times (critical thinking was mentioned 9 times (mostly as the first skill), flexible and creative thinking mentioned once each). Problem solving and finding skills were mentioned a total of 11 times as well (solving 5 times and finding 6 times). Analytical skills were mentioned 5 times which could be included in thinking skill or problem finding skills. Teamwork and leadership skills were also rated as top skills, 8 times and 6 times respectively, with leadership being rated as one of the top two skills. Communication skills were rated 7 times by participants with 4 of the mentions as the top skill. Time management skills were mentioned 6 times, project management skills 4 times and prioritisation once. Finally, technical/computing skills were included 5 times.

Referring back to the literature review, the 2017 Employer Skills survey (Winterbotham, et al. 2018) discussed the 'technical and practical skills' that are lacking in engineering. The survey showed the lack of analytical skills in employees was the highest concern in the field of engineering, in addition

to problem solving skills. However, from the participants' responses in the questionnaires, it is clear to see that the PDP modules have addressed these lacking skills as thinking and problem solving skills were mentioned as the top skills that participants developed. Similarly, digital skills were found to be lacking in the engineering sector, but again, this has been resolved in the PDP modules, especially through the Materials Library project as the participants were expected to create a website and use their digital/computing skills to complete this as well as project management forms in the form of a Gantt chart, agendas and meeting minutes on a cloud system. It is vital for students to be exposed to different software including creating documents, presentations, spreadsheets, using cloud services and meeting software as the work environment has now changed since the COVID-19 pandemic. Many employers now adopt a hybrid approach to working (Agrawal, et al. 2020), so being competent with different software for collaboration and communication is essential. The 2017 Employer Skills Survey (Winterbotham, et al. 2018) also discussed 'people and personal skills' and found a lack of time management skills and leadership skills with employees. Once again though, the questionnaire showed that participants felt they developed these skills from the PDP modules. By designing the PDP modules to address specific skills needed to a specific profession, this has developed the skills needed by employers and therefore shows the need for PDP modules in a university degree. Graduates would then have had the opportunity to develop the necessary skills needed for the workplace, which would then reduce training needs, meaning companies saving money as well as companies finding enough applicants for their advertised positions.

When asked to rate the 3 skills that they felt were not good, participants rated presentation skills, leadership skills and communication skills the most times (11, 8 and 6 respectively). Interestingly, the participants who rated presentation skills as not very good, rated their critical thinking (5 times), problem solving or finding skills (4 times), communication skills (3 times) or technical/computing skills (3 times) are their top skills. Therefore, if communication skills and technical/computing skills are very good, it is important to understand what difficulty the participants are perceiving they have with presenting. Similarly, if the thinking skills and problem solving/finding skills are rated highly, it must be the communication skills that are causing difficulty for the participants. It is also interesting that communication skills and presentation skills were those identified as needing improvement in questionnaire 1. An, Ravindran and Al-Shaibani (2022) discuss anxiety that Chinese Malaysian students feel when presenting in English. They found six main themes including feeling nervous, lack of preparation, making mistakes, judgement, expectations and fear of failure. Due to similar cultural backgrounds of students and being in an English-medium university, this anxiety could be the reason

why participants in this study rated presentation skills as being something which they are not very good at.

Another factor to consider is the effect of the COVID-19 pandemic on the language abilities of students. The participants of this study received two full years of online teaching, with some sporadic face-to-face teaching at the end of the third year when restrictions were lifted. There are conflicting opinions in the literature regarding speaking abilities post-pandemic, but from personal experience, the spoken English abilities of students have drastically deteriorated. Literature states that the pedagogy used in online teaching, especially in English language classes could be a factor in the poor spoken skills of Chinese students (Asmawi and Sun 2023). However, it could also be a matter of personal self-discipline and interest (Lian, et al. 2021, Zhang, K. and Wu 2022a). Lain, et al. identified that in addition to authentic language learning tasks (which heightened students' interest and motivation), students needed high levels of self-control to work in a group or by themselves as there was a lack of teacher monitoring.

One benefit of the pandemic has been the development of the technical/computing skills of the participants in this study. Using online software for meetings or development of coursework and having to send this to teachers for feedback has forced the development of these skills. Chinese students are generally not computer literate for academic work when joining university (although there is little research to give exact numbers (Fan and Wang 2022)), so the pandemic has developed these skills as teaching was moved online. Therefore, the literature indicates that it is in fact skills students need to learn such as teamwork, critical thinking, technical/computing skills and self-management skills to be successful which is why PDP modules are so important. It would be recommended to include PDP modules into undergraduate courses specifically focussing on skills that students need to develop in order to be successful. It would also be recommended to tailor these modules based on the needs and socio-cultural factors affecting the students.

4.4 The Effect of the Personal Development Planning Modules on Skills Development

In this section, the effect of the PDP modules was analysed in terms of skills development over the three years.

Questionnaire 1 (question 15) asked participants to rate how much PDP1 and 2 had helped them develop the 15 skills identified from the Materials Library project (Figure 4.3). The findings showed that participants rated PDP1 and 2 as helping develop all of the skills. The skills that were rated as being 'helped a lot' by PDP1 and 2 were communication skills (53.7%), presentation skills (48.8%),

problem solving (43.9%), teamwork and project management (both 41.5%). However, PDP1 and 2 were rated as not helping develop the skill of selling yourself (7.3%), leadership skills (4.9%) and networking skills (4.8%). Nevertheless, most of these rating came from the 'slightly did not help' category which could mean that the participants were unsure of the skill or felt they had developed this skill in a small way.

Q15. Please rate how much PDP1 and PDP2 have helped you develop the following skills. (Please choose one option for each skill.)

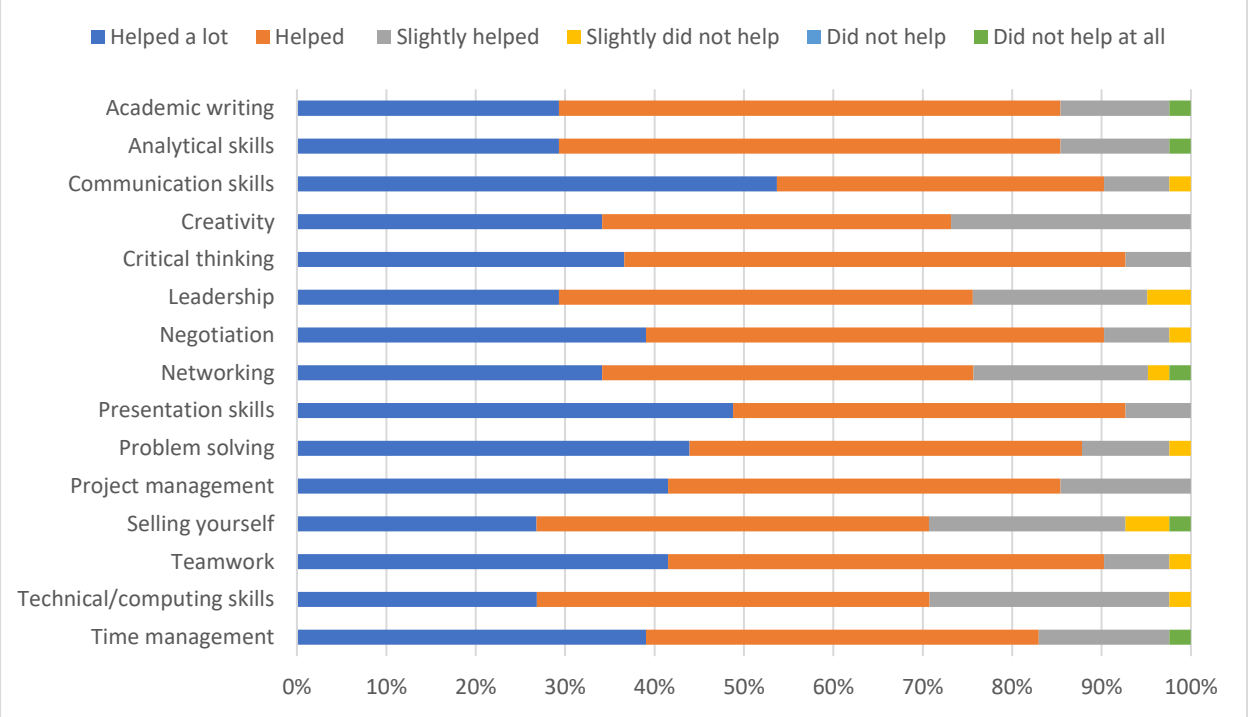

Figure 4.3: Questionnaire 1- helpfulness of PDP1 and 2 on skills development

Questionnaire 2 (question 8) asked participants to rate how much PDP3 helped them develop 16 skills which included some of the skills mentioned from the question asked for PDP1 and 2 but were more tailored to business skills as this is the focus of the third-year module (Figure 4.4). Teamwork skills were still rated highly as being 'helped a lot' by PDP3 at 48.1%, but so were systems thinking skills, also at 48.1%. Time management (44.4%) and critical thinking (40.7%) were also highly rated as being 'helped a lot'.

Q8. Please rate how much PDP3 has helped you develop the following skills.

(Please choose one option for each skill.)

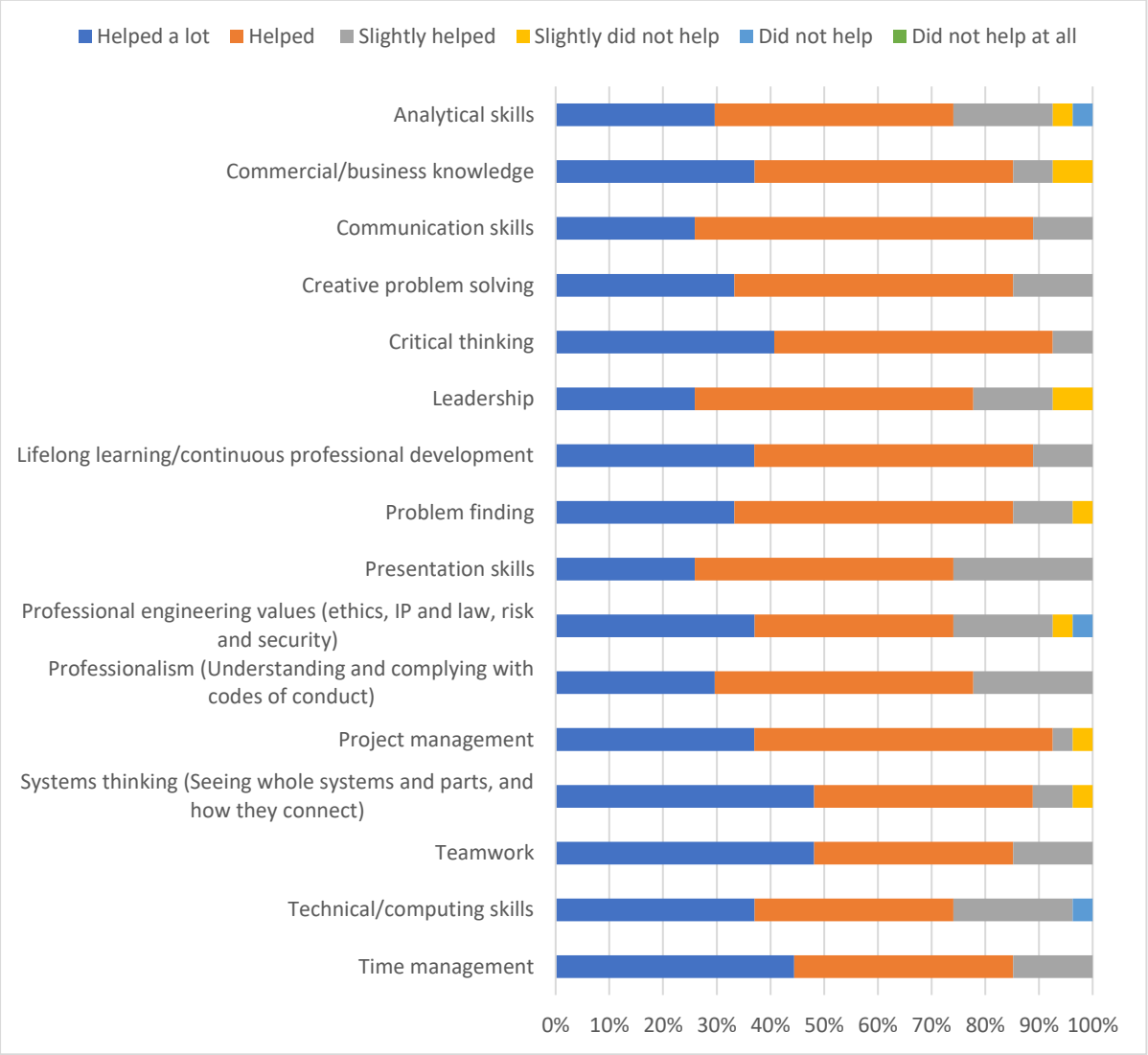

Figure 4.4: Questionnaire 2- helpfulness of PDP3 on skills development

In the final questions (questions 11 and 12) regarding skills development in questionnaire 2, participants were asked if they felt the skills they rated as their top skills and skills that needed improvement had changed from the beginning of the degree programme until now. All the participants agreed that they had with 11% saying they had changed a little, 56% saying the skills changed somewhat and 33% says their skills had changed a lot. All participants agreed that there had been improvements in their skills. There were several themes mentioned by participants as for the reasons they believe their skills changed which were written in the open-ended question 12.

One major theme alluding from question 12 was the pedagogy used in the classroom. The use of project-based learning has improved the communication, teamwork and critical thinking skills of the participants. One participant said,

> *"In my opinion, the biggest change is critical thinking and teamwork ability, because the course work of many of our major courses has tested these two abilities very much, especially the cultivation and development of critical thinking ability, which I think will help us to have the ability of independent thinking".*

Another said, *"My soft skills have improved a lot since the course taught me to train in practice".* It was also identified by participants that being given the chance to practice was key to skills development. One participant commented, *"I actually got the chance to give a presentation. It help me to practice my English speaking and make me confident to give a presentation".* A second said, *"My writing skills, group work skills, analytical skills, critical thinking, and presentation skilled improved the most because I practiced these skills a lot through various courseworks".* This shows that students developed through an active approach in the classroom, so a move away from the teacher-centred approach is key. The student-centred approach that the JEI takes is therefore the correct one to help students develop their skills. As mentioned in the literature review, deep learning takes place only in active teaching and learning situations, or when motivation is high in teacher-centred spaces (Hailikari, et al. 2021). However, as the following comment shows, sometimes students just do not have the motivation required to develop skills, *"The presentation skill is difficult to be developed for Chinese students who has bad English foundations. But when we're pushed to think and practice in the form of coursework, it may be changed a little bit. But actually I don't want to practice".*

Another theme was employability skills with skills such as project management and leadership being mentioned. *"I have also mastered some team management skills, such as sending agenda to team members before the meeting so that they can prepare in advance, and output a PM or meeting minutes after the meeting to better carry out work".* Another participant discussed how they had taken the tool learned as part of project management to employ in their everyday university life, *"I am trying to apply tools such as Gantt chart to manage my time. Although I am not good at it, I do see some improvement on myself".* This comment shows the transferability of skills into other aspects of life. This is key to employability and being able to function in the workplace. It indicates that the PDP modules have been designed successfully to show the use of these tools and skills not only in projects, but also in other aspects of life. Teamwork was mentioned several times in the questionnaire including a participant saying, *"I improved my leadership and teamwork skill because*

of 3-year PDP module". Because of the emphasis on teamwork and therefore leadership, the PDP modules have helped developed these collaboration skills which are key to the workplace and mentioned in any job advert (Rios, et al. 2020).

One participant also said, *"I built my professionalism".* This shows that the PDP modules are preparing students for the workplace. In engineering, professionalism is a fundamental skill because of codes of professional conduct (IOM3 2019), which this is especially important for universities who have programmes accredited by professional bodies. Therefore, universities should be promoting professionalism within their programmes and the comments made in this study show this is being highlighted in the PDP modules.

Lifelong learning was the third major theme mentioned by participants as they reflected and understood the need to continue practicing to see more improvement.

> *"As for some of the skills that I consider weak at this stage, such as presentation skills and leadership, they have likewise been improved. But I don't think it's quite where I want it to be. These are skills that I was not good at in the first place, so it will take more time to improve them".*

The reflection from this participant shows a growth mindset which is needed for lifelong learning both personally and professionally (Dweck 2016). As discussed as part of the literature review, lifelong learning needs to happen as part of the education setting in a supportive atmosphere (McCombs 1991). Additionally, this comment shows high levels of reflection from the participant; they have been able to identify where they have developed, but understood the skill is not as developed as they would like, and it takes time to do so. This shows the participant has developed reflective skills which as a key part of the PDP modules, especially as this questionnaire was conducted at the end of year 3 when participants had submitted their engineering logbook, which they were asked to reflect on prior to answering. Deveci and Nunn (2018) discussed self-reflection and the emotional intelligence it shows. These are skills needed in the workplace as part of everyday working as well as appraisals given by managers. However, to develop this reflection, students need guidance which is a key part of PDP modules. It can be seen that without reflection, this skill would not have been developed, so PDP modules and specific tasks within them, namely the engineering logbook, have aided development in these essential areas. These are also key in terms of CPD for engineers as discussed in E4 of the UK-SPEC for engineering (Engineering Council 2020b).

The fact that there are three PDP modules has also helped as one participant said, *"the change of my soft skills is mainly due to my continuous learning and optimization in class",* whilst another said. *"I*

think my soft power has been enhanced to some extent through the training of PDP courses". The aspect of continuous practice of skills in PDP was also seen as a positive as mentioned by two participants,

> *"Before taking the PDP course, I didn't have plenty of opportunities to have classroom presentations. The occasions of poster display presentation, video presentation and project presentation improved my communication, teamwork and presentation skills. I learned a lot from the preparation of the presentation, the practice of presentation again and again, and the final presentation"* and *"Through over and over practising".*

The literature review showed PDP modules that span three years and form such an important part of the curriculum and hence the development of students' soft skills in a wide range of areas; academic, professional and employment have not been written about. The participants' answers in the questionnaire show not only the need for this type of module, but the understanding of its helpfulness.

4.5 Analysis of the Personal Development Planning Modules

In both questionnaires participants were asked the extent to which they agreed or disagreed with statements pertaining to the PDP modules. The aim of this section was to see what value the participants placed on the PDP modules and how they could be improved upon in the future.

In questionnaire 1 (question 16), 92.7% of participants agreed or strongly agreed that PDP has helped them develop their soft skills. This was further assessed in questionnaire 2 (question 13). Figure 4.5 shows that almost all the participants (96.3%) agreed that the PDP modules helped them develop the skills they needed in their technical modules. This follows on from questionnaire 1 where 85.4% of participants agreed or strongly agreed with the statement, 'I can see how the skills I've developed in PDP can be used in my engineering subjects'. Figure 4.5 also shows when asked if they could have developed professional skills to the same level without the PDP modules, 62.9% were on the agreement side and 37% on the disagreement side. Similarly, when asked if participants could have developed the skills needed in the technical modules only, 55.5% were in agreement and 44.4% in disagreement.

Q13. For each of the statements below, choose to what extent you agree or disagree.

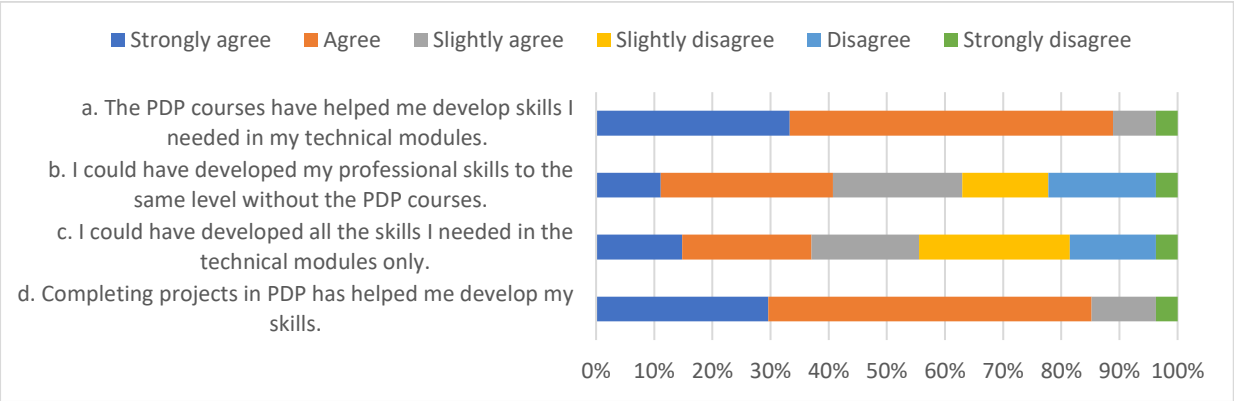

Figure 4.5: Questionnaire 2, question 13- Statements regarding skills and the PDP modules

From the results above, an argument can be made that the participants did not read the statements 2 and 3 correctly. This assumption can be made due to the fact that in statement 1, the participants are almost all in agreement that the PDP modules helped them develop the skills they need in the technical modules, but in statement 2, two thirds of the participants are saying that they could develop professional skills without PDP modules. In statement 3, participants similarly seem to have misread the statement as there is slightly more agreement than disagreement (55.4%:44.4%) that the skills could have been developed only in the technical modules, which again disagrees with statement 1. Peytchev and Peytcheva (2017) discuss the idea of measurement error due to survey length, where the longer the survey, the more tedious it becomes for the participant and therefore, the greater the error. This could possibly be an issue here, as this question did appear near the end of the survey, but the software expected the survey to be completed in around 7 minutes. This researcher believes the reason for this error is twofold; firstly, not reading the question carefully which is a common issue with the participants and secondly, the participants perceiving what the correct answer should be or what the researcher expects them to say. This could be part of power dynamics and unauthentic answers mentioned as a potential issue in the methodology (Banegas and Consoli 2020). Another point to note is in statement 3 it asks, 'I could have developed all the skills I need in the technical modules only' and raises the question of how the participants interpreted all the skills; was it technical or soft skills, or majority technical skills or majority soft skills. Because PDP can be seen through multiple realities (Waring 2021), it is valid to understand the differing perspectives on this statement. Additionally, thinking through the lens of constructive alignment (Biggs 1996), development of soft skills may not have been seen as something which the teacher of the technical modules wanted to develop with students in the learning objectives, so the students may not have understood if they were developing these skills or not. Therefore, it is possible that

the participants of this study were not aware of the soft skills they were developing the technical modules and so could not answer this question accurately.

To help answer the interdisciplinary aspect of research question 1, participants were asked the extent to which they agreed or disagreed with the following statement in questionnaire 1: 'Completing interdisciplinary projects has helped me develop my soft skills'. 87.8% of participants agreed or strongly agreed with this statement. In questionnaire 2, it can be seen in figure 4.5 participants were asked a similar question in statement 4. Here, 85.2% of participants agreed or strongly agreed that completing projects in the PDP modules helped develop soft skills. The literature review commented on a range of project-based tasks and assessments that developed soft skills and more recently Almulla (2020) has discussed the need for project-based learning (PjBL) to increase student engagement. He discussed some of the skills that PjBL developed including collaboration, knowledge share and authentic learning, and as this produced engagement, this also developed lifelong learning skills which were discussed previously. Beier, et al. (2019) also credited PjBL as an invaluable resource for helping students develop their STEM careers and skills through authenticity of real-world projects.

Continuing on from this theme, participants were asked in questionnaire 1 (question 16), the extent to which they agreed or disagreed that the PDP modules prepared them for academia, employability and the professional workplace (Figure 4.6). These three statements were added based on Clegg and Bradley's (2006) models of PDP.

Q16. How much do you agree or disagree with the following statements? (Please choose one option for each statement.)

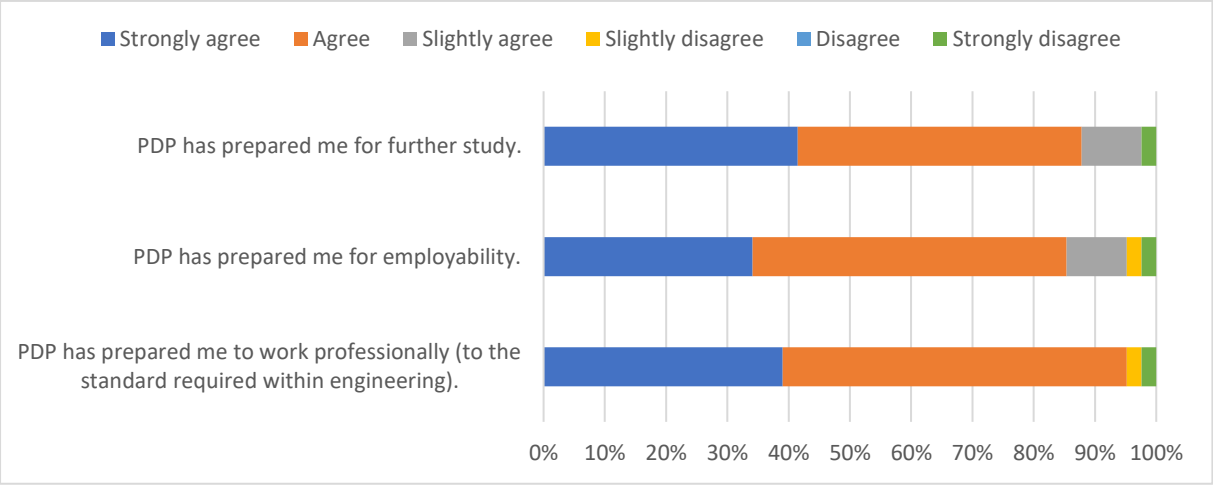

Figure 4.6: Questionnaire 1, question 16- statements about PDP, employability and the workplace

Figure 4.6 shows 87.8% of participants agreed or strongly agreed that the PDP modules prepared them for further study, 85.3% agreed or strongly agreed that the PDP modules prepared them for employability, and 95.1% of participants agreed or strongly agreed that the PDP modules prepared them for the professional workplace.

To determine the value of the PDP modules from the participants' point of view, questionnaire 2 (question 14) asked participants to consider how important they considered PDP to be in the following statements (figure 4.7).

Q14. How important was it for you...

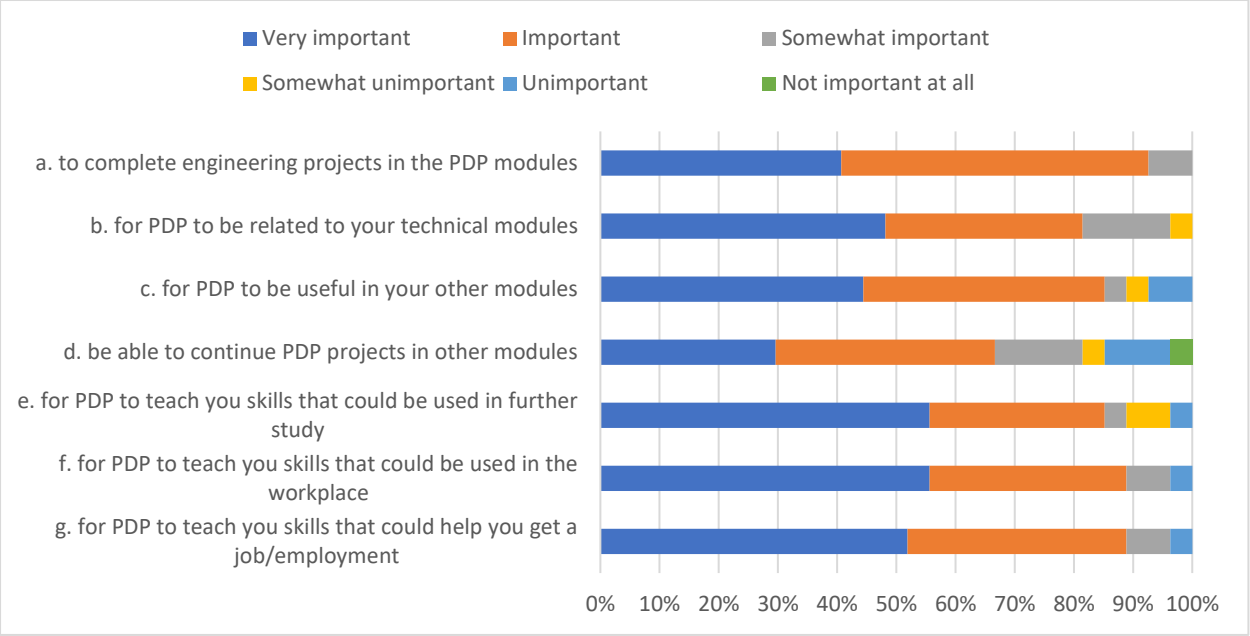

Figure 4.7: Questionnaire 2, question 14- Importance of PDP in different aspects

Figure 4.7 shows that over half participants thought it was very important that the PDP modules taught skills that could be used in the workplace and in further study (both 55.6%) and to help them get a job/employment (51.9%). Comparing this to the answers in figure 4.6 it can be seen that participants not only feel that the PDP modules have helped them develop their soft skills for employability and the workplace, but it is also important that these modules do this. This means that PDP modules need to develop beyond the basic soft skills that are often associated with personal development. They need to become tailored for students so that students are reaping the full benefits of PDP modules and are also finding them meaningful. This researcher is a major advocate for professional skills and development and believes that to develop work-ready graduates, tailored

PDP modules should be included in every undergraduate course, specific to the students' needs as well as industry and employment that those students will go into. With the recent rise in the promotion of graduate attributes at universities, universities should be doing more to develop the professional skills of students, especially in engineering. The recent National Student Survey (NSS) results show that in engineering there is a positivity rate of 83.9% for the question, "How has your course developed your knowledge and skills that you think you will need for your future?" (Office for Students 2023). Whilst this might look very positive, this researcher would argue that this survey is not asking a specific enough question as it covers 'knowledge and skills' and therefore, not asking students to carefully consider their skills. It is more likely that respondents to this survey and thinking more about their hard skills, or knowledge that they have developed. As graduate attributes are a hot topic now, the NSS should be asking more specific questions if there is really a focus on addressing the graduate skills gap.

To identify improvements that could be made to the PDP modules in terms of content, questions 15 and 16 (in questionnaire 2) asked participants to think about which skills were not developed or missing from the module. Question 15 asked participants to identify any skill that have not been developed during the PDP modules. 63% of respondents said there were no skills that has not been developed. 3 participants said leadership skills had not been developed. Arguably, leadership skills could have been more significantly focussed on during the PDP modules, but it would be interesting to know if these participants had taken on the leadership role in one of the projects of not, and if not, why, and is that why they believe leadership has not been developed. Reflecting on the answers that were given in this section, this researcher believes that participants perhaps listed skills that needed improving in the future, but not something which had not been developed at all as the following quote summarises,

> *"All my skills have been improved. However, my skills in public presentation and speech I believe still need to be significantly improved. Making a good presentation is very important for our studies now and in the future. However, I do not feel that I have the ability to give a good presentation".*

Two participants did add skills that would be classed as hard skills as they are knowledge related. One wanted to learn modelling skills (which is already covered in two other technical modules) and one wanted to develop business knowledge (which is covered in PDP3). However, two participants did add comments relating to personal, emotional developments: confidence and how to deal with failure. For a while now this researcher has considered the need and value of adding more

developmental emotional skills to the PDP modules and now this shows that participants would see the value in this.

The answers given above would have been more suitable in question 16 which asked participants if there were any other skills that they would have liked to develop. Interestingly from this question, the workplace was mentioned most frequently in this question (by 5 participants). Being able to communicate with a professional content and with professional, workplace skills, future career development, application of knowledge and employee rights in a company were mentioned. This shows that participants at this stage in their academic career are interested in the workplace, even if they are unlikely to go there straight after graduation. Whilst it would be useful to add some of these elements into the PDP modules, it would be more valuable perhaps to create a PDP module for master's level which could work with industry to develop these skills. Although literature already discusses some in China (Xiao 2020, Yi and Tang 2023), this researcher believes these do not go far enough in terms of developing professional skills. There also seems to be a focus more on the inventions or knowledge coming out of the universities, rather than a focus on developing talent to go to work in industry. This is where the development needs to happen. It is this researcher's belief that talented graduates should be nurtured in industry and developed within a company rather than industry trying to attract high achievers, already with a wealth of experience. Innovation is a driving factor in university-industry collaborations, but these collaborations were found to negatively affect the innovation efficiency (Hou, et al. 2019). In addition to innovation being a driving factor in industry-university collaborations, there are two other factors of note: proximity and the government. It was found that the closer the university and industry is, the better able to promote collaboration and enhance entrepreneurship (Shi, L. and Wang 2023). These authors also found that to harness university-industry collaboration, a more dynamic approach needs to be taken in China by setting up off-campus activities to combat the issue of proximity. This was also expressed by Zhuang, et al. (2021) who discussed university-industry-government relationships and first discussed the positioning of resources in China, categorising the "strong east and weak west" and "south fast, north slow". As a significant portion of industry lies in the southeast of China, for universities like Mountain, which is in the northwest, it is harder to find industrial partners. Zhuang, et al. also commented on support from the government will enhance movement of innovation and resources, and cooperation between regions developing the whole country. Government funding also enhances innovation efficiency (Hou, et al. 2019). The literature surrounding university-industry collaborations shows innovation at the heart, but this researcher believes that innovation also comes from soft skills development because it is with critical thinking, problem solving and solution finding using knowledge that pushes forward innovation. It is therefore important to show these to collaborators

and encourage more industry partners to also focus on soft skills development as part of improving innovation efficiency. Hou, et al. also point out that research institutes produce better team players because of their diverse experience and teams, meaning that collaboration with industry is easier for them than with universities who have academics who work alone to conduct research. This again shows the need for soft skills development in universities and by implementing PDP modules and showing the link between hard and soft skills can improve collaborations at all levels.

The final two questions in questionnaire 2 (questions 17 and 18) aimed to get a final evaluation of the PDP modules from participants. Question 17 asked participants to rate the likelihood of recommending the 3 PDP modules to other undergraduates. All but one participant rated at 6 or above on a scale of 1-10, 10 being definitely recommend. A third of the participants gave a 9 or 10 recommendation which shows the participants do see the value of the PDP modules. The one student that gave a low recommendation, gave 3 and in the comments about the PDP modules they wrote,

> *"I wished it could focus more on technical problems. It is not that I look down on commercial skills, but it is too far from me, and I lack time and energy. Most JEI students get employed more than 3 years after they graduate from the JEI, so during our undergraduate time, we want to focus more on technical skills".*

This shows the perception that hard skills are more important than soft skills and knowledge is power. However, this is untrue for employers (Winterbotham, et al. 2018). In an environment as competitive as China though, it is understandable why hard skills and knowledge are rated most important by students. It is interesting that this participant noted that there was a three-year gap between graduation and employment, which means their career plan would be to go on to study a master's degree, which is up to 3 years in China (Higginbotham 2022), so learning professional skills is not important now. However, Chinese employers are reporting a lack of soft skills in potential employees, so are unhappy with this situation as they are unable to find quality employees (Chan, J., Goh and Prest 2015, JP Morgan 2016). Whilst professional skills and personal development have been seen in international programmes (Goodliffe 2005, Baker, Perkins and Comber 2014, Singh, R., et al. 2019, Dorazio 2020, Reedy, et al. 2020), in China there is a still a focus on knowledge and research. Master's students need to undertake "practical studies", i.e. projects within industry, so there has been some development towards developing professional skills (Yi and Tang 2023). However, these industry-university partnerships are mostly focussed on project-based learning, which the PDP modules in this study have as part of the pedagogy. Additionally, the development of professional skills is being left up to these industry partners and for those that do not go to industry

for training, there is still a gap in the development of professional skills. It is also unclear what professional skills the master's students in this study are actually developing and how they are made aware of their skills development. Therefore, from the quote above, it shows this participant's knowledge of employability is lacking, and they could potentially find it difficult to become employed if they do not develop the understanding and recognise the value of learning professional skills through the PDP modules.

Finally, question 18 asked for any additional comment regarding the PDP modules. There were positive comments such as, *"In general, this is a very helpful subject for me, especially the lectures given by some teachers who are experienced in their respective fields, which gave me a lot of real examples for reference."* Another participant echoed this by saying, *"I really appreciate the guest lectures in the PDP!"* Three other participants mentioned the usefulness of the PDP modules or how much they enjoyed them.

Of course, improvements were suggested. Firstly, the COVID-19 pandemic was mentioned, *"Online courses have a significant negative impact on courses such as PDP, which may have a significant impact on my evaluation of this course".* This is to be expected as the participants received 5 and a half semesters out of 6 online due to travel restrictions. It is good to see this participant reflecting on the effect that COVID-19 has had on their learning, but being able to reflect does show that the participant has gained some skills from the PDP modules as reflection is a key part of personal growth. It also shows that the value of the PDP modules and skills development needs to be enhanced in the modules, so it would be recommended to highlight further to students the skills they are developing in each class or project, and why these are important for them as a student, as an employee and as an engineer.

Three comments were made regarding the syllabi and structure of the PDP modules. Firstly, regarding the syllabi, *"PDP consumes too much time. It would be better if there were less projects"* and *"I don't think the business part is that essential. I need more help for academic career. Maybe we can set more lessons in PDP 2 for those skills and put CV CL or interviews into the PDP3".* This shows the participant's perception of PDP and what is required by industry is lacking. Because they are unable to see the value of PDP, it is stopping them from understanding how the modules are structured to help them succeed academically as well as in the workplace. Additionally, for each year-long module there are a maximum of three projects for the students to complete and changes have been made recently to develop joint projects across modules to reduce assessment and focus on the development of skills. Secondly, the number of students per class, was noted in the comment, *"All nice. If the learning mode of PDP can divide students into small classes like academic*

English, that might be better to help each student to improve their soft skills". Because the programme is joint and there are partner universities, there are constraints regarding the amount of change that can be made to the modules. Whilst changes are permitted within the content of the modules, logistical changes such as reducing the class size are extremely challenging. Reducing class size would be ideal from a pedagogical point of view and class sizes of 60 have been trialled previously for a semester with the classes being taught four times, but this was difficult in terms of timetabling classes due to the number of other modules students take and also staff availability. To reduce the class size to 30 (the same size as academic English classes) would be currently impossible.

4.6 Summary

To conclude, the findings chapter aimed to help answer two research questions: *How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students?* and, *what soft skills do students develop?* The findings show that from the two questionnaires conducted, the PDP modules have benefited the students in the development of soft skills. Participants developed a variety of skills during the PDP modules that are suitable for use in further study, the workplace and employment. Participants developed people and personal skills, and technical and practical skills (Winterbotham, et al. 2018) all of which participants attributed to completing the three PDP modules. The study has also shown that by analysing the effectiveness of the PDP modules, there is a clear path to developing these for the benefit of undergraduate students.

The aim of this chapter was to analyse the results in order to start suggesting recommendations for the development of the set of PDP modules in undergraduate study. The following three recommendations are suggested:

1. To include PDP modules into undergraduate courses focussing on specific skills students need.
2. To tailor the PDP modules based on the need of students and the socio-cultural factors affecting them.
3. To highlight the skills that are being developed clearly in each class or project and how they relate to being a student, an employee and an engineer.

Chapter 5
Findings Part 2

5.1 Introduction

This chapter discusses the findings from the 15 semi-structured interviews that were conducted with participants from a joint education institute (JEI) between Canal and Mountain universities who had been taking the three personal development planning (PDP) modules as part of their degree programme.

As discussed in the methodology and methods chapter, the semi-structured interviews were developed based on the answers given in the two questionnaires, findings of which were discussed in chapter 4. The interviews were conducted as the participants begin their final year (fourth year) in the JEI and had therefore completed the three PDP modules over the previous three years, thus aiding the longitudinal nature of this study. Prior to the interviews, the participants were asked to review their engineering logbooks as the aim of the was reflective, and then they were all asked 13 questions (see appendix 4). Nine participants were also asked an additional question as it become necessary to ask about COVID-19 based on responses from the previous interviews. The interviews aimed to answer research questions:

1. How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students?

2. What impact, if any, does the interdisciplinary aspect have on preparing students for the workplace? and

4. How might these skills benefit students academically, professionally and in the workplace?

The aim of this chapter is the analyse the findings from the 15 semi-structured interviews that were conducted in this study and discuss reasons for these findings. Thematic analysis was used, and three main themes emerged from the data: skills development, educational approach and a sense of self. Each of these will be discussed along with sub-themes and conclusions and recommendations will be given at the end.

5.2 Theme 1- Skills development

5.2.1 Skills for Academic Success

Time management

Time management is a vital skill for Chinese students, especially when they join the university. This is because previously, their time has been dictated to them by their school or families (Zhang, Y. 2021), but when they move to university, they become more autonomous and therefore need to start to learn to manage their own time as discussed by interviewee 8,

> *"During my high school, all of our time timely schedule is determined by a super teacher and after we come into the university, there is so many things…[like] the study or other things. So we should take our time, then make our time, our study, or our life more efficient."*

It is not just study time either, the students also need to think about all aspects of their daily life and independent living including cleaning and personal hygiene and mealtimes as mentioned by interviewee 2 who talked about their personal time management when they said, *"…how long should I take in my lunch so that I don't get late for classes and meetings."* Therefore, the need for students to develop time management skills is crucial for their success academically, in daily life and in the workplace as noted by the interviewees. This shows the transferability of skills to different situations and how PDP can help teach a variety of skills in different contexts.

Presentation and writing skills

The interviewees also mention the development of their presentation and writing skills, especially regarding assessment and project work. Interviewee 7 comments,

> *"I improve these skills through the PDP training. We have a chance to do the academic writing and you can give us some guidance. When we made some problem we can ask for help…Due to the PDP course I can have chance to give a presentation and if I don't have the course, I have no chance to do that."*

Oral and written skills are of key importance for undergraduates as they are expected to use these to demonstrate their understanding of their core subjects. In addition to this, engineering students are often asked to present their ideas or complete research on an area and write it up to a mixed-level audience meaning they need to communicate their ideas to technical specialists, non-engineers and lay people such as customers (Brunhaver, et al. 2017). This shows that project-based learning is the most beneficial for developing these skills because not only do students get to practice the

essential academic written and oral communication skills, but they also develop professional skills such as project management, which will be discussed next.

5.2.2 Professional Engineering Skills

Project management

Project management is a key skill for engineers as they work mainly on specific projects for a specified time with a budget, a number of resources and people. Therefore, time, money, resource and people management as vital. In addition, it is part of the requirements to become a chartered engineer to have demonstratable project management skills (Engineering Council 2020b). Project management was mentioned by a third of participants in the interviews. They mentioned specific tools to help them with their planning and time management such as a Gantt chart. As mentioned in the first sub-theme, students identified time management as a tool for academic success, but it was also mentioned as part of project success as interviewee 11 says,

> *"[For the material library project] The teacher requests us to manage the project in advance, like before the winter holiday and make proper project management. But in reality, we didn't plan that perfectly. We actually started the whole project like three or four weeks before the deadline. And just through that extensive work during those four weeks, it was tremendous pressure. You know, it's a lot of other courses going at the same time, but it trains me. Really, the skill of teamwork with some of the group members and the time management in a short term, in a large extent, I think the project is well designed."*

Interviewee 11 also describes a project that they are currently working on, in their fourth year and how project management has helped them.

> *"But this year, I think all the soft skill at learning PDP can really, you know, play their role. And in this semester [in the ceramics course] I just designed it. It's true. I mean, I just have a clear project management. I'm not really rushing into it. Want to finish it in a relatively short term? I just desire it in a relative long term, like six weeks. I designed the division of labours to six members of the team. And assign a different work to the group member and set different deadlines and it actually works. I'm sure because it's, you know, the deadline. I'm not sure whether the outcome is decent or ideal or not, but I think the process is much more easier for me. And I think in this way, in this specific example, I think the soft skill I learned in PDP really helped me."*

Here there are two examples of the student using project management in engineering-based projects. Not only that, but it is also showing how the skills and lessons learnt in PDP2 have enable the student to employ project management more successfully in a technical module. Ballesteros Sánchez, et al. (2017) also discussed the need for the development of soft skills for engineers as there is still a prevalence for teaching hard skills in project management courses. This shows that PDP modules are necessary, and project management is a key skill to develop for engineers to use in technical projects.

As mentioned, a part of project management is people management, and just like interviewee 11 noted, 87% of other interviewees discussed working with others in their projects. However, what was interesting is that not only did respondents mention working in a group, but they also went on further to discuss the finer details of teamwork related to project management and individuals within teams. For example, 6 interviewees discussed learning to divide group work to the strengths of each team member.

> *"So, we need to work together and divide the work into some different parts. Everyone should do their best for their own direction, you know. Maybe someone who is good at speaking, speaking out, or someone is good at searching for information. So, we can try our best and to make a relatively better end" (Interviewee 1).*

Here there is acknowledgment that each person in a team has different skills, and teamwork therefore works better if the strengths of individuals are identified, and work is assigned accordingly. This also shows that the topics covered in PDP1 and 2 regarding individuals in teams have had a positive impact on students and they have used this in their own teamwork (see appendix 1). Being able to develop this skill at university for engineers is key as Wolniak (2022) discussed the importance of knowing people's characteristics and skills when it comes to managing engineering teams. Therefore, if students are able to learn this in PDP modules and implement it during their time at university, it will give them an advantage in the workplace as they already understand the concept of managing a team.

Further to this, two interviewees discussed team dynamics. They mentioned the fact that in the PDP modules they had learned to listen to others in their group, voice their own opinions, be respectful of others, have patience and also know that sometimes conflict may occur in teams. This shows deep understanding of the skills needed to work effectively as part of a team and therefore be successful in completing a project. The ability to understand one's own performance in relation to the team and how a team needs to function harmoniously, is an important part of leadership (Ghimire 2023), which is needed to be a successful project manager.

Critical thinking and problem solving

Critical thinking and problem solving are key skills that engineers must develop in order to be competent and be professionally registered as discussed in the literature review and introduction (Engineering Council 2020b) . It is interesting to consider that when interviewees were asked what skills they had developed in the PDP modules, these skills were only mentioned 4 times. However, when put into the context of engineering, the response rate doubled. This could be because students are taught that they need to be critical in all of their subjects and it is one of the first skills they are taught at the JEI as expressed by interviewee 9. They also continued by saying,

> *"To begin with, is to think professionally. When we enter the university we don't develop a mindset of engineering thinking and that helped me to like think critically and think more logically… The most important one is like a critical thinking skill because as an engineer, you have to create something or to be innovative and critical thinking skill is like you have to think yourself and use the knowledge you've learned to be more and not follow the other people's path."*

This shows the need to teach critical thinking to undergraduates, because in this context students do not come to the university with this skill. It is also important to develop critical thinking in an engineering context which is why PDP modules are important and they should be designed in a cross-disciplinary way which will be discussed in the next theme.

When it comes to problem solving, interviewee 7 made an extremely discerning comment which identified to difference between problem solving as a skill and problem solving as an engineer when they said,

> *"Because in the PDP course we need to solve the problem you give to us, but in the scientific we don't actually figure out the specific problem. And I needed to find out the problem. So the PDP course just split the many problem, but when we do the science research we need to solve many problem and they are complex. However, in the PDP course this problem was split one by one and we just solve one part and so I think this is a gap."*

They further continued by adding, *"The skills [are] to find out the question and the use teamwork and to solve the question we find out."* This shows a high level of understanding of what engineering thinking is and how it is developed. The interviewee notices that the problem solving used in PDP is much more structured, whereas in the technical modules it is freer. However, this would be expected as the aim of the PDP modules is to start the development process of problem solving and developing that critical and creative thinking that engineering students need. It is then the students

that need to take that base and evolve it using their technical modules and their own personal development and growth throughout their university degree. This is illustrated by interviewee 13 who says,

> *"I think the skills that we have learned, we have tried to develop in PDP class is maybe the important part that we lack awareness in our previous study. And it's the thing that we learn PDP not only give us an idea about how to develop them but also give us a very effective approach to enhance, to improve that skills."*

5.2.3 Employability skills

The interviewees mentioned a variety of skills during the interviews which this researcher would regard as employability skills. 4 interviewees mentioned developing cover letter and CV writing skills, whereas, professional attitude, workplace values, job skills and professional skills were all mentioned by one interviewee each. As discussed in the literature review, employability skills refer to generic workplace skills (Clegg and Bradley 2006). This researcher would therefore argue that the skills mentioned above fit into this category for two reasons; firstly, writing a CV and cover letter is a necessary generic skill to become employed and secondly, without context and specific examples, the other skills mentioned cannot be classed as professional skills (Specific skills being taught for a specific career and having evidence (through assessment) to demonstrate these skills (Clegg and Bradley 2006)). One of the aims of the PDP modules is to develop employability skills and the responses here clearly show that this aim is being met.

There are two further examples of this mentioned during the interviews. Firstly, interviewee 4 recounted their time they were able to use and develop their soft skills by becoming a volunteer during the COVID-19 pandemic when they said, *"I was thinking my soft skill was also enhanced because I also work[ed] as a team member and I was allocated to convey water and during that process I did communicate with two men is generous[?]. And also my confidence was also improved."* This recognition of transferring skills from one situation to another is important as it shows adaptability which is an important employability skill. Sony and Mekoth (2022) noted the extreme importance of adaptability in their study looking at the successful implementation of Industry 4.0. They discussed six concepts of adaptability which are essential for employees to have to realise Industry 4.0. For the participants of this study, this is particularly important as they will be the engineers effecting this change, so they should be confident in handling and adapting change in a work environment where technological development is key.

Secondly, whilst graduates of the JEI do not generally go straight into employment, they do seek further study which is common with 82% of Chinese undergraduates (De Perlaky and Watts 2018), therefore showing the need to employability skills as they need to apply and interview for courses. This study saw all 15 interviewees say they were going on to further study after completing their bachelor's degree and interestingly the PDP modules had helped them stand out in a very crowded market. When comparing themselves to the equivalent students in Mountain University, the interviewees identified that they had stronger skills.

> *"I compare with myself with them [Mountain University students] I realised that I do have more chances to practise on my soft skills such as presentation and paper writing. But what we [JEI students] lacked is hard skills, such as how to conduct an experiment, and the hard knowledge. We're not really sufficient about the knowledge but talk about soft skills, I think I'm quite confident about soft skills" (Interviewee 2).*

This shows the interviewee understands that they have clearly developed soft skills and this is due to the pedagogy of the course (discussed in the next theme). This was reiterated by interviewee 3, *"in this summer I participate in many interviews of many universities. My behaviours are relatively very good compared with all university's students. And through the discussion, I think the British teaching model really tells me many things".* Interviewee 3 goes on to mention the interest that the JEI received from other institutions and makes the comparison of English language ability and confidence in presenting, concluding, *"I know that many students at other universities or other colleges they are very unconfident".* Interviewee 1 also widened this train of thought when they compared themselves to other students at top universities in China and reflects on the fact that students at the JEI entered the university with a lower Gaokao score (university entrance exam), but *"I found some resolution like we have more soft skills than other Chinese students. And typically, like searching information, typically like academic English we just act better than them and if they have enough soft skills for PhD, so we can".* Finally, interviewee 15 summed up their abilities for further study by saying, *"I'm quite confident because I really learned a lot from PDP".* This shows the unwavering support for PDP modules to help prepare students for further study, give them confidence in their abilities and 'be better' than students who do not have the benefit of these modules. This is also shown by Balcar (2016) who identifies that in the job market soft skills are just as important when it comes to wages. Balcar also found that hard and soft skills need to be developed and used together in the workplace to be most effective. It can therefore be argued that adding PDP modules to university degrees bridges the gap between hard and soft skills, but the key is the ensure the PDP modules are tailored to the degree programme.

5.3 Theme 2- Educational approach

5.3.1 Interdisciplinary education

Interdisciplinary education is a key part of the PDP modules as it aims to promote cross-disciplinary learning i.e. where one discipline is used in another (DeZure 2017). This is because this researcher believes that context is needed for skills to be developed. In other words, soft skills cannot be developed in isolation. This is also echoed by Hattie and Donoghue (2016). The data collected in this study shows that the interdisciplinary approach benefits students as mentioned by interviewee 3,

> *"project-based learning is very common in PDP courses because I think almost every coursework about PDP is based is a project based one …it give me preliminary practise about it so that I can more effectively do the coursework about the science and engineering".*

Similarly, interviewee 6 said, *"what I learned in the PDP course I can also use it on different courses. Such as how to make a good PowerPoint or make a good presentation as well as the posters and some safety rules in the laboratory really helps me, especially in the material experiment".* This shows the need for PDP modules to be specifically designed for the overall degree programme.

This researcher also believes that the interdisciplinary nature of the PDP modules benefits the educators as well. Firstly, soft skills are often not taught in technical modules. This was ascertained in the interviews when participants were asked, "Do you think you could have developed the soft skills that you need in your technical modules only so without the PDP modules?" and 13 out of 15 categorically replied *"no".* This is exemplified by interviewee 13, *"I think in the like the scientific course that I have taken is more focused on the hard skills".* Interviewee 9 also comments,

> *"I think the technical modules, they basically helped us to focus on the engineering knowledge and they don't really develop some soft skills for us. But I think PDP courses helped us to develop soft skills more than other courses. For example, in the first year I learned how to write academically in the PDP course and this really helped me to write my module report in the second year of many engineering courses."*

Finally, interviewee 10 reported,

> *"When I learned those [technical] courses I it seems like I can just learn about some theoretical knowledge or I just to know how to do the experiments. But honestly, they are not helpful for my like other areas of learning [in] English, it just teaches me how to get a higher degree".*

What is of note here is that the interviewee is able to discern that in order to learn in the JEI using a different pedagogy, soft skills are also needed and by just taking the technical science and engineering courses, they are only learning knowledge related to one subject per class which therefore shows the need for interdisciplinary education and PDP modules to support this new learning approach.

Secondly, it seems that educators just expect the students to be able to perform academically and use soft skills as interviewee 1 said, *"you know about advanced chemistry, he will never tell me how to work hard together and how to do you lab safety work. It is so basic so that they will never tell me".* Interestingly, this participant identifies teamwork and lab safety as basic skills for students, so technical engineering modules will not teach them. Interviewee 5 also says that besides PDP they do not have another way to *"learn this professional basic",* when referring to soft skills, especially teamwork. This shows the need for PDP modules to support the technical modules and let those modules focus on developing the knowledge that these students need in their science and engineering subjects. Interviewee 10 would agree with this as they said, *"I think the soft skills means I can do well in the courses that closely related to my major".*

Often in engineering education, hard skills and knowledge development are still the focus and technical science and engineering modules do little to remedy this. However, interviewee 6 does acknowledge that, *"to be an engineer…technical knowledge is not enough".* The importance of developing soft skills was also echoed by interviewee 14, *"The best way to develop the skills is to combine both theories and practise".* These insightful comments from participants show the understanding that soft skills development is vital, and this is starting to be realised by universities more and more through the recent rise in the push towards graduate attributes and discussed in the literature review in the work of Wong, et al. (2022). A further point of note though is how graduate attributes are now being examined and strived for in China. This has been implemented in Mountain University as a requirement of the Ministry of Education (Ministry of Education and People's Republic of China 2024) following on from President Xi's speech to address graduate unemployment (Packer 2024). This shows that graduate attributes are now a global phenomenon further demonstrating the need for embedding soft skills into the curriculum (Majid, et al. 2019), or in this researcher's view, embedded PDP modules in degree programmes.

5.3.2 A student-centred approach

The pedagogy employed at the JEI is a student-centred approach focussed on active learning with some classes uses a flipped approach, but for PDP, a project-based learning approach is used to develop soft skills. As discussed in the literature review, Chinese students who enter the JEI have been used to a teacher-centred pedagogy and the 'teach-to-test' method (Lu, R., Goodale and Guo 2014). This means when they enter the JEI they are unfamiliar with the student-centred approach, it can be a challenge (Jiang and Kosar Altinyelken 2020) and this can take time to adjust to. However, Wang, Shutao and Zhang's (2019) research found that a student-centred approach promoted deep learning and improvement of Chinese students' abilities, especially in large classes. This is important as classes in the JEI are taught in groups of 120 students (except for English language classes) and use a student-centred approach to promote active learning. Jiang and Kosar Altinyelken (2020) highlighted that when Chinese students study using a foreign pedagogy, lecturers need to provide more support for learners to become acclimatised to the new way of learning and skills required, which shows the need for PDP modules. Additionally, Magano, et al. (2021) discussed the need for project-based learning to develop soft skills in Gen-Z students as part of an innovative educational approach. This is important as the new generation of students have different skills and abilities, so these should be taken into consideration when designing and developing undergraduate degrees. With a project-based learning approach, teamwork is a must in PDP and whilst the participants in this study all said they developed teamwork skills, the interviewees also discussed the challenges of teamwork by saying, *"So I think is a kind of challenge since when I think it in PDP in year one, we all hate the group work but I think till now I accept this and I learn a lot from the teamwork. So I don't think it's it is a bad thing"* (Interviewee 8). Shi and Mohamad (2020) studied Chinese students in petroleum universities and found that mutual trust and leadership style has a positive, significant influence on teamwork success. This researcher would argue that interviewee 8 mentions specifically 'hating' teamwork in year 1 but had accepted it by year 3 and this is significant. As student have progressed through university, they have developed collegiality with their fellow students and therefore the mutual trust mentioned by Shi and Mohamad, which this researcher believes is one of the reasons for this development. This is also echoed by Van Horne and Rakedzon (2024) who noted that teamwork increased friendships in their study of Chinese undergraduates.

In addition to this, this research believes that the curriculum used in PDP has helped students become more familiar with this student-centred approach. In addition to using project-based learning to reflect the work of an engineer, key topics are repeated and developed yearly so that students become more familiar and comfortable with them, especially if these are new concepts. These skills include technical skills such as lab safety, but also the topic of teamwork. In each year of

PDP, a different aspect of teamwork is discussed to aid students in developing this key soft skill. For example, in year 1, types of team member are discussed (which affects team dynamics), leadership skills are discussed in year 2 (which aligns with Shi and Mohamed's observation on leadership styles) and in year 3, teamwork is discussed in terms of company structure and hierarchy, so students are familiar with workplace dynamics. By including these topics in the PDP curriculum at different stages throughout the degree programme, it is helping develop the skills needed so that students become comfortable with teamwork and can accept it as part of their university career as noted by interviewee 8.

In addition to the pedagogy and curriculum, the delivery of these modules needs to be carefully designed as students in the JEI have never taken any course like this before. Because of this, the educators need to ensure they utilise transformational leadership. Bush (2018) says that transformational leadership is where, "leaders persuade followers to adopt certain behaviours in order to bring about what the leader regards as beneficial change." Now usually, this is discussed in terms of organisational leadership, but this researcher would argue that the PDP modules are designed to promote workplace skills and abilities, therefore the educators delivering these modules should be displaying and promoting transformational leadership in the classroom and through project-based learning. This researcher believes that this is especially true to students who perhaps are unfamiliar with PDP or do not directly see the benefit, especially at the beginning, like interviewee 14 remarks, *"some of the students may think that PDP lectures are very boring".* Budur (2020) discusses the relationship between transformational leadership and culture, but says this is less effective in collectivist societies, which China is described as. However, this researcher would argue that this is not necessarily true because in the JEI, where students are taught using a student-centred approach and in English, there can actually be impactful benefits to students who see transformational leadership in action. This is demonstrated by interviewee 14 as they continued on from their previous statement by saying,

> *"I debate with them that I think PDP lectures told us many important skills which will not be learned in other Chinese lectures. Moreover, PDP lectures give us many practical suggestions [like] in the interview or in other cases, so I think it will be extremely helpful in our future career".*

Therefore, this shows a case of a collectivist culture adopting new behaviours, in this case skills, to bring about a change. Consequently, the need for a student-centred approach with new educational innovations in curriculum and delivery is very clearly needed to develop the soft skills of engineering students.

Moreover, the need for this approach is essential in the context of China, the students and the job market. According to China Daily (Lu, M. and Wang 2024), more than 1 million Chinese students study abroad in a range of Western countries. Therefore, this ability to be able to function in a Western style of teaching is going to be favourable for Chinese students seeking to study abroad as it is more likely that they will succeed. More interesting however is the report from China Daily that since China opened up its' modernisation initiative, there have been more than 6 million overseas students have returned to help develop China's reforms. Therefore, if overseas students are returning and Chinese students in China are to join them in the workforce, then TNE students have a better chance of integration with the methods and skills that have been developed by studying in a TNE programme as they will likely be working with people who studied abroad. Particularly for engineering, China daily reports that in 2023, 39.2% of the new employees at the Chinese Academy of Engineering has overseas education experience. Therefore, there is a clear need for TNE programmes and a clear need for students to be taught using different pedagogies as this will keep them relevant in China's job market.

Additionally, there is a clear need for PDP modules as the skills students are developing in the JEI can be beneficial to them if they choose to study abroad or go to work in companies which are dominated by Chinese overseas returners. Shen, et al. (2023) suggest that to be competitive in the job market, developing professional competence and foreign language ability in addition to making an early career plan is vital for students returning from overseas. Shen, et al. clearly states that it is skills and the working ability of potential employees, rather than academic background. These are the advantages of students who choose to study abroad as they develop these skills, however, for students who choose to be educated in China, without PDP modules, there is a limited ability to develop and practice these skills. It can be seen that in the JEI, these modules have had a dramatic effect on the students and their skills meaning that modules should be mandatory not only in JEIs, but in all university courses to ensure graduates have the required competencies that employers are seeking.

5.3.3 In-person learning

The PDP modules were designed to be taught face-to-face with the students and teacher in the classroom. However, due to COVID-19, stay at home and travel restrictions, this was not the case for the participants in this study. They were taught PDP1, PDP2 and the first semester of PDP3 fully online. The final semester of PDP3 was taught 50% online and 50% face-to-face. In addition, the unique aspect of this case study is that students returned to the classroom in the second year and

the teacher was online, live streamed into the classroom. This change to online learning showed some issues with student satisfaction which is common not only in China but also across Asia (Lin and Wang 2024).

The student-teacher relationship is an important one in China. Liu and Chiang (2019) discuss the importance of the teacher's role in order to motivate students. They discuss the need for the student-teacher relationship as teachers are seen as similar to family members in China and therefore are needed to motivate students to learn. Liu and Chiang go on to also discuss the relationship between motivation and academic performance showing evidence that of the positive relationship between these. The interviewees in this study expressed their feeling about the teacher not being in the classroom, as expressed in interview 14, *"If teachers can in class to teach us, then I can have more interactions with teachers and some of my [confusion] will be solved by a teacher."* Also in interview 13, *"I feel strongly that the students in class, when we are facing [the teachers] we are more enthusiastic to express our idea. We are even happier in the class, …[when] you cannot face a teacher face-to-face it's difficult to express our ideas and our feelings".* This shows how important the face-to-face communication was with students during the pandemic and the effect that this had on their development and possible academic performance.

As the majority of the PDP modules were taught online, the other major negative that was mentioned in five interviews was a lack of interaction with the teacher and with other students. Interviewee 13 said, *"online make class like has less willing to communicate with other students in class",* and this was echoed by interviewee 12 who said, *"interaction between the teachers and the students will be declined…and some students will not come to class".* Additionally, the opportunity to communicate in the class was also discussed, *"just very few students actually discuss with their classmates in English"* (interviewee 11) and interviewee 10 said ,

> *"I didn't have so many chances to communicate with other students… I still don't know how to communicate with others. What's the right mind of expressing my own opinions and if there's no[thing] like COVID-19, I can have more chances to speak to speak to others, so this will improve a lot".*

Zhang and Wu (2022) found that students were disadvantaged with a lack of opportunities to communicate in English in online classes even if tools such as break-out rooms were used. In their study the younger years students were particularly affected, and parallels can be drawn with the JEI students as they were in their first year when the online classes began. However, perhaps there is also a case for the lack of digital literacy at the beginning of the online classes and then digital fatigue as this online situation went on in some form for 2.5 years. Song, Wang and Zhang (2022)

noted that in their study of Chinese students, the "online + offline" model that was employed, academic burnout was prevalent with significant use of an often poorly designed digital teaching and learning environment. Romero-Rodríguez, et al. (2023) also found that digital fatigue had a negative impact on student learning and was highly linked to motivation or lack thereof. They also noted that digital fatigue was elevated by "excessive use of a digital screen". Romero-Rodríguez, et al. also discuss the mental stress and inability to separate work and leisure space which lead to issues with anxiety and loneliness which could explain the responses given by interviewees 12 and 13 above. In conclusion, the face-to-face teaching approach is beneficial for Chinese students as they value the opportunity to build relationships with their teacher and classmates.

5.4 Theme 3- A sense of self

5.4.1 Culture and self

Culture is also discussed in terms of oneself which is pertinent due to the nature of the ontological perspective in this study. Interviewee 1 responded to question one regarding the skills they have learnt in the PDP modules by discussing culture, where they say,

> *"In China, the value system is about, you need to convert yourself to a country, like be kind to other people and the PDP courses told us about the British value system… This just told us how to be a complete person and told us to be a man, told us to be a woman. So it is more about values system we need to improve ourselves to be a good person or act as appropriate English student".*

Additionally, interviewee 1 talks about their education from school to university where they say, *"we are told how to be a Chinese man for 10 years, for 20 years. And suddenly when we go to the college you told us to be an Englishman or a British man".* There seems to be an understanding here that the pedagogy and expectations of students studying using the British method of teaching is different. However, there also seem to be a clash of identity here. The use of the term 'student' here seems to indicate that the interviewee has to change themselves to fit into a different system. This can be one of the hardest things for foreign students studying abroad or in a TNE programme as expectations differ. In an article by Wang, S. (2022) which discusses the 'in-between' identity of transnational Chinese students, the author concludes, "Chinese students are reflexive agents who continuously mediate social relations and transform localities appropriate to the diversity of their identities" (p. 874). This researcher agrees with Wang as the interviews show a complex level of reflection from Chinese students and it is clear that they must have multiple identities to be in a TNE programme. However, those identities can often be in conflict with each other, and it takes a skilful

student to navigate these complexities and switch identities appropriate to the situation. What this researcher also considers is that it is especially difficult for the students in this case study as 50% of the modules are taught by Canal University and 50% are taught by Mountain university meaning two different pedagogies which often conflict with each other, so a reconstruction of identities is a continuous process dependent on the context (Brooks and O'Shea 2021, Tharapos and O'Connell 2022).

One thing that was noted by this researcher is the humble responses when it came to self-development. Interviewees were asked, 'Do you feel confident with your soft skills and personal development?' and out of the 15 interviewees, 6 expressed doubts regarding their abilities, even though they had been keen in previous questions to share the skills they had developed. Examples of this can be seen in interview 6, *"I'm confident with the personal development in the past three years, but the soft skills I think it might need to might need further improve."* This was similar to the response from interviewee 12 who said, *" I need to continue to develop myself."* Interviewee 1, *"if I need to give it a score, I will give it about 80. 80 is a bit high but I'm not so high."* Interviewee 8 described themselves as a *"not very confident person"* and interviewee 4 gave a clear negative response but then began justifying and possibly questioning their own answer. They said, *"Actually no….Florida University that I Inquire for are the best university in this world so, you know, I'm little scared to come there; I can't imagine what people would like this would like there. Or maybe due to I didn't go abroad? So I'm little, I sometimes feel afraid of it."* So, this could actually be a concern about confidence in travelling and not in ability which would make sense if the person had never travelled outside China. Additionally, interviewee 4 said in the previous question, 'Do you feel that you have the required soft skills to take this next step? (master's degree)', *"Yes, actually because, I have already learned how to how to become a professional engineer."* This therefore shows the anxiety is actually coming from going abroad and not their abilities.

However, another factor in this could be the Chinese culture. Interviewee 13 gave a short and negative response, to the question regarding confidence. However, they went on the justify this by saying,

> *"Maybe I think from one perspective, the Chinese are taught to be humble. You should have. You should never be too confident to what you have achieved now and for another things is that yes, I'll I know that I achieved a lot, but I still do not know that was a society where they my supervise or what my teacher expected me to be and I'm still afraid that as I mentioned, there's a gap between their expectation and my point of my level that I achieve."*

This aligns with the Confusion perspective of the need for students to self-improve as reported by Li (2016). To develop this feeling of accomplishment, and to celebrate success in a culturally acceptable way, this is an opportunity for the PDP modules to be developed to include personal development skills such as celebrating success. This is important on a personal level as it helps boost confidence and motivation, therefore improving mental health. Bowden, Tickle and Naumann (2021) discuss how behavioural engagement (participation in class, attendance and professional conduct) is a large motivating factor in self-efficacy and self- esteem which helped students with their employability. This means that developing a system for use in PDP classes based on professional conduct (such as the Professional Practice System) can be highly beneficial for students both academically and in their future careers. The Professional Practice System was developed in the JEI as a means to encourage professional conduct. Students are given the opportunity to display professional behaviours and acquire merits for these as well as demerits for a specified list of unprofessional behaviours. These can then be used as part of assessment or certification for encouragement.

5.4.2 Self efficacy

During the discussion on the effects of COVID-19 on soft skills development, positive growth was mentioned in the form of the development of self-motivation. For the question, ' Do you think your skills development was affected by the modules being online?', interviewee 8 said,

> *"I think it depends on a person. For me, I think if I want to learn something that is not the online or face to face is not really affected to me because if I want to learn then I will try my best to get in touch with professor or just searching the Internet. So I think for me, it's not really have the negative effect."*

Interviewee 9 similarly mentioned themselves when they said,

> *"Not that much because I think all the skills you didn't gain them from your teacher. You basically gain them from your work and your own experience. And that's what you have to do outside the class when you try to figure out and finish all the course homework and all the project."*

Interviewee 15 also noted, *"I think it's doesn't affect a lot because I think for me, I have a lot of chance to practise these soft skills."* This was also echoed by interviewee 12 and 14 who both commented on the opportunities available to use and learn skills. This shows that motivation is an important factor in learning, no matter the situation and these interviewees have shown their ability

to develop lifelong learning skills through intrinsic motivation. It was found by Shafi, et al. (2020) that intrinsic motivation is linked to creativity in employees. Creativity and innovation are essential skills for engineers who have to develop creative and innovative solutions to problems, so being motivated is important to fulfil this job role. Additionally, Li, L. and Zhang (2021) found that in order for students to have a successful online learning experience, they needed to use effective learning strategies like self-motivation and being an independent learner.

Conversely one main negative discussed by interviewees in relation to COVID-19, being taught online and the skills they developed was distractions. Interviewee 13 mentions the distraction of messages and interviewee 4 says, *"I didn't realise the importance of these courses and the people, the people around me, just tell me to play games on the in the classes."* Interviewee 8 said, *"many people will think that there is no teacher so they can do anything they want"* and interviewee 11 echoed this by saying that because of online classes and no teacher being present, *"They (students) don't feel the pressure. Yeah, they're not in the mood to learning extensively."* In a case study of a Chinese University's online provision during the COVID-19 pandemic, it was found that 39.45% of respondents reported being easily distracted when having classes online (He and Xiao 2020). Now even in face-to-face classes, there are issues with distraction, but perhaps having someone who is able to directly look at you, stand by you or ask you a question and bring back your attention shows at least a sense of accountability, whereas in an online classroom setting, there was no-one to fulfil this role. Interestingly, Flanigan and Babchuk (2022) investigated the role of distraction on the educator and found that not only did it affect pedagogic decision, but it also affected the student-teacher relationship negatively and as discussed in the previous sub-theme, this is of significant importance for Chinese students. It is therefore important for students to be able to self-regulate themselves and limit their distractions. However, as noted by Parry, le Roux and Bantjes (2020) this requires a high-level behavioural change which is difficult and was unsuccessful with the participants in their study. This researcher also believes that Chinese gaming culture has an effect on the ability to self-regulate. Even though China created laws to prevent excessive gaming, it has had limited effect and gaming remains high (Stokel-Walker 2023).

5.5 Summary

The aim of this chapter was the analyse the findings from the 15 semi-structured interviews conducted in the JEI. The interviews aimed to answer the following research questions:

1. How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students?

2. What impact, if any, does the interdisciplinary aspect have on preparing students for the workplace? and

4. How might these skills benefit students academically, professionally and in the workplace?

From the discussion of the findings above, it can be seen that research question 4 is answered by theme 1. This first theme shows that the soft skills developed by the participants can be categorised into academic skills, professional engineering skills and employability skills. This aligns with Clegg and Bradley's (2006) three models of PDP. This is important as students need to be able to develop skills in all of these areas as they need to be successful academically, as they are studying for an undergraduate degree, but they also need to be able to integrate into the workplace and into their profession as engineers. Theme 1 shows that the soft skills that have been developed in the PDP modules are highly aligned to the workplace and profession because of the pedagogy used.

Using a project-based learning approach for students has shown that they are able to develop the required soft skills for engineering and as the projects are interdisciplinary, students are able to understand the skills required of engineers and use these appropriately in their technical science and engineering modules, which helps answer research question 1. However, what has been shown is that innovation and new educational approaches need to be used when designing PDP modules to address the new generation of students coming to study. Additionally, the module design needs to take into account the culture of the students and how this may affect their ability to function in an interdisciplinary project-based learning approach.

Based on the findings in this chapter, the following recommendations are suggested:

1. To teach students academic, professional and employability skills related to their degree programmes over a sustained period of time.
2. To teach PDP in-person using a student-centred approach, employing new educational innovations in pedagogy, curriculum and delivery.
3. To take into account the cultural background of the students and the context and the implications these have when designing PDP modules.

Research question 2 has been partly answered from theme 2, sub-theme 2, a student-centred approach as studying using the pedagogy of the JEI is beneficial for developing the soft skills necessary for the workplace, especially with China's modernization strategy and encouraging Chinese people to return from work and study abroad. However, it is clear that further investigation of this is necessary, which the next chapter with aim to address through the documentary analysis of the engineering logbooks and interview questions relating to these.

Chapter 6
Findings Part 3

6.1 Introduction

This chapter discusses the findings from the 15 engineering logbooks of the interview participants along with their interview answers related to this from the semi-structured interviews that were conducted with participants from a joint education institute (JEI) between Canal and Mountain universities who had been taking the three personal development planning (PDP) modules as part of their degree programme.

The engineering logbook was submitted as a summative assessment at the end of PDP3 and aimed to showcase the professional development of the students during the first three years of their degree programme whilst taking the set of PDP modules. This documentary analysis along with the interview questions related to the engineering logbook aim to answer research question 2, what impact, if any, does the interdisciplinary aspect have on preparing students for the workplace? From the analysis four themes emerged: lifelong learning, a record of achievement, a tool for reflection and an application tool.

The aim of this chapter is the analyse the findings from the 15 engineering logbook submissions as part of a documentary analysis, along with the related interview questions that were conducted in this study and discuss reasons for these findings. Recommendations and conclusions will be given at the end.

6.2 Theme 1- Lifelong learning

From the interview question, "How do you think completing an engineering logbook has prepared you for the workplace?", one of the major themes that is discussed is lifelong learning. The interviewees notice that the logbook has given them the opportunity to identify their strengths and weaknesses in terms of skills and has therefore given them an understanding of what they need to improve on. For example, interviewee 5 said, *"I can see that doing this logbook during these three years, which ability has improved and also some aspects that didn't or I need to improve now. So it helps me to know that next step what should I do and in the future which aspect I need to strengthen".* This shows the ability to self-assess and identify improvements which are the foundations of lifelong learning. As mentioned in the literature review, there are two reasons to

develop lifelong learning which are for professional or personal growth and interviewee 10 surmised,

> *"It's [the engineering logbook] not just something related to my specific courses, but more about my life. The lectures I attended or some extra activities that I join in. So the process of preparing for it make me have a clear mind of what I'm done and what I'm going to do in the future. I think it's an important factor of our whole life, we need to have a clear mind of what we going to do. So I think the logbook is really important and necessary."*

This shows the growth mindset that is needed as discussed in the literature review (Dweck 2016).

6.3 Theme 2- A Record of Achievement

Another key use of the engineering logbook was as a record of achievement. Interviewees noted the importance of the logbook for this and recognised the number of entries they had collected over the three-year period. For the interviewees in this study, they submitted between 29 and 56 logbook entries for their logbooks with an average of 36 per person.

Interviewee 3 also made a comment regarding the engineering logbook and the PDP modules when they said, *"maybe we can submit the logbook every year so that we can see the clear progress that we made through the three years".* This shows that the logbook is important, and that feedback is required. Interestingly, this interviewee submitted a logbook with 30 entries, which was the minimum for the assessment so perhaps this shows that they were unsure how to complete this task effectively. Feedback is an important part of the university experience and perhaps, as the engineering logbook was another new concept to the students, they need that additional guidance to be able to effectively use their logbook as a record of their professional development. There is significant literature about giving feedback to students, but ideally feedback should be usable, detailed and personalised (Dawson, et al. 2019). Although the students do submit a work record sheet on a yearly basis to show they have completed the logbook, this is ungraded and feedback is a rubric style that gives hints and tips, rather than detailed feedback. By implementing more detailed feedback each year, it would help develop the students' ability to produce a more detailed logbook. However, in addition to feedback, scaffolding is needed in order to ensure the students know the expectations. Morgan and Skaggs (2016) discuss the need for scaffolding though peer and teacher mentoring to aid students to bridge the gap in their zone of proximal development. Morgan and Skaggs discuss this through project-based learning in engineering which the PDP modules are based on. Therefore, this and the interviewee comments show that students need additional support in producing the engineering logbook as it is again something new which they have not tackled before,

showing a more detailed level of scaffolding and feedback would be more beneficial for the students as can be seen in the reflections which will be discussed next.

6.4 Theme 3- A Tool for Reflection

As discussed in the literature review, reflection is a key aspect of PDP and for professional registration as an engineer and applicants must be able to show a portfolio of work and skills (Engineering Council 2020b). PDP does teach reflection and gives examples of reflective tools such as Gibbs' reflective cycle (Gibbs 1998) and it is expected that students will reflect at different points during their undergraduate journey by using their engineering logbook. The reflection for each entry in the logbook aims to help students identify the skills they have developed and what they need to continue to develop and the action plan for this.

Interviewee 5 added the following comment to their engineering logbook submission,

> *"During summarized these records, I found that the content of reflection from Year 1 to Year 3 had changed and developed, gradually changing from the cognitive questions on posters and speeches to the reflection and feedback on critical thinking, engineers' judgment ability and professional experimental knowledge and skills. This can also reflect the three years of continual professional development, which has gradually changed my understanding of this professional field to exploration and independent thinking in this professional field."*

This in itself is a reflection and shows the development of thinking abilities during the three years. This comment shows a number of skills on show, but with the comment made during the interview, *"So it helps me to know that next step what should I do and in the future which aspect I need to strengthen.",* it shows the development of a reflective approach to skill development. This aligns with the ontology of this study as constructivism and the idea of constructing oneself which is also the essence of personal development.

One thing to note with the reflections in the engineering logbook, is how they develop, through the years. It can be seen in year 1 that participants are still used to reporting the facts rather than analysing the skills and how they developed personally. For example, interviewee 9 attended several guest lectures during their time at the JEI where the reflections will now be discussed. Firstly, the writing style is to use numbered points to write the reflection, with the first 3 points all notes about the knowledge they had learned or the topics that had been discussed. Only the final point noting that they had practiced their note taking skills. As interviewee 9 moved into the second year, it can be seen that they start to use Gibbs' reflective cycle to reflect using the subheading of the reflective

stages. There is, however, a difference between semester 1 and 2 that can be seen. In semester 1, the participant attends a guest lecture on sustainability and uses 4 stages of the reflective cycle: description, feelings, evaluation and action plan. In the description, note taking is mentioned and in the evaluation the listening and note taking abilities are discussed. However, in the action plan, it is simply to learn more about sustainability. In semester two though, it can be noted that the full reflective cycle is used and there is more of a discussion on their personal skills. Finally, in year 3, interviewee 9 attended a guest lecture on project management where they wrote in a paragraph and reflected on a previous group coursework, how work was divided, and, based on the lecture what should be done next time. This shows a real development in reflection, particularly noting the development of the discussion of skills and using what they have learned to put into action.

From the reflections of interviewee 9 and the comment made on the front page of the logbook by interviewee 5 a conclusion can be drawn that reflection takes a long time to develop, practice and become useful. This shows the need for a three-year set of PDP modules to help students develop their abilities during their undergraduate degrees, because without this the question can be asked if students would be able to effectively reflect and develop without being taught how to. Additionally, for students in the JEI, this is a key skill for being able to become professionally registered, so practicing in a safe space at university can effectively prepare them for their later professional careers.

6.5 Theme 4- An Application Tool

The final theme regarding the logbook was its use as an application tool for further study or when seeking a job. Interviewee 2 said, *"I can present it [the logbook] to my future company or future university."* Future careers were mentioned by several other interviewees as well, but interviewee 14 gave a clear description of the use of the engineering logbook when they said,

> *"I think some large companies pay much attention to our experiences. Engineering logbook is just a chance for us to take note of what we have done or especially what we have done excellently. More important, some experiences are related with our majors, but some are not. They are related to our development of personalities. So I think not only the large companies will pay much attention to our ability to finish the task, but also our personalities which are important in our engineering career. So logbook just help us to gather all of our strengths together and show our competence to the large companies."*

This demonstrates a clear understanding of the workplace and also shows an understanding of what employers are looking for; it is not just about hard skills and knowledge, but soft skills. This

illustrates the need for PDP to develop soft skills of students as these are the key skills that employers favour, as discussed in the literature review. Interviewee 2 shows that they understand the need to self-promote and show off who they are on a personal level as well to stand out in the crowded university graduate market in China which stands at 11.79 million in 2024 (Xinhua 2024).

6.6 Summary

The aim of this chapter was to analyse the 15 interviewee's engineering logbook submissions and related interview questions with an aim to answer the following research question:

2. What impact, if any, does the interdisciplinary aspect have on preparing students for the workplace?

From the discussion above it can be concluded that participants in this study have displayed skills appropriate for the workplace and in demand for engineering employers. The ability to record, reflect and use the engineering logbook for job or study opportunities and for lifelong learning shows the blend of hard and soft skills. This shows the usefulness of having a set of interdisciplinary three-year set of PDP modules on students and potential employers. The documentary analysis provided useful insight into the reflective abilities of participants and what entries they chose to record. Further investigation of the relationship between hard and soft skills are needed though to analyse which logbook entries have the greatest links between the two. This could then provide effective curriculum development ideas for educators.

Based on the findings in this chapter, the following recommendations are suggested:

1. To implement a record of professional development for students to record hard and soft skills for use.
2. To encourage the active use of reflection to promote lifelong learning.

Chapter 7
Recommendations and Conclusions

7.1 Introduction

The aim of this chapter is to present the recommendations and conclusions for this study based on the analysis of the findings in the previous chapters.

The full list of recommendations from the 3 findings chapters will be discussed and based on this, a model for Personal Development Planning (PDP) will be suggested. The model will be explained in more detail before finally giving conclusions from this study. The conclusions will include a discussion on the research questions in the study and the extent to which they have been answered.

The research questions of this study were:

1. How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students?
2. What impact, if any, does the interdisciplinary aspect have on preparing students for the workplace?
3. What soft skills do students develop?
4. How might these skills benefit students academically, professionally and in the workplace?

7.2 A Model for PDP

From the findings eight recommendations were made, which fall into four main themes: skills, positioning, pedagogy and culture as shown in Table 8 below.

Table 8: Recommendation themes from findings

	Questionnaires	Interviews	Documentary analysis
Skills	✓	✓	✓
Positioning	✓	✓	✓
Pedagogy		✓	
Culture	✓	✓	

The questionnaires showed that in order for PDP modules to be effective, the soft skills taught needed to be specific to the degree programme to enhance the validity of PDP modules for the students which aligns with the skills theme. In addition to teaching soft skills, those skills need to be

highlighted to the students as students are often unclear that they are learning a specific skill (positioning). Therefore, making the soft skill clear through learning objectives (as an example) can help students understand that they are learning a particular soft skill. It is also important when highlighting skills that students see how that soft skill relates to them as a student, an employee and in their chosen career (in this case, as an engineer). Finally, the questionnaires exemplified the need for PDP modules to take into consideration the needs of the students and the socio-cultural factors affecting them which supports the culture category.

The interviews also recommended that skills needed to be related to the degree programmes of the students, but they should also be academic, professional and employability skills. However, most importantly, the skills should be taught over a sustained period of time (positioning within the degree programme). When considering the pedagogy of teaching these skills, an in-person, student centred approach is recommended. Furthermore, innovative pedagogy, curriculum and delivery is key to developing skills. Finally, the interviews showed that in addition to the cultural background of the students being considered as mentioned in the questionnaires, the context in which the students are studying should be reflected upon and any implications that might have to teaching PDP.

Lastly, the documentary analysis recommended that a record of professional development for students be implemented so students are able to record their hard and soft skills. In addition to recording of those skills, reflection should be actively used to promote lifelong learning to help position those soft skills effectively throughout the degree programme and in further study or future career.

Based on the recommendations, the following model of PDP is proposed.

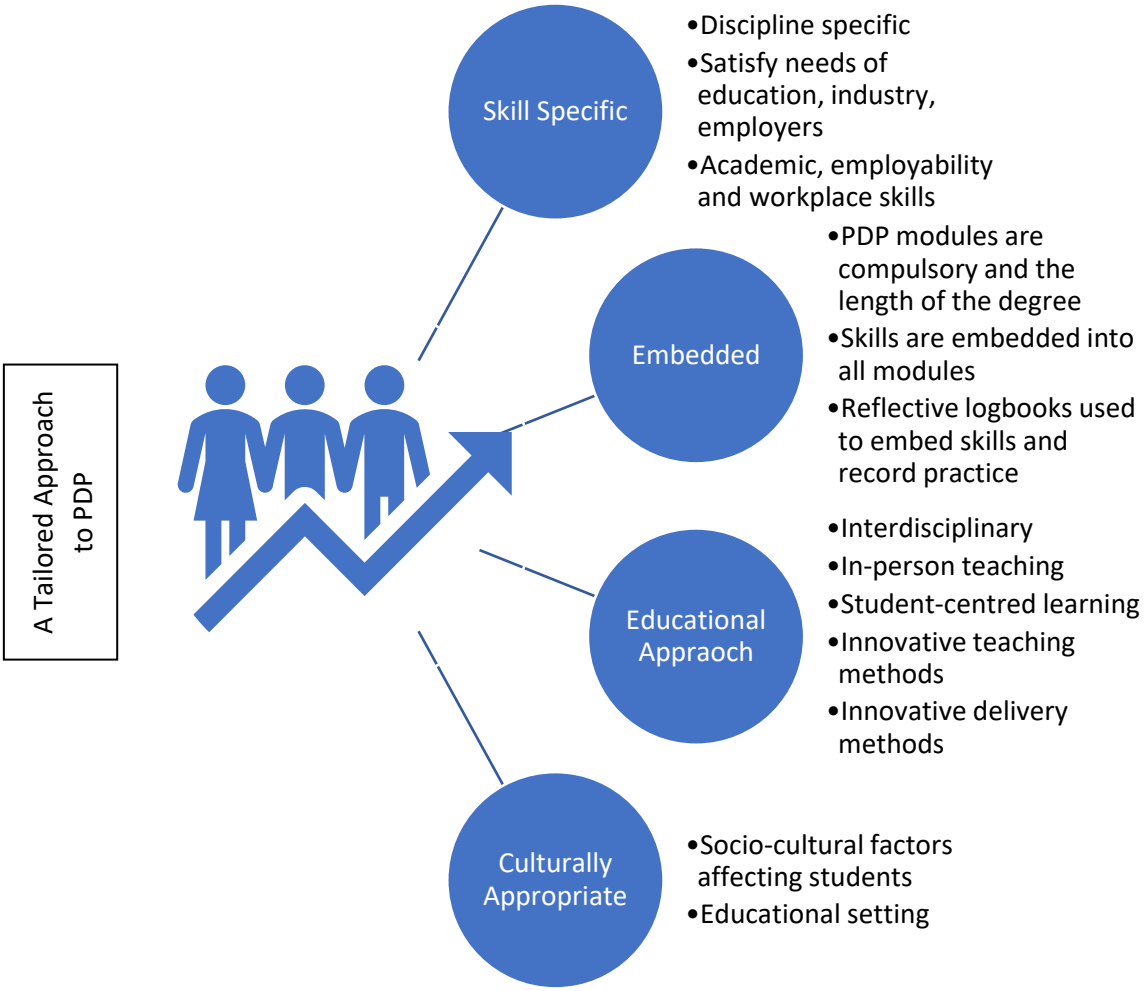

Figure 5: A tailored approach to PDP

Overall, this researcher believes in a tailored approach to PDP, ensuring that PDP is skills specific, embedded into the degree programme, uses an innovative educational approach and is culturally appropriate. Each of these areas will now be discussed.

7.2.1 Skill Specific

PDP needs to be discipline specific

From the findings, it is clear that PDP needs to be skill specific for students, and this therefore needs to be related to their degree programme. This case study presents PDP in terms of a material science and engineering degree, but this researcher believes that PDP can be tailored to any degree programme. To ensure that this can be done, the first thing to identify is the skills needed for that

degree and for that industry. This can be done by looking at accreditation and professional bodies, reviewing the literature, or by even searching job vacancies.

It is important that skills are developed in three areas: academic, employability and professional. This researcher prefers the term professional, rather than workplace as suggest by (Clegg and Bradley 2006) because it makes the skills more relevant to the profession, and by using a CPD record there would be assessment which Clegg and Bradley suggest there needs to be. Academic skills are necessary because, after all, PDP is being taught as part of the degree programme, so students must be able to perform academically as well. However, the academic skills taught in PDP should still be related to professionalism, so skills such as academic reading and writing should be taught in a language class otherwise there is repetition of curriculum which devalues PDP. These skills can also be aligned with the graduate attributes held by the university. By ensuring that the graduate attributes are being met, this aligns with university policy and also aids in NSS scores and TEF acquisition.

Employability skills should be taught to ensure that students know how to apply for further education or a job. It is important to include activities such as CV writing or interview skills as these are fundamental for students. These of course should be relevant to the discipline area and should also show students where to find these study or employment opportunities, as well as skills such as how to read job adverts. Using innovative pedagogy for these activities such as VR will also enhance the motivation of students, which will be discussed later.

Finally, the professional skills that each student needs would be dependent on the discipline area. However, general skills such as teamwork, communication, conflict resolution, critical thinking and lifelong learning can be added to any PDP module with relevant reference to the discipline. To ensure that the correct professional skills are included in the modules, needs collaboration with employers, industry and professional bodies which will now be discussed.

PDP needs to involve employers, industry and professional bodies

In this case study, the focus was on engineering, but PDP is for any subject discipline. However, to ensure the content of skills development is relevant to students, it is the educator's responsibility to ensure the right skills are being developed. This is done through effective curriculum design with involvement from employers, industry or professional bodies.

As discussed in this thesis, whilst the role of industry is important, there is a lack of industry involvement in university courses. However, one area that this researcher believes is not used

enough are standards that are set by professional bodies. This should be reviewed prior to any curriculum design. In terms of engineering, this study makes reference to the Royal Academy of Engineering and the Institute of Materials, Minerals and Mining (as the main relevant industry bodies) as well as other professional engineering reports. It is vital to know what these industry and professional bodies are looking for in graduates when designing modules, especially bespoke PDP modules. Without the knowledge of this, effective course development becomes impossible, and PDP modules become generic.

Additionally, by using industry and professional bodies in course design and implementation, this can build a professional network which is essential for students as these can provide links to employers. In the context of this case study, Chinese students can find it difficult to create that network which can provide employment opportunities which is key for the competitive job market. By inviting employers and industry into the conversation, they can provide talks to students to emphasise the value of soft skills which, in turn, add validity to the PDP modules, which this study has highlighted the importance of.

7.2.2 Embedded

Embedded PDP modules throughout the degree programme

One of the key recommendations is ensure that PDP modules are run for the duration of the degree as their own set of modules. This is important as participants in this study identified the time it took to see the benefit of the modules and how they could be used throughout the degree programme. As noted in the literature review, the lack of sustained PDP did not benefit students as much as the results of this study has shown. From the three-year set of PDP modules, soft skills have been developed in addition to confidence in taking the next steps in the participants' career journeys.

By having PDP modules that support students during their degree programmes, topics can be repeated or developed during the modules which also benefits students, especially with important topics such as safety, which are essential. By reviewing and building on the basic concepts, it reinforces reflection and helps to develop those skills. This is particularly important in undergraduate degree programmes as students are still learning and need the opportunity to repeat and develop key skills. As discussed in the literature, PDP is missing from undergraduate courses and employability is only really discussed as part of postgraduate study, which is detrimental to undergraduate students, especially if they come from a teacher-centred educational background such as in this study.

Embedding skills into all modules

The findings revealed that technical modules did not teach any soft skills to students, but it was expected that they could perform these. This shows a need for ensuring skills are developed in all modules. This can be done in two ways: highlighting skills development and recording skills development. To effectively equip students there needs to be a blend of hard and soft skills in all modules and it is key to raise awareness of skills development. In all classes, students should be made aware of the skills they are developing. This can be done through ILOs which can be discussed at the beginning of the class and again at the end by asking students to reflect on if they feel they have met that ILO. Often, students are unaware of the skills they are developing, especially if it is not an obvious skill such as communication. Therefore, the educator needs to clarify that students are developing those skills. Secondly, these skills can be further developed by using a logbook to record and reflect on the skills. In this study, an engineering logbook was created by students to show their record of professional development. However, as this logbook was specifically tailored to the students in this case study, it means the basic concept can be used and adapted to any other discipline. By having a record of the skills development and actively encouraging deep reflection, this can develop lifelong learning skills of students, develop their confidence and be used as a record for further study or job applications. However, this logbook can only be fully effective if it is used in all classes throughout the degree to highlight both the hard and soft skills development of students.

7.2.3 Education

PDP needs to be interdisciplinary

As stated throughout this research, PDP needs to have a context to make it relevant to students. By being able to practice their soft skills in other modules and through innovative pedagogy aids them in being employable (Winberg, et al. 2020). The data collected in this study showed an unequivocable case for interdisciplinary education as technical modules did not teach the required soft skills for students. Moreover, students found the interdisciplinary approach helped them link the hard and soft skills to be more effective. Klaassen (2018) discusses constructive alignment, problem selection and level of interaction between disciplines are the key factors when designing interdisciplinary education. An interdisciplinary approach can be developed across any discipline area and requires input from subject specialists and a willingness to learn from the skills educators. Whilst developing courses that are interdisciplinary takes time and effort, it is more beneficial for students. There is also required buy-in from all stakeholders in the programmes for this approach to

be effective. Constructive alignment is key in curriculum design as the ILOs should be aligned to teaching and assessment. As discussed previously, soft skills should be made part of the ILOs for each module to raise awareness for students and embed skills fully into the curriculum. As educators, deciding on the ILOs for a module should be the first step in what you want the students to achieve and then decide what content is taught to achieve those. This is where interdisciplinary collaboration with soft skills development is key. By working together, the skills can show transferability across modules which will them ensure students develop them fully and see the connection with the hard skills and discipline knowledge. Therefore, to be successful in embedding soft skills into the curriculum, flexibility is needed to enhance teaching effectiveness (OECD 2024).

Innovative teaching and delivery methods

In order to effectively teach PDP and the soft skills students require, innovative teaching and delivery methods should be employed. Just as industry 4.0 is revolutionising engineering, education 4.0 is also evolving to recognise the effect digitalisation is having on education (Miranda, et al. 2021). Not only do students need to be up to date with the latest innovations, but educators also need to be harnessing this to improve education and increase motivation in students. As discussed in the literature review, gamification has played an important role in learning soft skills, but this researcher believes the next step to develop soft skills is by using virtual reality. Especially in a large-class university setting, the use of virtual reality can help students practice their soft skills in areas such as communication with different audiences and interview skills, where they may not necessarily have the opportunities to practice thoroughly. Miranda, et al. describe four components of education 4.0: competencies (hard and soft skills), learning methods, ICT and infrastructure. From this model it can be seen that PDP has a core place in education 4.0 and innovation in the teaching and delivery is also key. As seen from the data collected in this study, in-person learning is highly favoured in this context and especially for teaching soft skills. This researcher believes that PDP modules need to be taught majority face-to-face, approximately 70% and online learning can account for 30%. This is because since COVID-19, hybrid working has become more prevalent, so students need to be familiar with working in this environment and therefore need to be confident using these skills which include conducting online meetings, using software tools and collaborating cross-culturally and in different time zones. By implementing a blended course, students are able to effectively develop soft skills required in all situations, but by conducting the majority of classes face-to-face, it gives learners the support they need from an instructor and the sense of community which is important for collaborative learning and wellbeing.

7.2.4 Culture

PDP needs to be culturally appropriate

Hora, Benbow and Smolarek (2018) discuss the notion of the 'Cultural Capital Paradigm' in relation to skills and how they are learned in context based on how they are defined, acquired and used. In short, social and cultural dynamics define how soft skills are learnt. This shows that it is extremely important to understand the context in which skills are being taught. It means an awareness of the place and the students in the classes. In this study, the transnational education setting in China influenced students and their sense of self and identity. It can be seen from the data that there was an identity clash between the pedagogy of the school and the cultural identity of students. It is therefore crucial to not only consider the educational setting that the learning is taking place in, but also the factors affecting students and learning. As discussed in the introduction, a PESTLE analysis helped identify factors affecting this study, but this can also be used to identify the needs of all stakeholders when designing education. In addition to that, the actual content of the PDP modules needs to be culturally appropriate and meet the needs of the students. I.e., in addition to the ensuring they are successful in the educational setting, an analysis of their futures would be appropriate to identify trends in further education or employment which will help identify topics relevant to them which can be implemented into the PDP modules. By doing this, students will be better positioned to relate the PDP modules to their identify and see the benefits of a multicultural approach and educators will be able to engage deeply with students appropriate to their cultural context (Yao and Tuliao 2019).

7.3 Contribution to new knowledge

This piece of research has clearly identified a gap in the current literature and therefore has contributed to the current knowledge on soft skills development and PDP modules. It has:

1. provided a model for the development of PDP modules
2. shown that PDP needs to be embedded continuously into all undergraduate degree programmes using an interdisciplinary, tailored approach
3. highlighted the importance of PDP modules for higher education and industry

With the current trend of employability and graduate attributes, this study enables development in these areas which is of upmost importance to universities as they need to be providing a worthwhile and value for money experience to their stakeholders. This research not only benefits higher education establishments, but also employers and the students themselves as developing soft skills

in university enables graduates to be employable or pursue further education, or provide ready-made graduates ready for work, thus reducing the need for training and the related expenses associated with that for employers.

This case study provided a unique approach to the development of soft skills using PDP modules and highlighted the need for these modules for undergraduate students using an embedded, continuous and interdisciplinary approach. None of the literature surveyed showed continuous PDP modules during a degree programme, but a very sporadic approach lasting a short time. The data collected in this research showed how important the continuous nature of the PDP modules was for the development of the students in this study as it took time for them to see the value as PDP was something which they had not experienced before, therefore offering a new perspective. Whilst interdisciplinary research is not something new, the interdisciplinary nature of the PDP modules specific to the degree programme also added value to the modules. Additionally, by tailoring the content to industry, this ensures the undergraduate students are meeting the needs of their chosen field, which therefore makes them employable. This approach also helps the higher education institute when it comes to programme accreditation, because not only are soft skills being taught, but they are also completely relevant to the degree, the profession and the accrediting body.

Further to this research, it is clear that an extension should be conducted on the graduates of this programme to understand if developing the soft skills through the PDP modules continued to help them in their next careers steps. It would also be worthwhile in this research to speak with the academics (if students went on to do postgraduate studies) or employers (if students went into the workforce) to gain their insights into the benefits of this model of PDP.

In addition to this, the proposed model of PDP should be implemented in other degree programmes to see the benefit for students in other fields besides engineering. It would also be worthwhile to investigate how this embedded approach to PDP can map against and develop the graduate attributes of universities. The success of this could then be measured by using the new skills question of the NSS survey, “How has your course developed your knowledge and skills that you think you will need for your future?” which is an important metric to universities.

7.4 Conclusion

This case study explored the development of Chinese undergraduate engineering students’ soft skills when taking an interdisciplinary three-year set of personal development planning (PDP) modules with the aim of answering the following research questions:

1. How does studying an interdisciplinary three-year set of PDP modules develop the soft skills of undergraduate engineering students?
2. What impact, if any, does the interdisciplinary aspect have on preparing students for the workplace?
3. What soft skills do students develop?
4. How might these skills benefit students academically, professionally and in the workplace?

This mixed-methods study used two questionnaires, semi-structured interviews and documentary analysis to explore answers to the research questions. Based on the recommendations from the main findings, a model of PDP was suggested where PDP needs to be tailored to ensure the skills are specific and embedded into the degree programme using an innovative educational approach which is culturally appropriate.

From the data collected in this study it is clear that studying an interdisciplinary three-year set of PDP modules developed the soft skills of undergraduate engineering students, answering research question 1. The continuity of the PDP modules over the course of three years helped participants develop their soft skills and feel supported throughout their degree programme. The participants identified that they would not be able to develop their soft skills in their technical modules only, which shows the need for PDP modules. The interdisciplinary aspect was also helpful for students as they could see their skills being used in real-life engineering situations which helped them to see the relevance of the PDP modules. However, in terms of research question 2, the interdisciplinary aspect could only be partly proved for helping prepare students for the workplace and this was through the engineering logbook.

The skills that students developed were varied but could be identified as being developed in areas of academic skills, employability skills and professional skills. The questionnaires identified academic writing as one of the top skills from completing the Materials Library project followed by teamwork and critical thinking skills. Communication skills and creativity skills were also mentioned in questionnaire 1 after the three previously mentioned skills, but in questionnaire 2, this changed to problem solving skills and communication. In the interviews, the participants focussed more on professional skills such as critical thinking, problem solving and project management skills as they recognised the use of these skills for engineers. They also discussed their interviewing and CV writing skills which would help them become employable or apply for further education. The documentary analysis also provided confirmation that participants of this study had develop reflection skills which are a key part of any PDP set of modules as discussed in the literature. Participants achieved this by

completing an engineering logbook which not only contained a record of their professional development, but also personal reflections which showed their soft skills development.

As discussed in the literature review, engineers need to be able to demonstrate they have developed a range of skills to become professionally registered, which has been shown that the PDP modules have done. However, there are improvements to be made in the course content of the PDP modules to meet the needs of the engineering profession. For example, the Royal Academy of Engineering (2020) identified six skills engineers need which are, "systems thinking, problem solving, visualising, improving, creative problem-solving and adapting" (p.10). Whilst some of these were mentioned in the data, systems thinking, visualising and improving were not specifically mentioned. Although these are covered in the interdisciplinary projects in the PDP modules to a certain extent, more needs to be done to highlight these, both in PDP modules and in the technical modules as these are some of the more technical skills that require knowledge. Therefore, research question 3 showed a variety of skills that were developed from taking the three PDP modules.

In terms of research question 4, it was clear from the data that the participants were confident in their soft skills development and rated themselves as more capable than their peers at other universities that did not have PDP modules. As most participants in this study were aiming to go on to further study, they felt they had developed the soft skills to achieve this. The participants also identified that the engineering logbook had provided them a with a vital resource to use in interviews for further study or employment later and was an excellent record of achievement that had developed them in a variety of areas, so they were ready for the workplace. Academically the skills participants had developed in PDP such as teamwork and project management had helped them successfully complete projects and assignments in other modules. Additionally, due to the assessment methods in the JEI participants felt they were given opportunities to practice skills such as presentation skills or poster making which aided their academic development. Therefore, the soft skills that were developed have benefitted participants in whichever area they choose to go into in the future, and whilst they are in their undergraduate degree.

Overall, this case study research shows that in a Chinese context, the PDP modules are essential to develop the soft skills of undergraduate engineering students as the pedagogy of studying in a TNE programme is new to the students and they need PDP to support them. The results of this study could be generalised to other TNE programmes, but as the model of PDP that was proposed shows there are several factors that need to be considered when creating personal development planning modules for undergraduate degree programmes.

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Appendix 1

Course Design of PDP modules and Philosophical Approach

Table 9 below shows the course design of each PDP module.

Table 9: PDP Modules Course Design

Course	Duration	Teaching Objectives	Topics
PDP1	28 weeks/ 2 semesters/ 56 hours	1. Public speaking and presentation skills, including use of presentation tools, such as Microsoft PowerPoint or others, to research and present on a range of current topics. Production of video on a range of topics, providing students with the opportunity to be creative and precise in the key messages they wish to convey. 2. Critical thinking, especially in reading and writing, and production of evidenced judgements. 3. Interpretation and evaluation of data from various sources for use in specific academic tasks. 4. Use of oral, written and electronic methods for the communication of subject specific information 5. Effective team-working with fellow students	• Time management • Safety • Engineering logbook • Critical thinking and reflection • Team working & SCL • Effective Lecture Comprehension • Reading and research • Argument and debate • Preparing to work in the lab • Joining your discourse community • Answering questions in Science and Engineering • Literature searching • Avoiding plagiarism • Designing a control experiment. • Results and discussion • Abstract writing • Employment and internationalisation • Employability skills • Guest lectures x2
PDP2	28 weeks/ 2 semesters/ 56 hours	1. Public speaking and presentation skills, including use of presentation tools, such as Microsoft PowerPoint or others, to research and present on a range of current topics. Production of video on a range of topics, providing students with the opportunity to be creative and precise in the key messages they wish to convey.	• Mini Project 1 - Emerging AI Technologies • Project Management • Marking criteria • Oral presentation • Mini Project 2- Bridge safety • Risk assessment

		2. Critical thinking, especially in reading and writing, and production of evidenced judgements. 3. Interpretation and evaluation of data from various sources for use in specific academic tasks. 4. Use of oral, written and electronic methods for the communication of subject specific information 5. Effective team-working with fellow students	• Lab safety • Engineering logbook • Mini Project 3 – Entering the world of work • Peer feedback- CVs and CLs • Interviews • Mock Interviews • Mini Project 4- Materials Library • Literature Review Writing • Safety data sheet • Abstract writing • Poster tutorials • Recruitment fair for website groups • Website Design • Website tutorials
PDP3	28 weeks/ 2 semesters/ 56 hours	1. Public speaking and presentation skills, including use of presentation tools, such as Microsoft PowerPoint or others, to research and present on a range of current topics. Production of video on a range of topics, providing students with the opportunity to be creative and precise in the key messages they wish to convey. 2. Critical thinking, especially in reading and writing, and production of evidenced judgements. 3. Interpretation and evaluation of data from various sources for use in specific academic tasks. 4. Use of oral, written and electronic methods for the communication of subject specific information 5. Effective team-working with fellow students	• Professional institutions • Continuous professional development/learning (CPD) • Safety 3 • Intellectual property • Quality management • Project management • Ethics in business • Business analysis case study • Corporate social responsibility • Company structure and hierarchy • Graduate programmes • Applying for an MSc • Personal statements • Guest Lectures x3 • Final year projects

The PDP modules evolve and become more tailored each year depending on student and teacher feedback through the student-staff liaison committee (SSLC), issues identified by subject teachers,

advances in engineering, quality assurance and university policies, but are there primarily to support students on their journey through university and into further study or employment.

PDP 1 and PDP 2 were originally designed by the Programme Convenor who previously taught this course. PDP 3 was fully designed by this researcher in collaboration with an engineer. Overall, the teaching objectives are the same for each course and the overall abilities the students should be aiming for. However, in each lecture there are 2-3 individual learning objectives for that lecture. At the beginning and the end of the lecture these objectives are discussed and reviewed, and students vote if they feel they have achieved the objectives from that day or not. This is done to show the students what they are learning and why this is important for their academic or professional careers. By giving aims, the students can understand what the lecture is about and how it can help them. There are no surprises, and the students feel more involved with the lecture.

The classes are referred to as lectures, however the classes take different forms depending on the topic. There are lecture style classes, especially in year 1 or when project information is given. However, in each of these classes there are always tasks that need to be completed individually or as a group and give feedback on, so there is never a prolonged period lecturer talking time. There are also tutorial classes for project work and guided independent study sessions where information is given in the first half of the class, followed by project groupwork.

Safety and engineering logbook are included in all three years of study. This is because it is vital that engineers understand safety and record their professional development. Safety information is built on year upon year with links to the technical chemistry classes. The engineering logbook is used by students to record activities such as lab work, giving or attending a presentation and internships. This can be used by students when they apply for further study, a job or chartership, so is vital for CPD.

PDP1 concentrates on building the academic and professional skills that students require whilst at university. This includes topics such as researching and plagiarism, exam techniques and safety and professional conduct. These topics are especially important as the UK model of student-centred learning is a new approach for students.

PDP2 asks students to use the academic and professional skills learned in year one and apply those to problem-based learning tasks. There is a focus on issues that real life engineers would face such as writing an investigative report based on a bridge disaster as well as creating a materials database that can be used in product design. There is also an opportunity for students to further consider their careers and skills through a simulation job application and peer interview.

PDP3 then moves on to focus more on corporate skills and knowledge that employees are expected to display such as understanding codes of conduct, ethics and professional development. It also recognises the students' desire for further study, so includes two lectures on personal statements and researching and applying for master's programmes or graduate programmes. These lectures replaced the recruitment fair that was previously conducted. The replacement happened due to COVID-19 as it is difficult to run the recruitment fair when it is not face-to-face. It was run in 2020 online but could not include outside companies which was the main aim. It was therefore not as successful as had been hoped, so was replaced in 2021 with something which would better facilitate the students' needs.

Appendix 2

Full PESTLE analysis

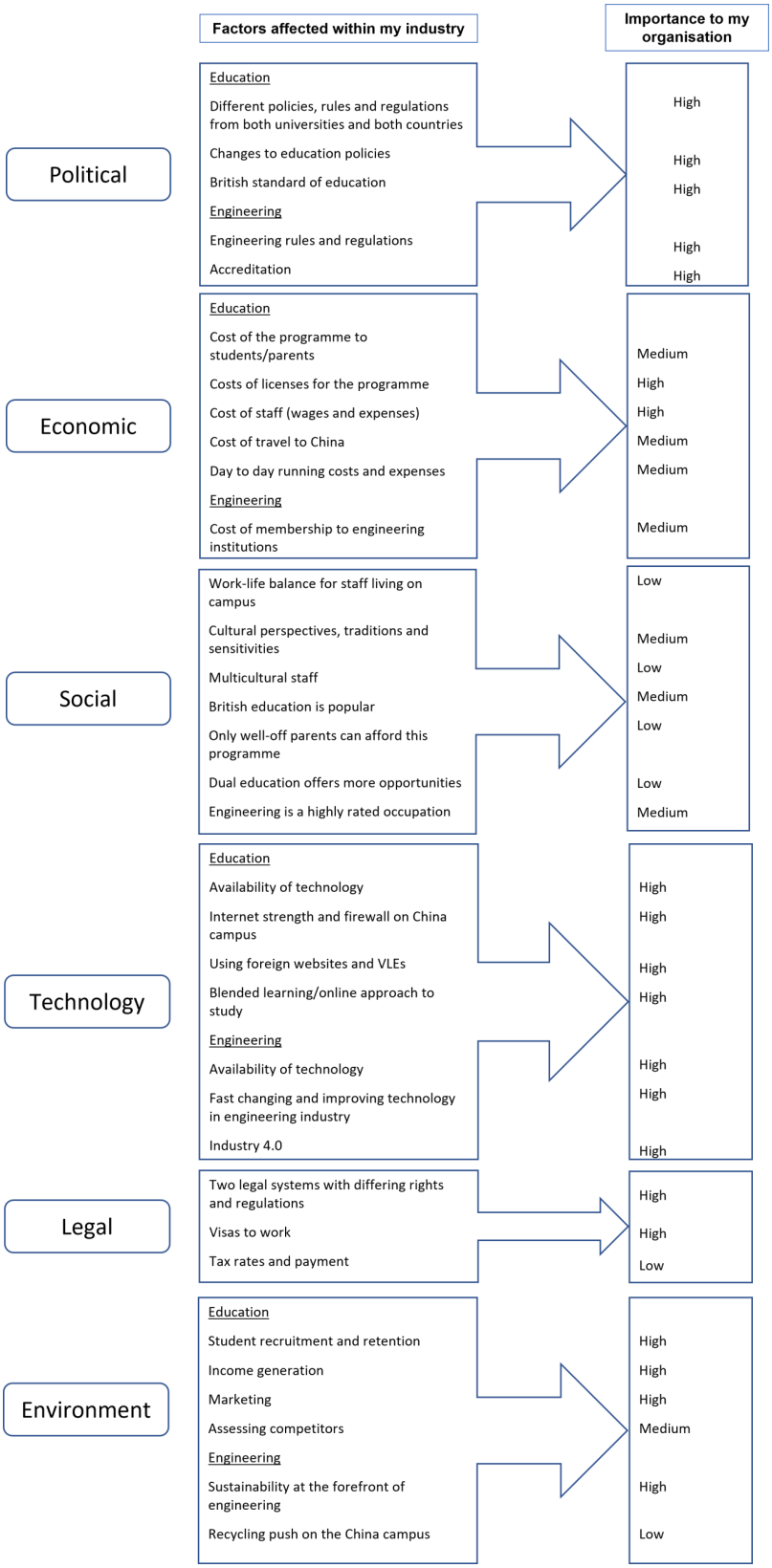

Figure 1.1: PESTLE Analysis

Economic

In terms of economic cost, running a JEI brings significant financial burdens to each university. There are significant costs for licenses (from the Ministry of Education) to run the JEI, staffing costs in terms of wages and travel expenses as the staff from the British university are flown to China multiple times per year. There are also the day-to-day running costs for the programme in terms of material needs and expenses for staff. There is also a significant cost to the student compared with taking a Chinese programme which is set at provincial level, this therefore leads to a socio-cultural factor of the financial commitment to parents of this programme.

The cost can be worth it though as a British style education is seen as prestigious in China and opens up international opportunities for students (Liu 2018). Therefore, the JEI provides a niche in the market of dual education and graduate students have more choices as they graduate with degrees from both the UK and Chinese universities. Engineering is also a highly rated occupation and can offer students several career pathways after completing an undergraduate degree. Career pathways include industry areas (medical, civil, energy or metals, minerals and materials) or job areas (research and development, academia or management).

Social

Other socio-cultural factors to consider are the cultural differences between the two countries. There can be sensitivities and differing traditions which can cause strain between staff or even staff and students. One thing that this JEI does is offer cultural classes run by students to showcase Chinese cultural and traditions to the British university staff. There is also an opportunity for the staff members to share culture from the UK and other countries as there is a multicultural staff working in the JEI. One difficulty can be the work-life balance for staff and the expectations from students. Unlike the 9-5 workday in the UK, China has 9-9-6 which correlates to 9am-9pm, six days per week (Mourdoukoutas 2019). This can mean that a work-life balance is difficult for staff due to the expectations from students that they are available for longer. Additionally, living on-campus can make it difficult to disengage from work.

Legal

Legalities also factor within the JEI as staff need the appropriate visas to work in China. There is also the issue of tax which must be paid in both countries.

Environment

From an educational standpoint, student recruitment and retention are highly important to the university as this leads to income generation and therefore a successful programme and company according to Carroll's CSR pyramid as it is meeting its economic responsibilities (Carroll 1991).

Marketing is also important and Canal university staff are often asked to go on recruitment trips to show perspective parents that foreign staff do teach their children, not just Chinese staff. This is important for the programme's success as the foreign staff are a major selling point. Other joint ventures may not have the sustained presence of foreign staff that the JEI has as there are always staff from the British university on campus in China all year round.

Finally, on an environmental level, within the engineering industry there is now a push towards sustainability and sustainable development which as filtered into the education of the students. There is also a bigger environmental push within China and recycling is now being made available on the campus to try to improve the carbon footprint within China (Huang 2019).

Nottingham Trent University

Questionnaire 1

How does studying an interdisciplinary three-year PDP programme develop the soft skills of undergraduate engineering students?

Section 1

Participant Information Sheet

Section 2

Consent form

Section 3

Questionnaire 1

13.Which of the following skills did you develop during the Materials Library project?
(You can choose as many as you want.)

Academic writing

Analytical skills

Communication skills

Creativity

Critical thinking

Leadership

Negotiation

Networking (communicating with companies)

Presentation skills

Problem solving

Project management

Selling yourself (your skills and abilities)

Teamwork

Technical/computing skills

Time management

Other

14.If you chose 'other' above, please write what skill you have developed in the box below.
If you did not choose 'other', please write N/A in the box below.

15.Please rate how much PDP1 and PDP2 have helped you develop the following skills.
(Please choose one option for each skill.)

	Did not help at all	Did not help	Slightly did not help	Slightly helped	Helped	Helped a lot
Academic writing						
Analytical skills						
Communication skills						
Creativity						
Critical thinking						
Leadership						
Negotiation						
Networking						
Presentation skills						
Problem solving						
Project management						
Selling yourself						
Teamwork						
Technical/computing skills						
Time management						

16.How much do you agree or disagree with the following statements? (Please choose one option for each statement.)

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
PDP has helped me develop my soft skills.						
Completing interdisciplinary projects has developed my soft skills.						
I can see how the skills I've developed in PDP can be used in my engineering subjects.						
PDP has prepared me for further study.						
PDP has prepared me for employability						
PDP has prepared me to work professionally (to the standard required within engineering).						

17.What skill or skills do you still need to develop?

Nottingham Trent University

Questionnaire 2

How does studying an interdisciplinary three-year PDP programme develop the soft skills of undergraduate engineering students?

Section 1

Participant Information Sheet and Consent form

Section 2

Own personal abilities

This section evaluates issues relevant to your own personal abilities.

5.Please read each statement and indicate the extent to which you agree or disagree by choosing the appropriate answer.

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
I am very clear about the importance of reflective activity to professional life.						
I am clear about which skills employers are looking for.						
I am confident that I have the skills employers are looking for.						
I have a clear understanding of how to evaluate my own performance.						

I am confident that I know how to improve my performance in most circumstances.						
I know how to apply my expertise in one area to a very different field.						
I am confident that I know how to make best use of my mind.						
I am confident that I can develop an effective strategy to meet most circumstances.						
I am aware of the best roles that I can fill for teamwork.						
I am confident at problem-solving.						
I am always very clear about which skills I am developing.						
I am confident that I will take a creative approach to most problems.						
I can see clearly how my skills apply to a wide range of other situations.						
I am confident about making competence-based						

applications for jobs.						
I am confident that when things go wrong, I am able to fix them.						
I am confident that when things don't go to plan I have the determination to carry on.						
I am confident that I can use my skills in new situations.						
I am confident that when I have a plan I can make it a reality.						

Section 3

My skills

This section evaluates your beliefs about your skills.

6.
Considering you have completed characterisation on your material and updated your Material Library project website from year 2, which of the following skills did you develop during the Materials Library project?
(You can choose as many as you want.)

Academic writing

Analytical skills

Communication skills

Creativity

Critical thinking

Leadership

Negotiation

Networking (communicating with companies)

Presentation skills

Problem solving

Project management

Selling yourself (your skills and abilities)

Teamwork

Technical/computing skills

Time management

Other

7.If you chose 'other' above, please write what skill you have developed in the box below.
If you did not choose 'other', please write N/A in the box below.

8.Please rate how much PDP3 has helped you develop the following skills.
(Please choose one option for each skill.)

	Did not help at all	Did not help	Slightly did not help	Slightly helped	Helped	Helped a lot
Analytical skills						
Commercial/business knowledge						
Communication skills						
Creative problem solving						
Critical thinking						
Leadership						
Lifelong learning/continuous professional development						
Problem finding						
Presentation skills						
Professional engineering values (ethics, IP						

and law, risk and security)						
Professionalism (Understanding and complying with codes of conduct)						
Project management						
Systems thinking (Seeing whole systems and parts, and how they connect)						
Teamwork						
Technical/computing skills						
Time management						

9.Reflecting on your own abilities, please write down your top 3 soft skills.

10.Reflecting on your own abilities, please write down up to 3 soft skills that you are not good at.

11.Reflecting on your own abilities using your logbook, do you think the soft skills mentioned in the previous two questions (Qs 9 and 10) have changed from the beginning of the degree programme until now?

Changed a little

Changed somewhat

Changed a lot

No change

12.How have your soft skills changed and why do you think this has happened?

Section 4

PDP courses

This section evaluates the PDP courses.

13.For each of the statements below, choose to what extent you agree or disagree. Required to answer. Likert.

	Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
The PDP courses have helped me develop skills I needed in my technical modules.						
I could have developed my professional skills to the same level without the PDP courses.						
I could have developed all the skills I needed in the technical modules only.						
Completing projects in PDP has helped me develop my skills.						

14.How important was it for you...

	Not important at all	Unimportant	Somewhat unimportant	Somewhat important	Important	Very important
to complete engineering projects in the PDP modules						
for PDP to be related to your						

technical modules						
for PDP to be useful in your other modules						
be able to continue PDP projects in other modules						
for PDP to teach you skills that could be used in further study						
for PDP to teach you skills that could be used in the workplace						
for PDP to teach you skills that could help you get a job/employment						

15.Reflecting on the PDP courses, are there any skills you think you have NOT developed?

16.Reflecting on the PDP courses, are there any other skills that you would have liked to develop?

17.How likely are you to recommend the PDP courses to another undergraduate student?

0	1	2	3	4	5	6	7	8	9	10

Not at all likely Extremely likely

18.Are there any other comments you would like to make regarding the PDP courses?

Appendix 4

Interview Questions

1. What skills do you feel you have developed through taking the 3 PDP modules? Do you think these are soft skills (interpersonal/people skills) or hard skills (technical knowledge)?
2. Do you think taking the three PDP modules has helped you developed your soft skills? How?
3. Do you think you could have developed the soft skills that you need in your technical modules only? Why/why not?
4. Thinking about your academic performance and abilities, do you think the PDP modules helped you to be more successful?
5. How do you feel PDP has helped you in your project-based learning tasks in your technical science and engineering classes?
6. Having looked back through your engineering logbook, what skills have you developed from doing projects based on real-life engineering situations such as the Industry 4.0 presentation, Materials Library and DMAIC video project?
7. Do you think the interdisciplinary nature of the PDP modules has helped you understand the skills engineers need? Why/why not?
8. How have you developed professionally from the PDP modules at university?
9. What skills have you developed that a professional engineer would need? Are these soft or hard skills?
10. How do you think completing an engineering logbook has prepared you for the workplace?
11. What are you planning to do after graduation? Do you feel that you have the required soft skills to take the next step in your career? Why/Why not?
12. Do you feel confident with your soft skills/personal development? Why/Why not?
13. Any other comments?
14. Do you think the COVID-19 pandemic had any impact on your experience with the PDP modules?