MSc Teaching Adults Dissertation Project 2017/18

The importance of soft skills: A study examining the effectiveness of teaching and learning methods for facilitating soft skill development in postgraduate engineering education in Scotland

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Dissertation submitted in part fulfilment of the requirements for the degree of Master of Science (Teaching Adults)

University of Glasgow
September 2018

Acknowledgements

I would like to express my endless gratitude to Dr Srabani Maitra, my dissertation supervisor, for her enormous patience, wise advice, as well as very elaborative and useful feedback for every step of my research work. Her encouraging support and strong care for my academic success allowed me to enjoy the process of the dissertation writing.

Also, I wish to express my high appreciation to Dr Mia Perry, the programme leader MSc Teaching Adults, who provided me with emotional support in times of anxiety and stress and was always there for all my inquiries and doubts towards my dissertation project. A separate warm appreciation for organising PARC sessions, which enabled me to build the dissertation step by step.

Special thanks to all students and professors from the School of Engineering and the School of Computing Science who provided me with their personal stories of teaching or learning in the University of Glasgow.

Lastly, I would like to express an enormous ‘SPASIBO’ (‘thank you’ in Russian) to Julia, my classmate, flatmate and good friend from the first days of my time at the university, for her continuous support, practical advice, and constant reality checks. ☺

Abstract

Recent academic papers and industrial reports emphasise the significance of soft skills for engineers and IT specialists in contributing to the productivity levels of enterprises and the prosperity of UK's knowledge-based economy. In this situation, universities play a vital role in preparing talented engineering and IT workforce with equally developed technical qualifications and soft skills. As the postgraduate taught engineering curriculum in the UK tends to be short and intense, the quality of teaching and learning methods becomes of utmost importance. This research primarily examines the effectiveness of pedagogical approaches and identifies teaching strategies for facilitating soft skills development in postgraduate engineering education. Additionally, the study investigates the philosophical underpinnings of soft skills development. The dissertation draws on a qualitative study including 14 semi-structured interviews with ten MSc students and four professors from engineering and IT faculties in the University of Glasgow. The results indicate that soft skills development is principally justified by employability-driven reasons than by humanistic development. Secondly, both students and professors value a similar set of skills for future engineering graduates: teamwork, communication, problem solving, analytical, critical, and design thinking. Existing teaching methods mostly cover these skills, mainly, by team-based courseworks; however, their quality could be improved. Moreover, the study suggests an embedded model of soft skills development with explicit communication of assessed soft skills.

The results have practical implications for teaching staff. Firstly, to facilitate soft skills development, the professors may apply interactive instructional strategies including active, cooperative, and experiential learning; adult learning principles and 'scaffolding' instruction for entering MSc students; and generally, diversify classroom activities. Existing team project-based learning could be enhanced with elements of cooperation or competition, continuous peer assessment, and ongoing feedback to students. The opportunity to receive individual feedback on request should be explicitly communicated for all types of assessments including examinations.

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‘If you make a good engineer, you make a good human being’

– excerpt from an interview with a professor

1 Chapter One: Introduction

According to the Organisation for Economic Cooperation Development (OECD) paper (1996), the 1980s defined a trend in OECD countries towards growth in high-technology industries and more highly skilled labour, or in other words, a gradual transition to knowledge-based economies – ‘economies which are directly based on the production, distribution and use of knowledge and information’ (OECD, 1996: 7). Multiple studies confirmed that STEM fields, particularly engineering, have the highest leverage for a nation to invest to maintain an Innovation- and Knowledge-Based Economy (iKBE) status (Abdulwahed & Hasna, 2017). Thus, starting from the 1980s, the engineering workforce preparation was also complemented with non-technical skills, which historically implied profoundly technical competencies and disciplinary content knowledge (Abdulwahed et al, 2013). According to Abdulwahed et al (2013), the skills of engineers can be divided into two fundamental categories: technical or ‘hard’ skills and non-technical or ‘soft’ skills. Soft skills indicate personal and interpersonal transferable competencies and social aptitudes, which are essential to delivering technical skills in a proper way (Abdulwahed et al, 2013; Cimatti, 2016). Some examples of soft skills could include communication skills, teamwork, problem solving, ethics, management, leadership, creativity, analytical, and critical thinking. The combination of both types of skills is essential for future engineers to be more valuable, effective, productive at the workplace, and to create positive interactions to achieve organisational success.

In United Kingdom, which is among the top countries ranked by Knowledge Economy Index (World Bank, 2012), a more well-rounded approach in higher engineering education was gradually being brought into the attention of diverse stakeholders such as employers, government, educational policymakers, academic researchers, management of higher education institutes (HEI), and finally, practitioners and students themselves. HEI define and develop graduate attributes which include academic abilities, personal qualities, and transferable or soft skills (Green et al, 2009). The implementation of soft skills development mainly occurs either through curriculum or pedagogical approaches (Shakir, 2009). Since the engineering curriculum is already ‘overstuffed’ (Grasso & Burkins, 2010: x), especially on a postgraduate level in the UK, the quality of teaching and learning methods becomes of utmost importance to develop soft skills of engineering students.

Also, apart from bringing technological advancements and increasing the country’s economic indicators, well-rounded engineers are capable of improving the quality of life and societal well-being. The typical justification in the academic literature on soft skills development in higher education is the human capital theory developed by Gary Becker (1994). According to this perspective, by investing in education and training, a person becomes a more valuable worker. This way, soft skills development in engineering education may lead more work-ready graduates who possess the required skills to contribute to the labour market. On the other side, the dissertation also considers an alternative purpose of soft skills development based on human capabilities approach theorised by Martha Nussbaum (2011). The author highlights that education is of utmost importance to live a dignified life, and she advocates the development of soft skills along the educational path because it can contribute to the formation of individual identity, develop critical awareness, and produce more socially responsible citizens.

To summarise, the research project primarily aims to examine how teaching and learning methods can develop the soft skills of postgraduate engineering students. The secondary aim of the research is to investigate the relevance and purposes of soft skills development in higher education (HE).

1.1 Background of the research project

This subchapter answers the question *‘How the research question emerges?’* by identifying a gap in academic knowledge and establishing initial motivation for undertaking the research. Firstly, it establishes the field of definitions by elaborating on the notion of ‘soft skills’ by historical background, multiple interpretations, and taxonomy. Secondly, the subchapter justifies the study by highlighting the role of engineering and IT sector of the UK economy, the role of the UK universities in preparing skilled engineering workforce, and the role of postgraduate engineering education.

1.1.1 Term 'soft skills': history, terminology, and taxonomy

1.1.1.1 Historical background

The origin of the term 'soft skill' can be traced back to the US Military in the early 1970s. To capture how success at combat can be derived from how the troops are lead and motivated (Whitmore & Fry, 1974), the US military coined the term 'soft' skills in contrast to 'hard' skills which involved working with machines.

During the 1980s, the term 'soft skills' was transferred to the industrial world and corporate environments (OECD, 1996). The need to maximise the profit forced numerous manufacturing and service companies to invest in human capital or knowledge and skills of employees (Becker, 1994). This movement led to 'significant changes in employment trends, career patterns and skill demands' (Hodgson, 2000: 4) which resulted in increasing demand across various sectors for multi-skilled workers who possess both technical knowledge, hard skills, and soft skills (Hayward & James, 2004).

Currently, the soft skills are considered crucial for employment at any organisation or enterprise and are essential for the competitiveness of any company on the market (Cimatti, 2016). Thus, employers highly value soft skills (Cinque, 2016; McKinsey Global Institute, 2013; 2014). Today, soft skill requirements may be commonly found in job advertisements (Ahmed et al, 2012; Cacciolatti et al, 2017), labour power strategies, and employers' practices, including recruitment, selection, training, and corporate culture (Hurrell et al, 2013).

1.1.1.2 Multiple definitions and names

According to both employers and academic researchers, it is difficult to define soft skills in a univocal way (Cimatti, 2016; Cinque, 2016; McKinsey Global Institute, 2013) since both naming and definition vary across contexts, research institutes, and countries. For instance, some other ways to name soft skills are transferable skills, generic competencies, key competencies, transversal competencies, core skills, social competencies, interpersonal skills, 21st-century skills, basic or life skills (Abdulwahed et al, 2013; Cimatti, 2016; Cinque, 2016).

Moreover, Cinque (2016) outlines a chronological record of organisational frameworks which take various approaches towards the topic of soft skills, as listed in Figure 1. Also, soft skills are context-specific, i.e. they depend on the work context and, thus, are interpreted differently by a variety of bodies (Hurrell et al, 2013).

Figure 1. Organisational frameworks to define soft skills (Cimatti, 2016; Cinque, 2016)

Additionally, words ‘skills’ and ‘competencies’ should not be used interchangeably: these notions are not necessarily synonyms, as OECD clarifies (Rychen & Salganik, 2000: 67):

> ‘competence refers to the ability to meet demands of a high degree of complexity [...] [while] skill is used to designate the ability to use one’s knowledge with relative ease to perform relatively simple tasks’.

To summarise, in the present study, the notion of ‘soft skills’ will be defined next way: *Soft skills indicate personal and interpersonal transferrable competencies which are essential to delivering technical skills accurately*.

1.1.1.3 Classification

While there exists an array of classifications of soft skills (Cimatti, 2016; Cinque, 2016), Abdulwahed & Hasna (2017) established a taxonomy which emphasises global competencies relevant for engineering graduates. From a literature review of more than 500 engineering and non-engineering articles and academic materials, the researchers proposed to cluster global competencies, which are essential for the prosperity of iKBEs. Each of the proposed dimensions included a specific set of knowledge, hard, and soft skills (Abdulwahed & Hasna, 2017):

- **Dimension I – Core Knowledge and Practice:** science knowledge (math, physics, and science fundamentals), disciplinary fundamentals, interdisciplinary fundamentals, multidisciplinary knowledge, practical experience, and ICT skills.
- **Dimension II – Cognition, Mental, and Thinking:** lifelong learning, problem solving, decision-making, analytical thinking, systems thinking, critical thinking, creative and Innovation, design.
- **Dimension III – Professional and Interpersonal:** Professionalism, ethics and responsibility, adaptability, communications, teamwork, foreign languages.
- **Dimension IV – Business and Management:** management, leadership, and entrepreneurship.

The notion of 'soft skills' in this research project aggregates the global skills of an engineer from Dimensions II, III, and IV. To make the final list for the research project more concise, some of the skills were either merged (like ethics and professionalism) or not covered. For example, foreign languages and skills from Dimension I constitute either knowledge or hard skills; therefore, they are out of the scope of the study. In Appendix A, each soft skill is provided with a generic definition compiled by Abdulwahed et al (2013).

1.1.2 Rationale for research

1.1.2.1 Role of engineering and IT sector in the UK economy

The engineering sector is a crucial component in the UK economy due to several reasons. Firstly, the sector's turnover contributes to up to 27% of GDP of the country (ECITB, 2018).

Secondly, engineering enterprises employ 20% of the UK workforce (EngineeringUK, 2018). Although IT sector has a less significant contribution to the UK economy – just 7% of the UK GVA (UK Parliament, 2017), it has one of the highest and stable growth rates among other industries. The PwC report (2018) shows that the IT sector has been showing above the average UK GDP growth over the last 20 years. These numbers strongly indicate that the engineering and IT sectors are critical for the UK to maintain its top positions among world economies and iKBE countries (World Bank, 2012).

Furthermore, the current situation on engineering and IT labour markets gives another perspective to focus on the skills of engineering graduates. According to the latest industry reports (ECITB, 2018; EngineeringUK, 2018), the UK labour market is expected to experience an estimated annual shortfall of approximately 22,000 engineering graduates. For the IT sector, the annual shortage is even higher – 53,000 job positions (The Tech Partnership, 2016). On the one hand, some of these numbers may be explained because less than a half of graduates who choose full-time work enter engineering professions (ECITB, 2018), while others find occupations in alternative destinations (mostly finance, banking, and retail). On the other hand, according to the previous employer surveys in the UK, the main reasons skills shortage include lack of work experience and lack of demanded qualifications and skills (Schwalje, 2011). Engineering and IT sectors are not exceptions: multiple industry reports suggest that engineering graduate attributes do not correspond to the current occupational requirements (ECITB, 2018; EngineeringUK, 2018; The Tech Partnership, 2016). More specifically, employers report that new graduates lack both required STEM qualifications and soft skills (Ahmed et al, 2012; ECITB, 2018; UKCES, 2015). Engineering and IT enterprises value interpersonal skills like teamwork, leadership, and ability to work in multicultural environments (EngineeringUK, 2018; Fernandez-Sanz et al, 2017; Nilsson, 2010) among both fresh engineering graduates and experienced job seekers. Additionally, many scholars and corporate experts point out that many graduates experience barriers to their labour market integration due to lack of employability skills (EngineeringUK, 2018; Gokuladas, 2010; Lowden et al, 2011; Pritchard, 2013; Stephens, 2013). All these arguments lay the groundwork for focusing on the reasons behind the lack of soft skills among engineering and IT graduates.

Skill shortages may create serious financial implications for enterprises (Schwalje, 2011) and on a larger scale – economic ramifications for the UK. That is why the employers across engineering and IT industries tend to agree that the engineering workforce is not provided with 'the right education for today's economy' (ECITB, 2018: 26). However, not all the 'blame game' should be directed at employees or educational institutes. Indeed, in some cases, inadequate HR practices and poor corporate culture may be the reason for an organisation's skill gaps (Hurrell, 2016). Nevertheless, the industry reports together with academia suggest strong evidence that there are competence gap and expectations mismatch between HEI and employers (Cacciolatti et al, 2017; ECITB, 2018; EngineeringUK, 2018; Lowden et al, 2011; Mohamad et al, 2017; Thurner et al, 2012). As highlighted by Cacciolatti et al (2017: 149), 'if universities really want to improve employability, they cannot afford ignoring employers' needs'. Therefore, to ensure the vitality of the UK economy, the HEI need to guarantee the development of soft skills of graduates in STEM-related fields, which include engineering and IT.

1.1.2.2 Role of UK universities in preparing skilled engineering graduates

Multiple stakeholders raise the necessity to develop soft skills of engineering students in the UK universities. To start with, engineering and IT enterprises distinctly demand soft skills when promoting starting position jobs among fresh graduates and job seekers (Ahmed et al, 2012; UKCES, 2015). Secondly, engineering graduates already employed in the field advocate that educational programmes should focus less on the substantive content of the engineering curriculum but rather integrate a soft skills component (ECITB, 2018; Nilsson, 2010; Pons, 2016). Finally, the engineering students themselves express the interest in obtaining soft skills training during the educational path (Urs & Catelly, 2010).

Scholars point out that focusing equally on teaching hard and soft skills exhaustively constitute professional competences of an engineer (Cimatti, 2016; Dalrymple & Dalrymple, 2017; Shekhawat & Bakilapadavu, 2017). Currently, to guarantee that UK engineering education imply students' achievement of a standardised set of soft skills, the regulatory body for the UK engineering professions, the Engineering Council, explicitly requires engineering and IT accredited courses to address soft skills like communication, ethics, teamwork, professional commitment, and management or leadership (Engineering Council, 2014a; b).

Under these circumstances, HEI should primarily establish effective collaboration among principal stakeholders: the faculty, students, accreditation bodies, and the engineering industry (Kaushal, 2016). On the other hand, some researchers are critical about the HEI' position to cater to the divergent needs of various stakeholders. According to Cacciolatti et al, while making an attempt to reduce the unemployment and simultaneously trying to train highly skilled professionals, the UK universities fail to achieve both, producing rather semi-skilled 'shallow generalists' (2017: 150). To foster the upskilling and boost innovation, needed for the iKBE, the universities, policymakers, and employers should introduce apprenticeships and programmes that promote critical thinking, creativity, communication skills, and problem solving (Cacciolatti et al, 2017).

In attempting to produce highly skilled specialists to drive the iKBE, the UK universities follow a general 'graduate attributes' framework to address the soft skills development of their graduates. The graduate attributes are a collection of diverse qualities that a university graduate may develop during his journey in an educational institute (Hager & Holland, 2006). For instance, in the University of Glasgow (UoG), this collection includes the academic abilities, personal qualities, and transferable or skills (University of Glasgow, n.d.-k). Due to a growing tendency of university curricula to serve the interests of global economy and 'emerging employability imperatives' (O'Donnell et al, 2017: 19), the graduate attributes, and as a result, soft skills play more and more critical role in HE.

1.1.2.3 Role of postgraduate engineering education

In 2018, Higher Education Statistics Agency (HESA) reported that over the last decade there had been a 24% increase in postgraduate taught (PGT) student numbers in the UK (HESA, 2018a). Despite the UK's decision to leave European Union in 2016, the popularity of UK Master degrees in the world remains on the same level and even slowly grows from year to year (HESA, 2018b). Furthermore, international graduates contribute to the perspective workforce in engineering and IT sector by making up to 69% of all PGT students in engineering fields (EngineeringUK, 2018) and 60% of all PGT students in the IT field (HESA, 2018c). On the other side, despite great employability of postgraduates (Smith et al, 2010), various employers do not equal a PGT degree to a guarantor of quality and, instead, they see deficiencies in postgraduates' soft skills (CIHE, 2010).

To summarise, postgraduate engineering education becomes vital for sustaining the UK's world-leading research base and essential for the UK economy to maintain its competitive advantage among iKBEs. Furthermore, there is very little research being conducted on soft skills development in postgraduate engineering education. Previous systematic reviews of engineering competencies (Abdulwahed & Hasna, 2017; Passow & Passow, 2017) together with a range of academic examples from previous subchapters focus primarily on undergraduate engineering students. This finding indicates additional evidence of a gap in the academic literature that this research project attempts to bridge.

1.2 Purpose, aims, and objectives of the study

The research aims to investigate how teaching and learning methods in PGT engineering education can develop the soft skills of Master engineering students. For that, the study explores the perceptions and perspectives of PGT students and professors on teaching and learning. The findings of the study will help to identify the existing pedagogical practices in postgraduate engineering education and their justification; enhance the teaching and learning methods used by teaching staff to prepare more skilful engineering graduates; ultimately, improve the learning experiences of Master engineering students regarding their satisfaction, engagement, and achievement of learning outcomes. The outcomes of the research project are expected to be reported to the Learning and Teaching Conveners of the College of Science and Engineering at the University of Glasgow.

The research objectives are clustered into three major topics for both PGT engineering students and the professors: (a) the relevance of soft skills and their development in higher engineering education; (b) perceptions of existing pedagogical practices in PGT engineering education; (c) suggestions to enhance the existing teaching and learning strategies. Therefore, the study raises ‘specific’ research questions (Punch, 2016: 49):

1. (a) Which soft skills are valued by PGT engineering students and professors? Why?
2. (b) Which current pedagogical practices used in PGT engineering education address soft skills?
3. (c) How do students and professors envision soft skills development in PGT engineering education?
4. (b) What are the main challenges to modifying teaching and learning methodologies for professors?
5. (d) What strategies can be adopted to improve pedagogical approaches to teaching soft skills?

1.3 Significance of the research

Previous studies mostly focus on quantitative or mixed-method approaches when assessing the perceptions of students or lecturers on their learning or teaching experiences. This study takes an interpretivist approach to understand the phenomena, accepting multiple viewpoints from many individuals from different groups. It allows gaining more insights and ‘in-depth’ information (Mack, 2010; Thanh & Thanh, 2015) about teaching and learning methods used in engineering education and what students or professors perceive as soft skills development.

Moreover, there is a lack of academic literature on soft skills development as in postgraduate engineering education, so in the United Kingdom as a geographically designated area. Lastly, most of the scholars consider the benefits of soft skills development in HEI mostly through the human capital theory lens, associating it with further career prospects, ability to meet the fast-changing demands of the industries, and enterprises’ productivity levels (Bryson et al, 2018; Cacciolatti et al, 2017; Cinque, 2016; Youth Employment Funders Group, 2017). This research study also considers an alternative perspective on education – Nussbaum’s human capabilities approach (2011).

1.4 Structure of the dissertation

The dissertation is structured in the following manner. Chapter Two describes an extensive literature review conducted to critically evaluate the existing theoretical and empirical data in the academic and non-academic literature on soft skills development in engineering education. Chapter Three provide philosophical underpinnings behind soft skill development in higher engineering education based on two opposing theoretical frameworks. As a result, these chapters justify and frame the research question and objectives that address a gap in the academic knowledge. Chapter Four underpins the methodological approach used to design the research project. Chapter Five presents the empirical findings and further discusses them through comparison and contrast with the literature review and conceptual frameworks. Finally, Chapter Six concludes the study and proposes recommendations for teaching staff and further research.

2 Chapter Two: Literature Review

Review of the academic literature identifies a variety of ways to include soft skills development in HEI. The Malaysian Institute of Higher Learning has developed a model, which suggests multiple approaches to implementing soft skills in HEI (Shakir, 2009). Figure 2 presents at least four distinct pathways to develop soft skills: teaching a stand-alone subject; teaching through an embedded model; co-curricular activities (support programmes); extra-curricular activities (campus life).

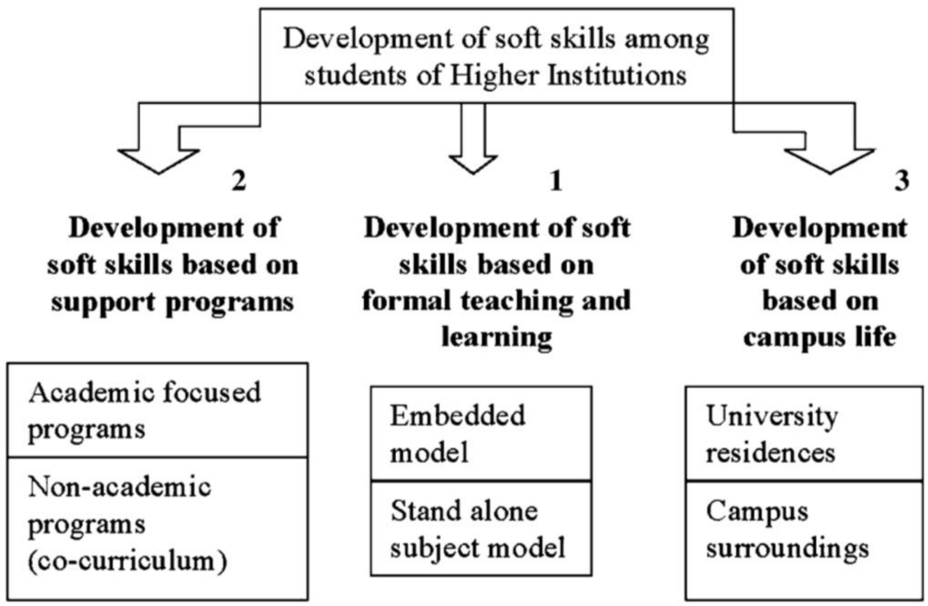

Figure 2. Models to implement soft skills development in higher education (Shakir, 2009)

Notably, other classifications of methods to teach soft skills in HEI were also considered. For instance, ‘Tuning’ Project (Cimatti, 2016) proposes alternative approaches based on time deviations. However, the chosen model proposed by Shakir (2009) appears to be more comprehensive and complete regarding the overall activities in the HEI context. This chapter details the first two approaches of this model including diverse instructional strategies and cases relevant to STEM education and later discusses the implication for PGT level of engineering education. The last two models of soft skills development are non-formal education approaches lacking educational research. Thus, they are out of the scope of this study and, therefore, are not included in the literature review.

2.1 Stand-alone subject model

To provide an opportunity to develop soft skills on a formal basis and at a deeper level, faculties may offer students to complete elective courses as a part of their degree. For instance, some undergraduate engineering programmes feature optional business and management subjects during the second year of studies (University of Glasgow, n.d.-j). Various papers across the world confirm that this approach serves numerous purposes, and it affects beneficially both undergraduate and postgraduate engineering students.

For example, in Portugal, first-year engineering students successfully undertaking a course 'Projeto FEUP' receive 2 ECTS credits added to their degree (Sousa & Mouraz, 2014). The programme aims to integrate the students into the university environment and improve their key competencies like teamwork, communication skill, organisational skills, and self-esteem. The results of the study indicate positive trends regarding soft skills improvement and students' satisfaction and engagement.

A different course in India, called 'Life Skills', aims to raise the importance of soft skills among first-year engineering and IT students and complement their technical knowledge with employability skills (Shastri, 2015). The curriculum of the programme is based on industry requirements and covers a large set of soft skills including communication skills, logical reasoning, confidence building, presentation skills, and leadership. The study discovers a growing tendency (up to 100%) of students who successfully finished the 'Life Skills' programme to find a placement right after their graduation.

On the other hand, Master engineering degrees may combine both management and engineering courses due to a shorter period nature of PGT level studies. For example, Electrical Engineering and Management programme in the University of Glasgow (n.d.-h) features one semester with a compulsory block of management courses like Managing Creativity and Innovation (University of Glasgow, n.d.-a) and one semester dedicated purely to engineering subjects. A similar practice exists in Birla Institute of Technology and Science (BITS), Pilani, India. A course on Business Communication and Technical Report Writing offered to both undergraduate and postgraduate engineering students, is designed to enhance oral and written communication skills and connect students with the industrial environment (Shekhawat & Bakilapadavu, 2017). The programme enables students to practice various types of communication skills (business presentation, active listening, interview skills, conflict management, cross-cultural communication) and features an interactive teaching approach including group discussions, teamwork, and ample space for practice.

As shown previously, the examples of stand-alone subjects on soft skills mostly take place during undergraduate studies, as they stretch over a more extended period than PGT level studies. In such situation, the undergraduate students have more flexibility to develop the soft skills of their interest and combine multiple ‘softer’ subjects; whereas programme leaders and teaching staff can design more intense learning experiences for students and teach the soft skills in depth.

Despite the apparent benefits of this model, recent trends consider the teaching of soft skills separately from hard skills as an obsolete approach. The argument is that soft and hard skills are usually applied side by side at the workplace, and it is more useful to study soft skills within the context of technical knowledge; thus, educators should consider teaching them in an integrative manner (Cimatti, 2016). When considering the PGT level, time management aspect strengthens these arguments, as it may be a challenging task to include separate softer subjects into the engineering curriculum. Also, even if a Master programme explicitly prepares managers in the engineering field, the approach of including purely managerial topics in engineering curriculum remains debatable.

2.2 Embedded model

A more practical way to incorporate soft skills component in HEI is to embed or interweave them into existing course content through different pedagogical methods. The approach seems more pragmatic, as, in some cases, it requires minimal or almost no changes to the current course content (Shakir, 2009). In this model, the faculty, firstly, has to identify specific graduate attributes to be developed. Secondly, it should recognise which subjects can be reasonably infused with softer elements. Then, the lecturers and teaching staff should be closely involved in the implementation process; while the students should become aware of the soft skills items (Kaushal, 2016) and their assessment methods during the module (Shakir, 2009). The academic literature provides a range of examples on how to integrate soft skills into the teaching process in engineering education and why the embedded model appears to be more effective than a stand-alone subject model.

2.2.1 Project-Based Learning

To start with, one of the oldest and most favoured instructional strategies used in engineering teaching community is Project-Based Learning (PBL). Project-based learning is a student-centred pedagogical approach where students comprehensively investigate complex engineering problems in a multidisciplinary manner and work on real-world challenges in teams within a limited timeframe. The students are expected to be actively involved in the learning process, while the teacher takes the role of a facilitator or a mentor. According to several papers, PBL, applied in engineering curriculum, enhances improves students' engagement and motivation (González-Morales et al, 2011); promotes communication skills and critical thinking (Hadim & Esche, 2002); fosters initiative, design thinking, independent learning, and results in 'significantly better qualifications in cooperation'. Moreover, a review of the 20-year experience of applying PBL in higher engineering education concludes that it is the 'most adequate educational methodology' (de Los Rios et al, 2010: 1377), which offers multiple opportunities for students to develop technical, contextual and behavioural competencies and immerse in pre-professional experience.

Also, to tailor the learning process to the faculty requirements, university context, and the needs of the students, PBL recently gained several modifications. For instance, a study in the U.S. used a 'scrum' method to infuse leadership skillset into engineering education (Stawiski et al, 2017). Initially developed in software engineering, 'scrum' technique helped student teams to lead themselves through complex projects that required a high level of collaboration and innovation. The study showed that in a series of iterative two- or three-week stages or 'sprints', team members practised and developed self-awareness, self-management, problem-solving, creativity, and communication skills; and learnt from experience how merging development of technical knowledge with soft skills impacted the outcomes of the project. The article implications also suggest initial evidence that infusing leadership development using scrum practices into an existing engineering course can be more effective than adding a separate component to the programme structure.

2.2.2 Problem-Based Learning

A second instructional approach commonly used in engineering education is called Problem-Based Learning (PrBL). Although PBL and PrBL partly have shared goals and some implementation aspects like combining both teamwork and independent learning, they are nonetheless two distinct teaching techniques. Brassler & Dettmers (2017) provide an array of differences between both pedagogies; however, the most fundamental contrast lies in their ultimate goal and core process. While PBL focuses on creating a tangible product by following the broad steps of project management, PrBL emphasises learning and knowledge acquisition and follows specific steps to analyse a problem. Initially started in medical school education in the 1960s (Takahashi & Saito, 2013), PrBL is now widely used in HEI, including engineering education. A notable example of designing and implementing PrBL in an engineering curriculum in Scotland was described in a recent paper by O’Donnell et al (2017). Firstly, the study identified a list of specific soft skills by surveying industry employers. Later, the authors created two research-based case studies for students with numerous stages, which addressed every skill on the designated list. Through students’ reflective accounts and mid-term evaluations, the study showed that the students considerably improved many of the skills from the list, though the integrated course should have given more time to practice critical reflection. Noteworthy, ‘[a]ll students felt that their sense of identity shifted towards belonging to a professional engineering community’(O’Donnell et al, 2017: 35).

2.2.3 Other active instructional strategies

Apart from PBL and PrBL, standardly used in engineering education, there is a spectrum of other active learning methodologies, which can be implemented also in an engineering context. Cinque (2016) lists cooperative learning, action learning, experiential learning, reciprocal learning, progressive mastery, critical reflection, and active seeking of meaning. Moreover, the researcher collects soft skills teaching strategies both from university and corporate sector, grouped into expository, guided, and active (Cinque, 2016), as shown in Figure 3.

Expository	Guided	Active
Lecture	Discussion, debate	Brainstorming
Seminar	Workshop	Role play
Conference	Case study	Business game
Demonstration	Project work	Visits, Journeys
	Simulation	Outdoor training
	Mentoring	Coaching

Figure 3. Soft skills teaching strategies (Cinque, 2016)

Particular attention should be given to guided and active teaching practices involving two-way communication between teachers and students. According to Esa et al (2014), it is easier for students to practice soft skills if they are encouraged by lecturers through their teaching classroom practices. For instance, in a UK study of Pulko & Parikh (2003), first-year engineering students of the University of Hull were offered a module based on four study skills sessions: presentation skills and personal impact, report writing, teamwork, and working in projects. The authors highlight dynamic teaching intended to increase the interest, personal relevance, and attention span of students. Some of the pedagogical tools included an empathic and captivating introduction, elements of storytelling and humour, group exercises, brainstorming, simulations, opinion polls, and an overall preference towards facilitation of learning experiences instead of lecturing. The results of the study indicated a significant improvement in student engagement and perception of personal relevance compared to traditional lectures. The outcomes of this study are in line with research on teaching and learning methods fostering generic attributes which reveals that they are best developed by active approaches (Moy, 1999). To illustrate, Hager & Holland (2006) highlight several active learning considerations. Firstly, the instruction may be based on adult learning principles or andragogic assumptions (Knowles, 1984). Secondly, passively transferring factual knowledge may be replaced with teaching 'how', 'why', and exploring 'what if' which can be achieved by basing the instructional strategies on experiential learning cycle (Kolb, 1984) or 4MAT system® (McCarthy & McCarthy, 2006). Finally, the teacher may assume and switch various roles during the teaching process: facilitator, presenter, mentor, coach, or evaluator.

To conclude, teaching engineering community tends to prefer more the embedded model for soft skills development due to its effectiveness and efficiency: training engineers and developing excellent communicators and leaders can be achieved simultaneously (Stawiski et al, 2017). Moreover, integrated multidisciplinary approaches like PBL or PrBL comprehensively prepare engineering students for professional environments and allow developing soft skills within the context of technical subject knowledge. Indeed, the data from the academic literature review strongly suggests that modified courses develop students not 'at the expense of their engineering education, but in addition to' (Stawiski et al, 2017: 345). Furthermore, dynamic classroom teaching practices and relevant active instructional strategies also play a crucial role in nurturing students' soft skills and improving their satisfaction, engagement, motivations and personal relevance of a given subject.

Also, there is a belief in academia that the embedded model is relatively easy to implement in engineering education (Cimatti, 2016), especially when the benefits are clear, and some frameworks for incorporating soft skills are developed (Barrie, 2007; Inra et al, 2016). However, due to constant and rapid changes of engineering profession including its global mobility, multicultural environments, and overall pace and nature of technological advancements, the content and the pedagogies in engineering education remain a matter of hot debates (O'Donnell et al, 2017). Therefore, not all initiatives to embed generic attributes into engineering courses are met with enthusiasm: some colleagues express apathy, while others – even resistance to changes (Barrie, 2012). In this situation, modifications in course structure and pedagogies require strong educational leadership, orientation towards the industry, and decisions, based on the hard evidence from educational research.

2.3 Implications for PGT level studies

Currently, the UK universities tend to take a 'blanket approach' (Anderson, 2017: 11) in developing graduate attributes and soft skills of PGT students that does not differ among both undergraduate (UG) level and PGT level students. Although this approach reflects institutional aspirations and philosophies, it may often disregard the backgrounds of students entering Master level studies as well as the nature of postgraduate education. Firstly, the PGT-student body mostly comprises students transitioned directly from UG studies, international students, and students who return to HEI after a work period (Thomson, 2015), making Master students a heterogeneous group with their motivations, numerous educational experiences, expectations, and support needs (Alsford & Smith, 2013). Secondly, in the UK, PGT programmes compared to UG and postgraduate research studies tend to be 'short and fat' rather than 'long and thin' (Anderson, 2017: 12), meaning that they are time intense and full in curriculum subjects. All listed factors make PGT studies challenging and may not leave enough room for students to take a 'deep' learning approach (Biggs & Tang, 2011) to comprehensively develop soft skills, particularly, through stand-alone subjects or extra-curricular involvement. This way, for engineering students, an embedded model appears to be a more effective way to foster soft skills.

3 Chapter Three: Theoretical Frameworks

In the previous chapter, the prime justification for focusing on the soft skills of engineering graduates was stipulated by their practical implications to contribute to the productivity levels of the UK workforce (EngineeringUK, 2018). In this scenario, HEI transform into an 'educational pipeline' (EngineeringUK, 2018: 9) producing a highly skilled workforce, and the educational aims shift towards solely vocational. However, various researchers are critical about a wholly economic-driven approach to education while advocating differing educational purposes and pedagogies (Baptiste, 2001; Biesta, 2009; Nussbaum, 2011). Thus, this chapter aims to underpin the development of soft skills in engineering education through an alternative conceptual framework besides the human capital theory, namely, Capabilities approach by American philosopher Martha Nussbaum. For that, firstly, the chapter provides a short background on human capital theory and its academic critique. Secondly, the given theoretical approach is discussed to provide an additional rationale for soft skills development in higher engineering education. Finally, the implications for the research project design are outlined.

3.1 Human capital theory at a glance

The notion 'Human Capital' started increasingly to appear in academic and non-academic literature from the mid-twentieth century and was propagated mainly by two eminent economists and Nobel Prize winners, Gary S. Becker and Theodore W. Schultz. According to Becker, human capital comprises a person's 'knowledge, skills, health, and values' (1994: 16). By investing in education, training, and medical service, one can directly increase the professional capabilities and productivity levels, and on a broader scale, bring organisational added value and economic benefits for a nation-state (Becker, 1994). This way, education and training are primarily considered as the most significant investments, as they contribute to developing productivity and resourcefulness of workers.

The theory's implications for education have both advantages and disadvantages. On the one hand, human capital approach and resulting quantification of education may invite substantial funding and expenditures to the educational field, including modernisation of educational institutes, enhancing teaching and learning technologies, and teacher preparation. On the other hand, the ‘public opinion swells to exaggerate the economic purpose of education’ (Sweetland, 1996: 356) that results in educational providers, policymakers, and educators constantly chasing the market demands in skills. This endless race shifts principal educational aims towards more economic-driven and explains perpetual gaps between employers’ needs and HEI’ skills supply.

Notably, nearly every academic paper, discussed in the previous chapter, validates soft skills and graduate attributes development in higher engineering education through the human capital theory lens. This way, the direct effects of soft skills development are assumed to include enhanced employability, increased effectiveness of graduates at the workplace, and ability to meet the fast-changing demands of engineering and IT industries that will ultimately keep the UK economy competitive and top-ranked among other iKBEs.

However, the human capital theory features significant deficiencies from the perspective of educational research. Firstly, it leads to the economisation of education (Spring, 2015), which turns the educational field into a competitive marketplace with customer relations (Schreurs, 2016). In this paradigm, ‘good’ education constitutes cost-efficient education which focuses on the fulfilling the learning outcomes and satisfying the needs of the customers instead of value-based holistic development of a person (Biesta, 2013). Additionally, the human capital theory disregards existing social inequalities in societies (Nussbaum, 2011), as income and wealth are not necessarily the proxies to measure the capabilities or life possibilities of individuals. To summarise, the theory appears reductionist, as it ‘treats humans as lone wolves: radically isolated hedonists, creatures of habit (not intentions) who temper their avarice with economic rationality’ (Baptiste, 2001: 197).

3.2 Contribution of Capabilities Approach

The Capabilities Approach (CA), firstly formulated by Amartya Sen and often referred to as Human Development Approach, evolved as an alternative paradigm of comparing the quality of human life not through average economic indicators like GDP per capita but individual capabilities of a human being. Martha Nussbaum defined capabilities as human potentials, freedoms, and opportunities to choose and to act (2011), e.g. access to education, life expectancy, political liberties, or employment prospects. The central concern of CA is ‘what is each person able to do and to be’ instead of a person’s income and productivity levels (Nussbaum, 2011: 20). According to Nussbaum, living a dignified life equals achieving a minimum level for most significant capabilities or Central Capabilities (Nussbaum, 2010; Stewart, 2013). This way, the role of nation states is to secure all citizens to reach the threshold. Thus, CA can be used to diagnose both the levels of the individual human dignity social justice within a country.

In this paradigm, education has vital importance to be able to live a life full of value (Wood & Deprez, 2012), and it serves as one of the primary measures to promote human capabilities and alleviate social justice. Specifically, in higher engineering education, CA can change the economistic discourse to wider intellectual and moral ones, promoting human prosperity and well-being (Cimatti, 2016; Cinque, 2016; Hart, 2013; Nussbaum, 2010). For instance, Walker (2006) and Peercy & Svenson (2016) suggests alternative roles for HEI instead of employability-driven ones: contribution to the formation of individual identity, fostering tolerance, increasing awareness and responsibility for social inequality issues, and generally strive for equitable human development. Furthermore, Nussbaum (1997), being concerned about profit-making trends in higher engineering education, strongly advocates liberal arts education which focuses on preparing open-minded, critically autonomous, and engaged in societal matters active citizens (Eide, 2014; Elias & Merriam, 2005). Regarding engineering education, Walker (2015) argues that capability-friendly science and engineering education would be not only instrumentally but also intrinsically and socially valuable. In this context, the curriculum and pedagogies address students’ capabilities and encourage an attitude of understanding other peoples’ lives and concern to develop individual capabilities through professional contributions (like developing cheap and sustainable energy sources or simple technologies for water supply in a community).

In the case of soft skills development in engineering education, CA can provide a solid foundation for more holistic and humanistic development of engineering students. For example, there is a significant difference in teaching creativity merely to become more employable and organisationally productive or to create frugal technologies for communities and address other societal challenges and improve the capabilities of disadvantaged groups. A study, undertaken by Boni et al (2012) in a Spanish technical university, found that an elective subject on Development Aid Projects, provided in the engineering curriculum, contributed to students' interdependent and global vision of development. The article reports that the capability-based course featured various real-world societal cases studies and a dynamic teaching approach by professors and civil society organisation members. Additionally, the study advocated for a holistic engineering education by including humanities in the engineering curriculum to develop cosmopolitan students' capabilities and cultivate humanity among engineering graduates. Furthermore, Boni-Aristizabal & Calabuig-Tormo (2016) argue that formal and informal engineering education has the potential to promote pro-public-good professionalism among students and foster capabilities including participation, commitment, empathy, intercultural respect, critical thinking, and self-reflexivity.

To conclude, based on CA, Walker (2015) argued that science and engineering education allows living a rich human life. However:

> 'capability is a kind of power, and it would be a mistake to see capability only as a concept of human advantage, not also as a central concept in human obligation' (Sen, 2008: 336).

This way, an emphasis on soft skills development among engineering students may be justified by the formation of graduates with a high sense of responsibility and commitments to make professional contributions oriented to the society. Although it may be complicated to shift current economic-driven trends and human capital implication in education towards more humanistic and holistic, the change can start from speaking the language of capabilities instead of employability-driven language skills and competencies (Boni-Aristizabal & Calabuig-Tormo, 2016). According to the researchers, CA could be beneficial if used to complement the mainstream skills-based approach in HEI. Therefore, the CA has the potential to redefine the purposes of soft skills as well as to change the vocabulary of 'soft skills' in the prevailing human capital paradigm.

3.3 Implications for the research project design

This section shortly discussed the human capital theory, which mainly motivates the contemporary academic literature on soft skills development in engineering education. The human capital theory also provides a theoretical framework for this research project. However, the chapter provided an alternative conceptual framework based on the Capabilities Approach by Martha Nussbaum that provides an unconventional viewpoint on the justification of soft skills development in engineering education. Therefore, the contrast of the human capital approach and CA extends one of the research objectives to investigate the relevance and perspectives on purposes of soft skills in engineering education from students and professors. This way, the study additionally intends to identify whether soft skills development in engineering education is reasoned by purely career-oriented or also by human development aims.

4 Chapter Three: Methodology

This section describes and justifies the methodology undertaken to address general and specific research questions emerged from the previous chapters. For that, firstly, the type of educational research and current methodology are reflected in specific philosophical underpinnings. Secondly, the chapter discusses the sampling and ethical considerations during the participants' recruitment and data gathering stages. Further, it underpins and details data collection techniques and data analysis procedures. Finally, the researcher's position and current research project limitations are outlined and elaborated.

4.1 Research aims

The prime aim of the study is to examine how effectively teaching and learning methods applied in engineering education facilitate the soft skills development of PGT students. To gain a deeper understanding of the phenomenon, the study examines the teaching and learning process in PGT engineering education from the viewpoints of Master students and professors, teaching in corresponding Master level courses. Also, emerging from Theoretical Frameworks, another aim of this study is to investigate the relevance and perspectives on purposes of soft skills development in higher engineering education.

4.2 Research framework

To justify the methodology, it is of utmost importance to identify the ontological and epistemological positions relevant to the current research project. This study focuses on teaching and learning process in HE that is a multifaceted phenomenon perceived differently by different parties (Willis et al, 2007): students, professors, and programme leaders. Therefore, '[the] reality is neither objective nor singular, but multiple realities are constructed by individuals' (Arthur et al, 2012: 16). This statement suggests a constructivist ontological research position. As the reality of teaching and learning process is not transparent but seen from different viewpoints, the construction of knowledge about the phenomenon is developed through ‘the act of interpretation [that] produces a ‘truthful perspective rather than the truth’ (Cousin, 2013: 126). Such epistemological position, namely interpretivism, accepts multiple perceptions and perspectives and allows to discover the realities through participants’ eyes, backgrounds, and experiences (Creswell, 2014). Therefore, it leads to a more comprehensive understanding of the situation (Morehouse, 2012). In educational research, the interpretivist paradigm is often adopted to understand the social reality better (Mack, 2010) and generate rich, ‘in-depth’ data (Thanh & Thanh, 2015), also called ‘thick descriptions’ (Geertz, 1973). According to Thanh & Thanh (2015), it is a qualitative research methodology that allows deeper understandings, experiences, and interpretations of students’ and teachers’ reality, including student-teacher interactions. Moreover, in the context of teaching and learning in higher engineering education setting, qualitative research is more valuable than quantitative (Cousin, 2013), as it captures different aspects which are hard to measure like learners’ anxiety, teacher-student trust, or rules of engagements.

The particular qualitative methodology, chosen for this research project is a case study research, as it explores a specific phenomenon in a particular context, namely, teaching and learning process in postgraduate engineering education. This study answers the *why* and *how* research questions (Arthur et al, 2012); aims to understand the case in depth, recognising its complexity and context (Punch & Oancea, 2014); and also, has the potential to evaluate the effectiveness of the case. Thus, this case study is ‘evaluative’ (Cohen et al, 2018: 377): it evaluates multiple cases in teaching and learning in PGT engineering and IT programmes in two different university schools.

4.3 Sample

The participants of the study were current PGT engineering students and their professors from UoG. This university is remarkable for its high employment rates among engineering and IT graduates and overall excellent reputation of respective schools in Scotland and the United Kingdom. According to the data of Times Higher Education (2018) and Complete University Guide (2018), the engineering and IT programmes in UoG hold top positions in both graduate prospects and overall scores among other Scottish universities. On the other side, the above-average rankings of teaching quality based on students' satisfaction rates in these programmes indicate some room for improvement in instruction. Moreover, a complementary reason to recruit students and professors from UoG was their accessibility for interviews.

To acquire 'in-depth' information about teaching and learning cases in PGT engineering education in UoG, the research project targeted students and their professors from the School of Engineering (ENG) and the School of Computing Science (CS). A variety engineering- and IT-related Master degrees stipulated the selection of the schools. Notably, apart from purely engineering degrees, ENG also offers joint PGT engineering and management programmes.

Nevertheless, the sampling procedure varied for students and professors. Snowball sampling was used for recruiting students from each school, appearing to be a successful sampling practice. The professor-participants were initially selected using purposive sampling (Cohen et al, 2018) on condition of teaching in the same specific PGT engineering courses which student-participants had undertaken. However, after a low number of responses, snowball sampling was applied to recruit more professors in both schools who matched the conditions.

The sample size overall comprised five MSc engineering students and two professors from each school. Thus, overall, ten student-participants and four professor-participants were recruited for interviews. The sample size (N = 14) appears adequate, as it is defined by the qualitative and interpretative nature of the research, and the resources available to conduct, code, analyse, and write up the data from in-depth interviews (Lichtman, 2013; Punch & Oancea, 2014). The following tables summarise the demographic profiles of participants, including students (see Table 1) and professors (see Table 2). The names are replaced with codes (S for Student and P for Professor) for anonymity reasons.

#	Gender	Age	Country	School	Programme	Work experience, sector
S1	Male	34	Mexico	Computing Science	Data Science	10 years, Business intelligence
S2	Male	31	Kazakhstan	Engineering	Electrical Engineering & Management	6 years, Oil and gas industry
S3	Male	24	India	Computing Science	Software Development	2 years, Investment banking
S4	Male	28	Russia	Computing Science	Data Science	5 years, IT sector
S5	Female	29	Paraguay	Computing Science	Data Science	5.5 years, Banking sector, trade
S6	Male	27	Iran	Computing Science	Computing Science	2 years, IT sector
S7	Male	26	Palestine	Engineering	Mechatronics Engineering	6 years, Engineering sector
S8	Female	23	Russia	Engineering	Civil Engineering and Management	No prior experience
S9	Male	24	Kazakhstan	Engineering	Mechanical Engineering and Management	1 year, Public sector
S10	Female	25	Pakistan	Engineering	Electrical Engineering and Management	1 year, Telecommunication systems

Table 1. Demographic profiles of student-participants

#	Gender	Country	School	Teaching in PGT programmes	Teaching experience
P1	Male	Greece	Computing Science	Big Data Systems; IT Architectures; Software Engineering for Mechanical Engineers	14 years
P2	Male	England	Computing Science	Cyber Security; Cryptography Fundamentals; Software Project Management	35 years
P3	Male	England	Engineering	Electronic and Nanoscale Engineering	20 years
P4	Male	Scotland	Engineering	Simulation of Aerospace Systems; Robotics; Fault Detection, Isolation and Reconfiguration	19 years

Table 2. Demographic profiles of professor-participants

4.4 Ethical considerations

The ethics approval was sought from the Ethics Committee of the University of Glasgow as the educational research involved empirical part and gathering of primary data from a population sample. As the study involved students from more than one school (ENG and CS) within one college, the approved ethical form was later forwarded by email to Dean of Learning and Teaching in the College of Science and Engineering (University of Glasgow, 2017).

All participants of the research project were adults over 18, competent to give consent. Before the interview, they were informed verbally and in written form about the study using Participant Information Sheet. Participation was on a voluntary basis. All participants confirmed their will to partake in audio-recorded interviews through a signed consent. It was explicitly communicated to the participants before the interviews that they could withdraw from the study at any time without stating the reasons.

All participants' information collected during the research was kept strictly confidential. The interviewees were made aware that their responses were anonymous. Additionally, they were not addressed by names during the interviews. Due to anonymity reasons, this paper identifies students and professors by codes assigned to each participant. All personal details and interview transcripts were downloaded on a drive and stored securely with a password for further transcription and analysis.

4.5 Data collection

To explore participants' experiences in higher engineering education setting, the research project implied semi-structured one to one 'contextual' interviews (Punch & Oancea, 2014: 182) as the primary data collection tool both for students and professors (Arthur et al, 2012). They allowed to generate rich data and collect various interpretations and definitions of soft skills; purposes of soft skill development in HEI; perceptions of teaching and learning experiences; perspectives on teaching in postgraduate engineering education; and, generally, multiple constructions of teaching and learning reality (Punch & Oancea, 2014). Moreover, semi-structured or guided interviewing lead to a more flexible and timed flow of the interview. In turn, such flexibility resulted in somewhat informal and nondirective conversations with participants letting them tell their own story (Lichtman, 2013).

The case study design did not feature other qualitative data collection tools like classroom observations or focus groups due to several reasons. Firstly, classroom observations were not possible, as the ethics approval for the research project was received after the second academic semester finished. Secondly, 'group think[ing]' in focus groups often discourages the individual voices (Leshem, 2012: 3), while the study emphasises students' personal experiences and opinions about the teaching and learning. Additionally, the dynamics among the participants in a group interview could deny access to more personal types of data (Cohen et al, 2018).

The data from 14 participants was obtained over a two-week period in June-July 2018. Notably, annual leaves of teaching staff during this time of the year in ENG affected the availability of professor-participants; therefore, no replies were received from email invitations. All interviews took place on the Gilmorehill Campus of the University of Glasgow: the interviews with students – in agreed locations in the campus library; the interviews with professors – in their school offices.

Before collecting the empirical data, a guide for semi-structured interviews was developed following suggested steps (Lichtman, 2013; Punch & Oancea, 2014). The sections of the guide (see Appendix B for students and Appendix C for professors) addressed three major topics of the research and contained different types of open-ended questions. After establishing a rapport with the participants, the interviews started with 'grand-tour' questions (Lichtman, 2013: 198) to encourage the interviewees to talk and 'explore an answer to the focus of inquiry […] [on their] terms' (Morehouse, 2012: 80). Depending on the answer to the general introductory question, the next follow-up questions were asked that enabled to close any logical gaps (Cohen et al, 2018). Additionally, to validate the interview data, all participants were given a single definition of 'soft skills' concluded in Literature Review and a list of soft skills relevant for engineering education (Appendix A). Finally, the interviews finished with a closing question intended to provide a chance to add anything new. To ensure the validity and reliability of interviews, the research project followed all recommendations from Cohen et al (2018: 276) including asking non-leading questions, keeping neutral position during the interviews, and assuring the students that the interview data does not affect their grades.

Also, based on the outcomes of the theoretical frameworks chapter, one practical implication was considered for interviews. Both interview guides did not have an apparent emphasis on employability and work-related reasons of soft skills development expressed in the implicit or explicit wording of interview questions.

4.6 Data analysis

To obtain meaningful results out of the interview data that answers the research question, the data analysis procedure incorporated several steps: transcription, coding and memoing, identification of themes or concepts, displaying and reporting, and concluding the results (Lichtman, 2013; Punch & Oancea, 2014). Thematic analysis (TA) was applied as a general framework due to several reasons. Firstly, it provides a systematic approach for identifying and analysing recurring patterns across the dataset – themes (Braun & Clarke, 2013). Secondly, it is a straightforward approach to data analysis that implies flexibility regarding research questions (Braun & Clarke, 2013). The data was analysed inductively to assure the validity of the research findings (Cohen et al, 2018). The codes from student and professor interview data were gathered into categories and crosschecked with priory-defined categories. As a result, the categories were clustered into three major themes with various ‘sub-themes’ (Braun & Clarke, 2013: 231): (a) relevance of soft skills in higher engineering education; (b) teaching and learning methods; (c) assessment and feedback.

4.7 Researcher’s position

The prerequisites for undertaking this study combined my previous educational academic and professional backgrounds in computer engineering, my student NGO experience as a soft skills trainer, and my future interests to pursue a career in higher engineering education or community education and training. Also, I had profoundly negative impressions of teaching and learning methods from my undergraduate engineering studies back in Russia, as the learning environment was teacher-centred, rigorous, and authoritative. Throughout the six years of the specialist degree, the courses feature only several team projects, did not encourage critical thinking, and overall did not pay attention to developing soft skills in engineering students. These experiences together with my backgrounds and interests were not only active drivers to undertake a research project, but they also justified the researcher's position and expertise in the field which tends to strengthen the validity of the qualitative research (Cohen et al, 2018).

In practice, it helped me understand the perceptions and perspectives of interviewed engineering and IT students and draw consistent interpretations from their narratives. Additionally, my prior engineering backgrounds could help the students and professors to tell about their experiences more naturally. Also, to clarify my philosophical stance and informally raise the awareness of respondents about human development approach, after the interviews, I introduced an alternative educational purpose and attempted to promote critical awareness on the nature of learning experiences in HEI.

4.8 Research limitations

The nature of the study imparts specific limitations on its implications. Firstly, due to the interpretative approach, sampling nature, sample size, and lack of diverse data collection methods, the outcome of the research is not explicitly generalizable or externally valid in broader contexts, such as the UK universities. For example, the study could yield richer data if the researcher observed teaching practices in a classroom; teaching session outlines were analysed; professors could be gathered in a focus group; or interviews could be conducted across a broader demographic of participants. However, the outcomes of the qualitative research can be generalised to an identifiable specific setting rather than universally, mainly, by studying multiple typical cases within a specific context (Cohen et al, 2018). This way, the research outcomes can be transferred within UoG and might be considered across other Scottish universities with similar PGT engineering curricula, courses structure, and student-teacher ratio.

5 Chapter Five: Discussion

This chapter presents the major findings emerged from 14 interviews with students and professors. This section links the study results with the literature review and theoretical concepts and discusses multiple issues related to soft skills development in PGT engineering education. The outcomes of empirical work are clustered into three central themes with various sub-themes addressing the research question and objectives. The section starts with findings and following discussion about the underpinnings of soft skills relevance in higher engineering education. Further, it shows how existing teaching strategies in CS and ENG in UoG cover the set of soft skills defined in the literature review and how the pedagogical approaches could be improved. Finally, the chapter describes and examines the current perceptions and perspectives on soft skills assessment methods and feedback process.

5.1 Relevance of soft skills in higher education

The first theme has vital importance to the research question, as it addresses the first research objective by identifying which specific soft skills related to engineering education are more valued by students and professors. Besides, the theme captures the philosophical underpinnings of soft skills development in higher education and links them to the theoretical frameworks described in Chapter 3.

5.1.1 Awareness of the notion

All participants were initially asked about the awareness of the notion of 'soft skills' based on their life experience. Half of the student-respondents were not familiar with the concept, while the other half was aware of due to their professional experiences or cultural backgrounds. Furthermore, students provided associations of soft skills strongly connected with communication skills, teamwork, responsibility, and ability to work independently. Concerning professors, all of them were aware of the notion of 'soft skills' due to their vast professional experience in industry or teaching in the higher engineering education field. Interestingly, although UoG explicitly promotes graduate attributes on their website (University of Glasgow, n.d.-k), the vocabulary of 'soft skills' tends to be barely present in the university environment.

5.1.2 Relevance of specific soft skills

All participants were asked to value the soft skills list according to their significance for an engineering graduate by picking four or six skills from the list. The students from both schools valued the most (in descending order of frequency): teamwork, communication, analytical, critical, and design thinking. Meanwhile, most of the professors valued (in descending order of frequency): problem solving, design thinking, analytical thinking, teamwork, and communication.

Analysis of the comparison of emphasised skills between students and professors identifies several issues. Firstly, the top skills in the students' and professors' rankings are partly in alignment with highly emphasised skills identified by the literature review of Abdulwahed et al (2013): communication, teamwork, and problem solving. Secondly, most of students and professors tend to value the same soft skills for a future engineering graduate, specifically, communication, teamwork, problem solving, design, analytical and critical thinking.

5.1.3 Purpose of soft skills development

When the student- and professor-participants were asked about the purposes of soft skills development in higher engineering education, almost everyone justified soft skills as being critically useful for the workplace, employment, professional environment, or entrepreneurship at first place. Also, throughout the interviews, most of the respondents used work-oriented language. Both findings may suggest the consequences of prevailing human capital paradigm in the higher engineering education, as indicated previously in Theoretical Frameworks chapter (Boni-Aristizabal & Calabuig-Tormo, 2016; Walker, 2006; 2015).

Interestingly, a few students and one professor found broader applications of soft skills taught at HEI: volunteering, to foster future generations to respect other nations, 'to alleviate national level problems', 'to strive for international peace', and 'to make sure that the solutions, services and products have a positive impact on the society' (student S3). These findings suggest that only a small number of students and professors support the role of HEI to strive for equitable human development (Peercy & Svenson, 2016) and may advocate Nussbaum's key capacities for cultivating humanity (1997; 2006) like global citizenship and ability to empathise with others.

On the other side, several professors highlight the current trends of employability-driven university role (Cacciolatti et al, 2017): 'One-year Master [programme] looks like a conveyor belt of Masters' (professor P1). Some professors question this stance of universities while expecting MSc students to become scientists and have a researcher mentality:

> 'the university is supposed to produce scientists, whereas if you are looking for practical [skills] – that's what vocational institutes are for' (professor P1).

Others professors seem even sceptical about the holistic and humanistic development of students:

> 'Some of the soft skills are skills for human beings. We teach [them] because it makes people better engineers. We are not teaching them, so they can be better at home, or better in fixing a car, or better in handling an electricity bill. […] If it happens to be a benefit somewhere else, great. But I am not stunningly interested where' (professor P3).

These outcomes suggest that, currently, Capabilities Approach has various obstacles to be adopted in higher engineering education: dominant human capital approach in education, the employability-driven role of the universities, and conservative teachers' attitudes. However, as individual professors and students acknowledge broader enactment of soft skills, it may be assumed that contemporary engineering education still has a potential to nurture social responsibility and develop students' capabilities to encourage human flourishing further.

5.2 Teaching and learning methods

The second theme that emerged from interviews addresses several issues related to pedagogical approaches to soft skills development. Firstly, it examines how each soft skill from the list

(Appendix A) is covered by existing teaching and learning methods. Secondly, it justifies opting for the embedded model of soft skills development and the more explicit teaching of soft skills. Thirdly, the sub-chapter outlines major challenges and barriers that professors experience in developing soft skills. Finally, different areas of improvement including classroom instruction, team projects, and implications for PGT level are elaborated.

5.2.1 How existing teaching and learning methods cover soft skills

5.2.1.1 Communication skills

This skill incorporates other related skills mentioned by students and professors: presentation skills, persuasion, written communication, pitching, and body language.

In CS, communication skills were covered mostly through team projects in the courses ‘IT architecture’ (ITA) (University of Glasgow, n.d.-d) and partly in courseworks of Research Methods and Techniques (RMT) course (University of Glasgow, n.d.-f). During the ITA course, the students delivered presentations and practised pitching and body language. RMT course taught students how to present and communicate findings to both tech-savvy and non-tech-savvy audiences. Besides, reports in ITA course, various critical essays, and a summer project required students to practice written communication.

MSc programmes in ENG featured an Integrated Systems Design Project (ISDP) M-level course (University of Glasgow, n.d.-c) which enabled students to practise presentation skills, pitching, written communication, and persuasion. Also, students delivered presentations to bigger audiences in courses like Robotics 4 (University of Glasgow, n.d.-b).

Students’ perceptions of acquiring communication skills were mostly divided. For example, some students were positively excited that they delivered presentations the first time in front of a large audience in a higher engineering education setting. Meanwhile, others were more apprehensive about having a speech in public, as they lacked confidence, prior experience, and the English language was not their mother tongue. Additionally, evidence shows that no support was explicitly given to students who experienced troubles delivering presentations.

5.2.1.2 Teamwork

Almost every course in both CS and ENG featured team projects in either smaller or larger groups (ITA, ISDP, Robotics). Other courses like Software Project Management (SPM) (University of Glasgow, n.d.-g) paid significant attention to teamwork. Notably, students from both schools appreciated the presence of teamwork in their MSc programmes, as it resembles a real-world professional environment. However, the majority of interviewed CS students reported mostly negative perceptions of teamwork. Firstly, some students were dissatisfied with the group division, behaviours, and poor commitments of other team members as well as the impossibility to change teams. Secondly, several students reported difficulties when communicating with teammates from other nationalities due to strong language and cultural barriers. Finally, students indicated low guidance, supervision and mentoring of the teamwork process from the professors' side.

5.2.1.3 Problem solving

All respondents agreed that problem solving was covered by the nature of MSc studies in almost every course in both schools. More specifically, it was practised in team projects, individual courseworks, laboratory works, and in tutorials through questioning and group discussion. Additionally, in courses like ITA, the professors provided specific knowledge of problem solving techniques to develop the skill.

5.2.1.4 Ethics and professionalism

In CS, according to one student, some professors covered ethics in the lecture context by using various examples, case studies, and personal stories. In ENG, professionalism was reported to be partly covered by the requirements of the written reports. Also, in courses like ISDP, professors explicitly made students aware of the environmental, safety, health, and social aspects and impact of engineering solutions while briefing the task for the team project.

5.2.1.5 Management and leadership

During team projects in ITA or ISDP, students claimed that both management and leadership were either taught implicitly or not addressed at all. Evidence shows that some students took the initiative to develop those skills. For instance, some students organised the teamwork in a way that leadership role was rotating among team members and there was no self-assigned leader. On the other side, in courses like SPM, professors explicitly teach how to run software development projects in groups.

5.2.1.6 Creativity and innovation

Creativity and innovation were covered differently in CS and ENG. In CS, students reported that in courses like Machine Learning (ML) (University of Glasgow, n.d.-e), professors encouraged through various courseworks to come up with creative solutions which would bring better performance. Moreover, in ML, the professors introduced a competition element among student teams to promote most innovative and out-of-the-box solutions, which could lead to the top of the leaderboards. In ENG, a similar element of competition was present in Robotics course, where the robots, designed by student teams, 'fought' each other, so the winning team received additional points to the team grade. Also, in ENG, the management semester featured a course on Managing Creativity and Innovation (University of Glasgow, n.d.-a). However, several students were dissatisfied that the course provided rather gave an understanding of the creative process instead of practising the skill. According to Bloom's taxonomy, it indicates that students did not reach higher levels of learning and conceptualisation of creativity, though it could be expected from the course title (Anderson & Bloom, 2014).

5.2.1.7 Analytical, critical, design thinking

Professors and students from both schools shared the same opinion that these skills were promoted by the nature of engineering and IT studies on Master level. Also, according to the Bloom's taxonomy, analytical, critical, and design thinking correspond to the higher levels of learning – respectively to levels ‘analyse’, ‘evaluate’, and ‘create’(Anderson & Bloom, 2014). The skills were covered by team projects in ISDP or ITA and by fulfilling various assignments like reports, summer projects, individual courseworks, examinations, and critical essays. Particularly in integrative engineering MSc programmes, the combination of engineering and management semesters brought positive results to student’s conceptualisation of the material.

5.2.1.8 Intercultural and social awareness

All respondents agreed that intercultural awareness was covered generally by studying on Master level in UoG. Most of the students found the international component of their MSc programme appealing. More specifically, the students highlighted formal and informal cooperation with students of other nationalities who had different backgrounds, cultures, and values. On the other hand, some students stated that this cultural and background diversity was underused across the courses during classroom instruction.

5.2.1.9 Lifelong learning

Several students and professors agreed that lifelong learning was encouraged generally by the learning environment: the nature of the MSc programmes in UoG actively promoted independent study and self-directed learning. More specifically, throughout the studies, the students were asked to familiarise with the state-of-the-art academic papers to become updated with the latest advancements in the field.

5.2.1.10 Decision making

According to the majority of students, decision making was covered mostly during the team projects like ITA, ISDP, Robotics. However, some students reported that their decision-making skills did not improve by the end of the semester.

5.2.1.11 Change management

According to students, the ability to manage changes was covered differently in CS and ENG. In CS, the skill was not covered, whereas, in ENG, the management semester of the integrative engineering degree featured a course on Managing Innovation Change. However, the course provided mostly an understanding of the change management process instead of skill practice.

As a summary, mainly the soft skills valued both by students and professors are mostly covered by existing teaching and learning methods. However, generally, the students' perceptions of soft skills coverage were divided. On the one hand, many students argued that most of these skills were addressed mainly in team projects and individual courseworks. On the other hand, some students perceived that their soft skills hardly improved during the MSc programme, so they questioned the attempts of teaching staff to develop soft skills in some subjects at first. Moreover, individual students in CS and ENG reported that some lectures were purely technical, lacked interactive elements, and did not address any of the soft skills.

It is noteworthy that the concepts of team projects in courses like ITA, ISDP, Robotics, or SPM resemble PBL methodology but do not feature PrBL methodology. Both Literature Review and empirical findings suggest that team-based courseworks projects executed in engineering education have a robust potential to address various soft skills and enhance students' engagement and satisfaction.

5.2.2 Embedded model of soft skills development

The study identified that almost all student- and professor-participants found more advantageous and feasible the embedded model of soft skills development (Shakir, 2009). Both categories of respondents recognised various benefits of the model in PGT engineering education. Firstly, to maximise the learning outcomes, the soft skills should be taught in a real-world context along with the technical knowledge and skills. This way, the application of soft skills is more natural and resembles professional engineering or IT environment. Secondly, the use of academic time during an MSc degree is pivotal. When compared to UG studies, one professor highlighted that ‘there is much less time for MSc students to inculcate soft skills in any specific fashion’ (professor P3). Additionally, all academics accepted that, on PGT level, the stand-alone subject model is not practical due to the lack of time and human resources, sophisticated and long accreditation process, and most importantly, reduction of academic time dedicated to technical subjects: ‘Having a 10-credit course in soft skills means 10 credits less in technical skills’ (professor P1).

To summarise, these findings are aligned with the outcomes of the literature review discussion (Shakir, 2009) and confirm that the embedded model is a more effective way to develop soft skills in PGT engineering education.

5.2.3 Explicit or implicit teaching of soft skills?

The findings showed that the teaching of soft skills currently happens mostly implicitly in both schools. Some of the skills are not explicitly taught but either assumed to be already possessed or expected to be practised during the courseworks. Thus, during team projects briefing and explanation, some professors did not explicitly emphasise soft skills. However, the majority of students would prefer more explicit instruction. Only one professor stated that he directly refers to the soft skills relevant to the assessment process and clarifies the reasons for their practice and evaluation. Step-by-step briefing of the task is an essential component of ‘scaffolding’ instructional strategies which allow students to reach a greater understanding and independence in the learning process (Belland, 2017; Pol et al, 2010).

5.2.4 Major challenges and obstacles

All interviewed professors indicated various administrative barriers and teaching-related difficulties that both impede effective soft skills development. Firstly, contemporary university recruitment trends result in large numbers of students (200 students per course on average) and an increasing student-teacher ratio which affects students’ attainment (Koc & Celik, 2015), including soft skills development. Secondly, the professors confirmed the lack of time available in MSc degree to properly teach soft skills, as MSc programmes tend to be ‘short and fat’ (Anderson, 2017: 12). Furthermore, professor-respondents indicated a substantial variation of backgrounds of students entering Master level studies and knowledge on how to develop and assess specific soft skills (e.g. creativity or leadership). As a result, all professors reported high academic and administrative workload, lack of time and teaching staff to provide individual feedback on soft skills, and complex accreditation arrangements to infuse soft skills in existing courses. Unfortunately, according to professors, these conditions get worse from year to year.

5.2.5 Strategies to enhance teaching soft skills

The student-participants of the study proposed most of the suggestions to enhance soft skills development in PGT engineering education, whereas professors provided various cases of good practices of teaching. Notably, some of the suggested improvements, which are problematic due to limitations underpinned by professors, are not mentioned in this subchapter.

5.2.5.1 Classroom instruction

There are multiple strategies which student-respondents proposed to assure that classroom instruction could also complement are sufficient to develop soft skills development. The first suggestion is to diversify and introduce more interactive classroom activities to increase student engagement and interaction: for instance, active or guided teaching methods (Cinque, 2016) presented in the Literature Review chapter. For example, ITA course implies peer instruction techniques (Ahmed & Roussev, 2018) during lectures and comprises interactive sessions conducted by JP Morgan and IBM engineers and a 2-day workshop at the end of the course.

Moreover, the professors could use supplementary materials like music, video, visuals, and even learning spaces. Also, to keep students engaged and their levels of attention sharp, the teaching staff could apply storytelling and humour. As a vivid example, Robotics course features Lego®

constructor, which reinforce the theoretical material, so students learn in an engaging environment that promotes fun, creativity, and curiosity.

Also, almost every student-respondent emphasised the presence of diverse backgrounds (nationality, age, culture, values, educational systems) and prior experiences (personal, academic, professional, civic) in the learning environment. According to andragogic assumptions (Knowles, 1984), these prior experiences may be used as a vast source of learning, including soft skills development. Thus, teaching staff can apply adult learning principles and use students' backgrounds as learning resources (Knowles, 1984; Knowles et al, 2011).

These findings strongly suggest alignment with the academic literature on soft skills development in HEI by using active approaches (Hager & Holland, 2006; Moy, 1999). The methodologies may include active learning (Prince, 2004), cooperative learning like jigsaw classroom (Aronson & Patnoe, 2011; Yu, 2017), or instructional strategies based on experiential learning theory (Kolb, 2015) or 4MAT® system (O'Neill-Blackwell, 2012).

5.2.5.2 Team projects

Both students and professors highlighted that team projects have a strong potential to incorporate different soft skills to be developed throughout the coursework. Firstly, to emphasise the importance of teamwork and communication, the teaching staff could explicitly brief students on how the peer assessment exactly affects teamwork grade and encourage teams to discuss and agree on peer evaluation openly. Additionally, to emphasise leadership skills and simulate a more realistic professional environment, professors could ask teams to self-assign team leaders or project managers or to implement 'scrum' practices (Stawiski et al, 2017).

Secondly, many students reported that the group sizes in ISDP could be smaller (from 10 people to 3-5 persons) to enable actual teamwork. Also, when dividing students into groups, teachers should give students a chance to choose not to work with people they do not feel comfortable working with. Currently, some professors allow students to make groups with people they feel comfortable; however, according to the findings, this practice is somewhat sporadic.

Finally, the course designers and programme leaders in CS and ENG might introduce an element of competition among teams to foster creativity and teamwork. Otherwise, they could introduce an element of cooperation, i.e. cooperative learning (Johnson & Johnson, 2009). This learning methodology explicitly addresses communication and teamwork, as the teams are interdependent since they have to interact with each other to perform in a larger group.

5.2.5.3 Implications for PGT level studies

Currently, when approaching the teaching of PGT students in comparison with UG students, the majority of professors accept the heterogeneity of students' backgrounds entering Master level studies. That is why some professors prefer to 'go more slowly with graduate students' (professor P3), especially in the beginning of the MSc programme, to make sure that PGT students have a strong foundation which enables to get to the end of the course to achieve intended learning outcomes and master both soft and hard skills. By applying 'scaffolding' instructional strategies (Belland, 2017; Pol et al, 2010), the professors may acknowledge the multiple levels of competences of Master students and guide them through the Zone of Proximal Development (Vygotsky, 1978) to reach deeper learning outcomes (Biggs & Tang, 2011). Consequently, soft skills should also be 'scaffolded' for better understanding.

Furthermore, when teaching on PGT level, professors should be cautious when making preliminary assumptions about the level soft skills of entering MSc students. The next two excerpts from professor and student interviews serve as a vivid example:

> 'It's impossible to have an M-level student without presentation skills. You have to do presentations in your undergraduate degree. That would be assumed. Although I had students claim that have never done it, they've mostly been fibbing ((chuckles)). Every [student] would do that in the undergraduate degree' (professor P3);

> '…we had presentations to give. It was really nice to develop this skill, as compared to my previous experience; I never did it in the university' (student S8).

That is why:

> ‘For MSc students, you can’t make an assumption that their previous undergraduate course covered these things. For PG students, there is more variation [of their prior experience], as they are coming from all over the world and their educational practices might not focus on softer skills’ (professor P4).

5.3 Assessment and feedback

Another dimension of the educational process, apart from curriculum and pedagogies, is the assessment (Bernstein, 1990). Assessment enables to measure the learning outcomes and the extent to which soft skills were developed. Thus, the third theme describes the current perceptions of assessment methods and feedback processes and relevant improvement strategies.

5.3.1 Perceptions of existing assessment methods

In general, student-participants in both schools found course assignments interesting, challenging, and inviting deep analytical and critical thinking. However, various students indicated significant drawbacks for some individual evaluation methods.

For instance, although peer assessment was conducted differently in CS (delta system, mostly quantitative evaluation) and ENG (peer review, qualitative evaluation); both students and professors in CS reported several downsides of the assessment process. Delta system (also called deltas) is a quantitative peer evaluation method used in team projects in CS where students distribute points among the team members for their team efforts. Though deltas are there ‘to identify free-loaders’ (professors P2) and serve as a guideline for grading process, the system may work against the responsible and hard-working students. For example, some students experienced troubles working with other team members and thus, received unfair point’s distribution. Additionally, according to professors, in case of grade reduction caused by unequal distribution of deltas, a student may not understand whether the low mark was due to one’s poor teamwork (soft skills), or due to one’s contribution to the solution (technical skills).

Another common issue, which emerged from interviews with students in both CS and ENG, were the examinations. Currently, course designers give a high percentage of the course grade to individual examinations to prevent probable cheating and plagiarism in courseworks. Besides, examination period of MSc students in CS and ENG occurs in April-May within 20 days for all subjects that took place during the year (from six to ten subjects). The examination period is currently explained mostly by difficulties in timetabling. The students' perceptions of various examination aspects were highly negative. Firstly, many students claimed that intense examination period mostly encourages rote memorisation and impedes knowledge retention:

> 'having ten exams within 20 days. It's nonsense. It should NOT be like this. It just discourages students to learn anything. It's a mess. You cannot remember anything after several weeks' (student S4).

Secondly, students complained that examinations lack the transparency of grading and do not improve soft skills, which they are supposed to assess. According to one professor, these skills include problem solving, analytical thinking, and creativity. However, according to students:

> 'the professors cut the will of students to answer in a creative way by not giving enough feedback and not providing transparent grading' (student S4).

In summary, the topic of examinations in contemporary UK higher engineering education goes beyond the scope of this study. It is suggested to undertake a larger research project aimed at evaluating the concept of written examinations in STEM studies and their effects on students' achievement and satisfaction.

5.3.2 Perceptions of the feedback process

Feedback in learning brings students awareness of their strengths and weaknesses and helps in identifying further actions to bridge knowledge and skills gaps. The study found that currently, in CS and ENG, after team projects, students received only team feedback. The majority of the students did not obtain personalised feedback on soft skills like teamwork or presentation, so 'you do not know where you made a mistake and what the nature of the mistake is' (student S5). This way, students could barely identify areas of improvement regarding their soft skills.

Professors explained it by limited human and time resources to address students individually. Additionally, peer evaluation data may contain sensitive information, so the feedback was anonymous, confidential, and thus, it was not shared back to students. Also, though professors in CS acknowledge the demerits of delta system regarding the amount of generated feedback, they claim that 'it is the best we can do with available human resources' (professor P1).

Nevertheless, all professors state that the option of individual feedback was always there. However, it was up to students to take the initiative to get more individual feedback:

> 'Among all the courses where I teach, […] very few of [students] will actually go back and collect the coursework with feedback on what should be addressed and improved. Very few students come and ask for a more detailed breakdown of the grade. However, any student who wishes to know more can come and ask me. I would consider the peer assessment within the group anonymously. In the end, it's up to the students to come and ask' (professor P4).

5.3.3 Strategies to enhance soft skills assessment and feedback

Regarding examinations, students strongly suggested restructuring the examination period to reduce the stress and academic workload. Also, they advocated more transparent grading and individual feedback provided on an examination script. One professor even encouraged students to question his academic judgement after receiving the grade. Interestingly, even though UoG promotes critical thinking, especially on Master level, students still are not encouraged and, thus, have complicated mechanisms to doubt academic judgement and contest their grade. Additionally, though UoG has a policy of not expecting provision of individual feedback to all students, the university states that 'individual feedback should be made available on request' (University of Glasgow, n.d.-i).

As for team assessment, the respondents proposed to introduce ongoing feedback of soft skills by providing continuous peer assessment and responsive formative assessment (Clinchot et al, 2017; Panadero et al, 2013). Also, if providing individual feedback is impossible due to limited teaching staff to mark, the opportunity to receive individual feedback on a request to improve both hard or soft skills should be explicitly available and communicated to the students.

6 Chapter Six: Conclusions

The final chapter of the dissertation summarises the significant findings and analysis from Discussion and provides a set of recommendations.

The primary aims of the present research were to examine the effectiveness of existing pedagogical approaches and identify teaching strategies for facilitating soft skills development in PGT engineering education. The study has found that primarily the soft skills valued both by students and professors are mostly covered by existing teaching and learning methods. Also, mainly team projects have a robust potential to address multiple soft skills. Nevertheless, the students' viewpoints about the quality of soft skills improvement throughout the MSc programme were divided. On the one hand, postgraduates highlighted specific teaching techniques, like peer instruction or leaderboards, and highly appreciated the intentions of team projects to simulate professional engineering and IT environments. On the other hand, the students felt unsatisfied and shared concerns about classroom instructional strategies, classroom levels of engagement and interaction, and overall organisation of team-based courseworks including briefing, grouping, and teamwork process.

Moreover, the study confirmed that the embedded model of soft skills development (Shakir, 2009) is a more effective way to address soft skills in PGT engineering education. Additionally, the teaching of soft skills is mostly implicit in both schools, though the majority of students would prefer instruction that is more explicit. Furthermore, the study has identified various teaching-related challenges and administrative obstacles to facilitate soft skills in PGT education that intensify from year to year including growing trends of student-teacher ratio and high academic and administrative workload.

Other significant findings which emerged from this study are connected soft skills assessment and feedback. The study has shown that, particularly, the students from the School of Computing Science reported notable drawbacks of quantitative peer assessment (delta system). Another stumbling block in soft skills assessment were the examinations. Students of both schools were strongly critical about examination period intensity and lack of transparency of grading. Additionally, they reported lack of continuous feedback during the team projects and individual feedback generally after any assessments. Moreover, students are mostly unaware about the possibility to have individual feedback on request.

The secondary aim of this study was to investigate the relevance of soft skills in higher engineering education. The research has shown that the vocabulary of ‘soft skills’ tends to be barely present in the university environment. Secondly, both students and professors lean towards a similar set of skills for future engineering graduates: teamwork, communication, problem solving, analytical, critical, and design thinking skills. Finally, the study confirmed that soft skills development in higher engineering education is principally justified by career-oriented reasons, as opposed to more humanistic and holistic development. The predominant human capital paradigm in education, the employability-driven role of the universities, and conservative teachers’ attitudes were identified as various obstacles in adopting the human development approach in higher education.

6.1 Recommendations

As the study explicitly asked participants about the suggestions to enhance soft skills development in PGT engineering education, students’ and professors’ proposals played a vital role in drawing most of the next recommendations. To facilitate soft skills development through teaching strategies, assessment, and feedback, different stakeholders like professors, programme leaders, or course designers of both schools could incorporate the following solutions.

6.1.1 Recommendations for teaching and learning methods

- Diversify classroom activities and introduce more engaging and interactive instructional strategies based on active, cooperative, or experiential learning;
- Make use of supplementary materials like music, video, visual, and learning spaces;
- Apply adult learning principles and use MSc students’ backgrounds source of learning;
- Use elements of competition or cooperation in team projects;

- Stress the attention of students on how peer assessment evaluates teamwork;
- For team-based courseworks, give students the ownership of group division process;
- Encourage leadership development of students during team projects;
- Be cautious about the assumptions of knowledge and skills of MSc students;
- Apply scaffolding instructional strategies to ease the comprehension of taught material, especially for international students;
- Promote university's extra-curricular training programmes (e.g. events from Career Services) or co-curricular academic support programmes (e.g. Learning Enhancement and Academic Development Service – LEADS).

6.1.2 Recommendations for assessment and feedback

- Introduce continuous peer assessment, ongoing feedback, and responsive formative assessment in team projects;
- Increase the teamwork grade weight, e.g. from 5% to 15% – to show the importance of the soft skill in team-based courseworks;
- Restructure the examination period, e.g. allocate it across two semesters or introduce sub-modular examination system;
- Explicitly communicate to students the opportunity to receive individual feedback on request for all kinds of assessments including examinations;
- Encourage students to question academic judgement.

Apart from teaching staff responsible for summative examinations, the last three points could also be considered for the Learning and Teaching Committees of both School of Engineering and School of Computing Science.

6.1.3 Recommendations for further research

This study contributes to a growing body of academic literature on soft skills development in higher engineering education with an emphasis on pedagogical approaches on Master level. The outcomes of the dissertation suggest a variety of ways the research could be further extended. Firstly, to obtain richer data and extend current findings, this qualitative study could include a quantitative dimension or combine series of continuous interviews, focus groups, and classroom observations of teaching and learning in PGT engineering education throughout the academic year. Secondly, to collect useful teaching practices and existing instructional strategies in developing soft skills of engineering students, a larger mixed methods study could be launched across various schools in the University of Glasgow or across different universities in Scotland. Thirdly, this study sets the exploratory grounds for evaluating the concept of written examinations in STEM studies and their effects on students' soft and hard skills development. Finally, further research could be conducted to explore the ways to facilitate the integration of the human development approach in higher engineering education.

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Appendices

Appendix A: Generic definitions of soft skills

Abdulwahed et al (2013: 760-763) provide the definitions for each soft skill:

Communication skills: 'Communicate effectively, in various ways (verbal, oral, written, …), with all stakeholders (Public, Engineers, …) across all boundaries (cultural, language, …)';

Teamwork skills: 'The ability to work and cooperate efficiently in a diverse, multicultural, and interdisciplinary team';

Problem solving skills: 'Use knowledge systematically to identify, analyze, formulate, solve, and evaluate complex and multidisciplinary problems – by applying cognitive skills (logical, critical, and creative thinking)';

Ethics: 'Understand ethical norms and demonstrate ethical reasoning, behaviour, and integrity of social responsibility and service in any context (work, community, country, etc…)';

Professionalism: 'Maintain high-level of social and professional behaviour, demonstrate accountability, accept responsibility, and achieve excellence in work and everyday life';

Management skills: 'Awareness of business literacy and practice in the context of engineering; manage organization and Resources efficiently, develop processes, plan projects, take-risk';

Leadership skills: 'Engaged, interact, lead, and influence people effectively toward accomplishing a common or shared goal and contributing positively to diverse communities';

Creative thinking: 'Envision original ideas and concepts, inventing new products and solutions, and apply 'lateral thinking'';

Innovation skills: 'Add values through introducing new novel ideas, methods, directions, opportunities, and solutions that meet new requirements, through more effective products, processes, services, and technologies that are readily available to stakeholders';

Design skills: 'Design products to meet specified needs and develop optimal solutions for complex problems';

Analytical thinking: 'Use knowledge and skills to issues, diagnose, and reflectively analyse a variety of information, considerations, and perspectives in order to make logical and effective decisions to a particular challenge/problem in own area of work and other areas as well';

Critical thinking: 'Use critical, conceptual, reflective, and rational thinking in drawing and evidence-based assessing systematic conclusions and finding underlying relationships for solutions';

Cultural and social awareness: 'Demonstrate contextual social, cultural, environmental, and global responsibility and awareness, and bridge differing issues in the context of work value';

Lifelong learning: 'Continuously acquire new knowledge and skills for self and professional development at all levels (life and career)';

Decision making skills: 'Apply personal and professional judgment, take-risk and initiative, in effectively making strategic decision and managing risks, from a range of alternatives, based-on available information in response to ambiguous and complex situation';

Managing change skills: 'Demonstrate ingenuity in addressing challenges and flexibility and adaptability for actively managing rapid and diverse change successfully in workplace'.

Appendix B: Interview guide for student-participants

University of Glasgow

College of Social Sciences

General RQ:

How effective are the teaching and learning methods to facilitate development of soft skills in postgraduate engineering education in Scotland?

Specific RQs include:

1. Which soft skills are valued by PGT engineering students and professors? Why?
2. Which current pedagogical practices used in PGT engineering education address soft skills?
3. How do students and professors envision soft skills development in PGT engineering education?
4. What are the main challenges to modifying teaching and learning methodologies for professors?
5. What strategies can be adopted to improve pedagogical approaches to teaching soft skills?

Interview guide for student-participants

- Introduction questions
    - Name of the programme enrolled
    - What is your general impression of postgraduate engineering education in UoG?
        - *Does it fulfil your expectations? How?*
        - *How do you feel about your PGT education?*
        - *What do you find useful in your education?*
        - *What do you find not useful for your education?*

- Personal relevance of soft skills
    - Are you aware of the notion of 'soft skills'? If yes, what do you know about soft skills?
    - Based on your previous life experience, which soft skills did you find the most valuable?

    - Could you name five soft skills you consider the most valuable in everyday life and for a future engineering graduate?
    - Where and when do you use soft skills? At which circumstances/areas of life?
    - What is the purpose of soft skills development in PGT engineering education?
    - What is the purpose of soft skills development in PGT engineering education apart from the workplace?

- <u>Perception of soft skills development in Master programme</u>
    - How are the soft skills currently addressed in your PGT engineering education?
    - How are the soft skills currently assessed?
    - How do you find the feedback given to you after assessments?
    - Are the soft skills currently taught implicitly or explicitly?

- <u>Suggestions to improve teaching and learning methods in engineering education</u>
    - What teaching & learning methods do you consider the most effective for you to address both technical and non-technical skills?
    - What would you do differently if you were a programme leader or a professor?
    - What should the professors take into consideration when teaching PGT students (compared to UG students)? What makes PGT engineering education different from UG regarding soft skills development?
    - Do you believe that soft skills should be taught separately (through optional courses or electives) or should be included into the engineering curriculum (through teaching and learning methods)? Why?
    - Should the soft skills be taught explicitly or implicitly?
    - How should the soft skills assessment be arranged from your perspective?

- <u>Closing question</u>
    - Is there anything you would like to add to what you have already said?

Appendix C: Interview guide for professor-participants

University of Glasgow

College of Social Sciences

General RQ:

How effective are the teaching and learning methods to facilitate development of soft skills in postgraduate engineering education in Scotland?

Specific RQs include:

1. Which soft skills are valued by PGT engineering students and professors? Why?
2. Which current pedagogical practices used in PGT engineering education address soft skills?
3. How do students and professors envision soft skills development in PGT engineering education?
4. What are the main challenges to modifying teaching and learning methodologies for professors?
5. What strategies can be adopted to improve pedagogical approaches to teaching soft skills?

<u>Interview guide for student-participants</u>

- <u>Introduction questions</u>
    - Name(s) of the course(s) you teach
    - Can you tell about your teaching experience in engineering education in UoG?
        - *How did you start to teach?*
        - *What do you find challenging in your teaching practice?*
        - *What to you pay attention to when educating future engineers?*
        - *How is teaching PG students different from teaching UG students in engineering education?*

- <u>Personal relevance of soft skills</u>
    - Are you aware of the notion of 'soft skills'? If yes, what do you know about soft skills?

- Based on your previous life experience, which soft skills did you find the most valuable?
- Could you name five soft skills you consider the most valuable for a future engineering graduate?
- What is the purpose of soft skills development in PGT engineering education?
- What is the purpose of soft skills development in PGT engineering education apart from the workplace?

- <u>Perception of PGT engineering students' soft skills development through teaching methods</u>
  - How do you currently address the soft skills in the courses you teach or programmes you supervise?
  - How do you currently assess the soft skills?
  - How do you give the feedback to your students after assessment?
  - Do you address currently address soft skills assessed implicitly or explicitly?
  - What are the main challenges or obstacles to improve soft skills students in PGT engineering education?
  - When you teach PG level students, what do you pay more attention to (compared to UG students)?

- <u>Suggestions to improve teaching and learning methods in engineering education</u>
  - What would you do differently in your courses? If you had enough resources?
  - What should be more emphasised in PGT studies when compared to UG studies?
  - Do you believe that soft skills should be taught separately (through optional courses or electives) or should be included into the engineering curriculum (through teaching and learning methods)? Why?
  - Should the soft skills be taught explicitly or implicitly?
  - How should the soft skills assessment be arranged from your perspective?

- <u>Closing question</u>
  - Is there anything you would like to add to what you have already said?

Appendix D: Participant Information Sheet

University of Glasgow

College of Social Sciences

Participant Information Sheet

A qualitative study exploring how to facilitate soft skill development of postgraduate engineering students in UK universities

You are being invited to take part in a research study on soft skills development in engineering education. The study is being carried out by Alexander Vaniev, PGT student in the School of Education.

Please, take time to read the following information carefully and discuss it if you wish. Feel free to ask me anything that is not clear or if you would like more information.

Once you have read and understood the information, please complete the checklist on the following page to indicate that you agree to take part in the research.

What is the purpose of the study?

This is a study to explore how teaching and learning methods in engineering curriculum contribute to the development of soft skills of postgraduate engineering students. The ultimate goal of the research is to bring more added value to the teaching and learning methods used in engineering postgraduate studies in University of Glasgow in order to improve the learning experiences of Master engineering students and prepare skilful and well-rounded future engineers for the society.

Why have I been chosen?

You are invited to participate in this study, since you are currently either a professor or a Master student in School of Engineering or School of Computing Science in University of Glasgow. For this research professors and Master students from each school will be invited.

Do I have to take part?

It is up to you to decide whether to take part or not. If you decide to take part, you will have to read this information sheet very carefully. You will be asked to sign a consent form on the next pages. If you decide to take part, you are still free to withdraw from the study at any time without giving a reason. For students: if you decide not to participate, there will be no effect on your course grades in any way.

What will happen to me if I take part?

You will be invited to respond to a set of questions about your perceptions or perspectives on teaching and learning methods during a face-to-face or telephone interview. Please, answer them to the best of your ability. The interview will last approximately 30 minutes. An audio recording of an interview will take place in order to increase the accuracy of the provided information.

Notice that you are free to stop and leave the interview at any time. Any record of your interview or personal details will then be destroyed.

Will my taking part in this study be kept confidential?

All information which is collected about you during the course of the research will be kept strictly confidential. You will be identified by an ID number and any information about you will have your name removed so that you cannot be recognised from it. All the records about your details and interview will be stored securely with a password and destroyed after 5 years.

Please note that assurances on confidentiality will be strictly adhered to unless evidence of wrongdoing or potential harm is uncovered. In such cases the University of Glasgow may be obliged to contact relevant statutory bodies/agencies.

What will happen to the results of the research study?

A summary of the results will be available at the end of the study. They may also be published as a Master dissertation work. If you would like to receive a copy of the results summary, please, get in touch using the contact details at the end of this sheet. Additionally, an oral presentation will be delivered to teaching staff of School of Computer Science and School of Engineering interested in enhancing their teaching and learning methods. Both dissertation and oral presentation will not mention your personal details.

Who has reviewed the study?

The research project has been reviewed by the School of Education Ethics Forum.

Contact for Further Information

If you have any questions or require more information, please, contact the researcher, Alexander Vaniev (2273820V@student.gla.ac.uk).

Alternatively, you can contact the research supervisor, Dr. Srabani Maitra, at the School of Education by e-mail (Srabani.Maitra@glasgow.ac.uk) or by phone (01413 303446).

You can also contact the Ethics Officer at the School of Education, Dr. Kara Makara Fuller by email: kara.makarafuller@glasgow.ac.uk.

Thank you for taking the time to read this information sheet and for taking part in the research!

Appendix E: Consent Form

University of Glasgow

College of Social Sciences

Participant Consent Form

Title of Project: The importance of soft skills: A study examining the effectiveness of teaching and learning methods for facilitating soft skill development in postgraduate engineering education in Scotland

Name of Researcher: Alexander Vaniev

Please read the following statements and tick to indicate that you agree to them. You must also sign the form below before beginning the research.

I confirm that I have read and understood the Participant Information Sheet for the above study and have had the opportunity to ask questions. ☐

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason. ☐

I consent to interview being audio-recorded. ☐

I acknowledge that I will be referred to by pseudonym. ☐

I agree to take part in this research study. ☐

Name of Participant:	Name of Researcher: Alexander Vaniev
Signature:	Signature:
Date:	Date:

Email (to contact about research outcomes):