COMPETENCIES FOR FOOD GRADUATE CAREERS

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Abstract

Food sciences-based technical graduates are a significant proportion of the food and drink industry's intake. Unlike many other graduate career pathways in the UK, aside from technical standards, there is no cohesive food science competency framework to support the key stakeholders of employers, students and degree providers. Clarity of desirable competencies for the range of graduate opportunities available, would enable students to undertake effective career planning and personal development, and educators to refine programmes to satisfy market needs.

This study aimed to develop a competency framework using a mixed methods approach. By engagement of a stakeholder group, an initial language tool was developed by a series of semi-structured interviews, followed by thematic analysis and group consolidation using a modified-Delphi approach. Steps to increase confidence in validity included student group interviews at three universities. After identification of typical graduate roles, the new language tool was incorporated into an industry-wide online survey (UK and Republic of Ireland), evaluated by descriptive analysis and principal component analysis. The tailored competency framework, Competencies for Food Graduate Careers (CFGC), is a set of 48 *elements* outlining which are desirable for each of 14 typical graduate roles.

Following development of appropriate methodology, CFGC was mapped against food sciences curricula at University of Nottingham (UoN) to evaluate appropriate levels of inclusion of each *element* in degree programmes. Initial integration of CFGC for careers education of UoN undergraduate students

has been successful. Online resources have been developed to complement direct use at UoN, and support wider access to CFGC.

To increase the quantity of ‘oven-ready’ graduates entering the food industry, it is recommended CFGC be used for careers education and competency development by other degree providers. It can also underpin national initiatives already begun to encourage young people to enter the food industry as career.

For my husband and daughter, who supported me in this endeavour and for my father, who has supported me every step of the way in my life.

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List of Publications and Presentations

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WESTON, E., CRILLY, J., MOSSOP, L. & FOSTER, T. (2017). Competencies for food graduate careers: Developing a language tool. *Higher Education Pedagogies,* 2**,** 101-115.

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WESTON, E. (2018). In IFST Education & Careers Forum: strengthening the food sector talent pipeline, Food Matters Live, 20 November 2018. London, UK (Oral Presentation).

Abbreviations, Glossary and Symbols

BRC	British Retail Consortium
CBI	Confederation of British Industry
CFGC	Competencies for Food Graduate Careers
CIPD	Chartered Institute of Personnel and Development
CMU	Cardiff Metropolitan University
Compulsory education	All education before the age of 18 in UK or equivalent
Course	A programme of study, such as a bachelor's degree course
CV	Curriculum vitae
DEFRA	Department for Environment, Food & Rural Affairs
EHEA	The European Higher Education Area
FA	Factor analysis
FMCG	Fast moving consumer goods
FDF	Food and Drink Federation
Food industry	Food and drink industry (comprising suppliers, manufacturers, technical support and retailers of foodstuffs)
GVA	Gross Value Added
HE	Higher Education
HEA	Higher Education Academy (from 2018 renamed 'Advance HE')
HEI	Higher Education Institute
IFT	Institute of Food Technologists (USA based)
IFST	Institute of Food Science and Technology (UK based)

ISEKI	The term used to refer to project activity undertaken by the ISEKI-Food Association.
LOs	Learning outcomes
Module	A defined and timetabled subsection of a course or programme of study
OBE	Outcome-based education
OfS	Office for Students
NPD	New product development
PCA	Principal component analysis
Programme	A course of study, such as a bachelor's degree course
R&D	Research and development
QAA	Quality Assurance Agency for Higher Education
QUB	Queen's University Belfast
TEF	Teaching excellence framework
SMEs	Small and medium-sized enterprises
STEM	Science, technology, engineering and mathematics
TLA	Taught, learned, assessed
TPA	Taught, practised, assessed
UoN	University of Nottingham
URL	Uniform resource locator
[ ]	Denotes an infill of words
~~1234~~	Denotes removal or correction of raw text data

“The production and distribution of food is the largest and most important economic activity in the world” (Institute of Food Science and Technology website).

Chapter 1 Introduction

The food and drink industry provides a sizeable contribution to the UK economy and employs a significant quantity of its workforce. The breadth and level of employment opportunities it affords, is arguably unsurpassed and it has a significant and sustainable advantage in being associated with a fundamental human requirement; food. To ensure the success of any industry, the attraction and development of a fit for purpose workforce is vital. This project centres on a key section of its personnel, food science graduates, seeking to develop, test and disseminate a competency framework tailored to typical technical career pathways for graduates entering the food industry.

1.1 THE UK FOOD INDUSTRY

With 19% of UK turnover, the food and drink industry is the largest manufacturing sector and contributes £28.8 billion to the economy (Food and Drink Federation, 2018). Statistics from Department for Environment, Food & Rural Affairs (2017) or 'DEFRA' in Table 1.1 provide some categorisation of the types of food and drink manufacturing prevalent in the UK.

The Gross Value Added (GVA) figures, defined by DEFRA as value of goods produced after removing cost of raw materials and other inputs, provide some indication of the contribution of each product type to the industry. There are ten 'product types' outlined, where 'other food products' incorporates prepared meals, confectionery, condiments and seasonings and, with a GVA of £5.9 billion, is a significant contributor to UK manufacturing.

Table 1.1 UK food and drink manufacturing by product type taken from section 1.4, Department for Environment Food and Rural Affairs (2017).

Product	Gross value added (GVA) of sector in 2016 (£ billion)
Meat and meat products	3.7
Fish and crustaceans	0.7
Fruit and vegetables	2.1
Oils and fats	0.1
Dairy products	2.6
Grain and starch products	1.4
Bakery	3.9
Other food products	5.9
Prepared animal feeds	1.9
Beverages	7.2

Some product types are placed at the start of the food supply chain such as 'prepared animal feeds', whilst others such as 'bakery' are situated directly at the point of consumer purchase. Manufacturing can range from primary processing of single food components such as butchery, or milling of cereal crops, to slightly more complex conversion including brewing and baking, and then finally more elaborate processing of numerous ingredients or assembly of sub-components into final products such as chilled ready meals. Recent statistics (Food and Drink Federation, 2018) report that 97% of these businesses are small and medium-sized enterprises or 'SMEs', which are classically defined as those with fewer than 250 employees.

However manufacturing is only part of the food industry[1]. All categories of the agri-food sector, with the exception of 'Agriculture and Fishing' in Table 1.2

[1] Throughout the project the terms food industry or food sector will be used to describe the food and drink industry.

are in scope. For example, retailers undertake minimal (if any) processing of foods, but are considered part of, and contribute significantly to, the overall food industry.

Table 1.2 Gross value added of the UK agri-food sector taken from section 1.4, Department for Environment Food and Rural Affairs (2017).

Sector type	Gross value added (GVA) of sector in 2016 (£ billion)
Agriculture and Fishing	9.2
Food and Drink Manufacturing	29.5
Food and Drink Wholesaling	12.3
Food and Drink Retailing	29.4
Non-Residential Catering	32.7

The agri-food sector contributed £113 billion or 6.4% to national GVA in 2016. The GVA of the food industry (thus excluding agriculture and fishing) of £103.90 billion, increased by 2.7% in 2016, following a 3.9% increase in 2015 (Department for Environment Food and Rural Affairs, 2017).

Research and development (R&D) is also a facet of the wider food industry. Some of this activity is based internally within manufacturing companies (and thus accounted for in earlier data), but a significant proportion resides within, or in partnership with universities and research institutes. Research can be in the form of fundamental technological advances funded by UK government bodies (Biotechnology and Biological Sciences Research Council, n.d.), or focussed, market driven projects of incremental or stepwise change, with aims such as profit, market advantage or consumer need (Traitler, Coleman & Burbidge, 2016). Historically the UK has been at the forefront of many food innovation milestones, was the first to create frozen food and the 'ready meal',

and led developments in functional food innovation (Chen, 2015). Typically £1 billion has been spent on food and drink R&D each year in the UK (University of Nottingham, 2013).

Finally there are technical and laboratory services to include, supporting businesses in the UK food industry with routine testing, validation, product development or incident support. Some are purely accredited laboratories, others consultancies and several combine the two to provide a broader, technical service.

From a European perspective, the significance of the food industry is replicated (Mayor, Flynn, Dermesonluoglu *et al.*, 2015), where it is the, “single largest manufacturing sector in the European Union” the, “biggest employer” and, “one of the most complex in terms of diversity of businesses” (pp.871-2).

The categories of the ‘food industry’ could be summarised as:

- manufacturing
- retail
- technical and laboratory services
- research and development
- food service and catering
- logistics, storage and distribution

These categories employ food sciences graduates to varying levels. With regard to the future of the UK food industry it is worth understanding the current context,

> *"Food and drink companies around the world face threats and opportunities from a range of factors, from automation to product safety regulation. Those in the UK, though, face a unique additional source of anxiety: Brexit."* *(BDO LLP, 2018, p.1)*

Brexit or the 'British exit from the European Union' (EU) due on 29 March 2019 (Department for Exiting the European Union, 2018) will have an impact on food industry trade and labour markets; two of the UK's three biggest export markets (Ireland and France) and a third of its current workforce are from the remaining EU (Food and Drink Federation, 2018). It is not feasible or beneficial to predict the outcomes of Brexit to the food industry in the short or long term at the time of writing. However it is reasonable to assume that the requirements to meet global technical challenges will continue, and the requirement to maintain a productive and innovative food industry will remain, something exemplified in a recent government report (Universities UK, 2017).

1.2 GRADUATE EMPLOYMENT IN CONTEXT

The Food and Drink Federation (2018) or 'FDF' estimate the UK food industry as a whole employs over 400,000 workers. An interesting inference made by a food industry recruiter links the range of products available in supermarkets to the variety of opportunities available with manufacturing suppliers (More People, n.d.).

However the industry suffers from a number of skills gaps, namely in science, technology and engineering related roles. The independent qualifying body for food professionals in Europe and the only professional food body in the UK, Institute of Food Science and Technology (IFST) (n.d.-c) states the sector

is “crying out for well-qualified and experienced specialists” to play their part in a “complex and increasingly sophisticated food supply system” (para.2). The FDF (2018) forecast that by 2024 the industry will need 140,000 new recruits at all levels to meet growing demand. Within this demand there is a requirement to enlist graduates into a wide range of fields, a significant proportion to be deployed in the technical field, and thus sourced from food science or technology based courses.

At this stage it is worth clarifying for the purposes of higher education (HE) statistics and UK publications, that the use of a variety of degree course codes or ‘JACS’ codes (Higher Education Statistics Agency, n.d.) and associated groupings used for food science degrees, presents difficulty in interrogating national graduate destination data or programme performance trends, so are generally avoided at this level of detail.

1.2.1 Perception of careers in the food industry

UK manufacturing as a whole requires more talent entering industry from STEM (science, technology, engineering and mathematics) backgrounds, including the food sector (Foresight, 2013). It is also reasonable to state that recruitment in the food and drink industry can be hampered by poor public image (Mayor *et al.*, 2015, The Agrifood Training Partnership, n.d.). In a report prepared to drive future productivity, the FDF (2016) comments that despite the broad range of ‘fulfilling careers’ available in manufacturing it suffers from minimal public awareness of its pace and dynamic nature.

From a global perspective, the International Academy of Food Science and Technology (IAFoST) reports that the role of food science and technology is poorly articulated in many national strategies and visibility must improve to

attract future ‘thought leaders’ (Hermansson & Lillford, 2015, pp.111-3). The Graduate Recruitment Bureau (n.d.), a UK recruitment consultancy comments the traditional perception of the sector may contribute to a low profile with graduates, however resulting shortages can allow for rapid career progression. Many are aware that enhancing industry’s image at school and university level is a key enabler to secure future talent, including the National Centre for Universities and Business (2015) or ‘NCUB’ and the FDF (2008). The NCUB launched the ‘Food 4.0’ task force in 2015, focussed on, “innovation, leadership, entrepreneurship and talent for the food sector” (pp.6-7). They commissioned a survey (Hughes, Spong & Sheen, 2015) directed to a range of undergraduates (n=500), and recent graduate entrants to the food industry (n=154), posing key questions about the attractiveness of food careers. The Food 4.0 task force were heartened that “most of the graduates working in it see it as a good career option and score it almost six out of seven for attractiveness” (National Centre for Universities and Business, 2015, p.18).

Undergraduates and recent entrants (n=281 and n=43 respectively) who disagreed that the food sector was ‘attractive to graduates’ in the survey (Hughes *et al.*, 2015), were asked for suggestions of how to improve the situation. Grouped suggestions were highest for improved advertising and marketing to increase awareness of the sector overall (44.6% and 30.2% respectively), and making information on careers and opportunities more available (42.3% and 34.9% respectively). One student commented “Break down the stereotype that the sector is low skilled and poorly paid” (Hughes *et al.*, 2015, p.20), reflecting relatively low suggestion for increased wages from

respondents (reported 11% for undergraduates and 29.9% for recent graduates).

The ‘Food4Thought’ campaign in the USA (Wagner, 2015) was launched by the US-based Institute of Food Technologists (IFT), with an aim to ensure students, teachers, and parents are aware it is a ‘premier STEM field’ to enter, reflecting similar needs for improved publicity, although data were not retrieved on the success of the campaign. The IFT’s target audience reflects a recent assertion from the new UK Food and Drink Sector Council (Keohane, 2018) at IFST Education and Careers Forum (2018), presenting parents and teachers as significant influencers in young people choosing to embark on a career in the food industry.

1.2.2 Graduates entering the food industry

The Graduate Recruitment Bureau (n.d.) have illustrated the proportion of food industry graduates they have placed in jobs by degree type (Figure 1.1). They report 45% have a food related degree, 37% from other science study, and 18% from business degrees. From a pan-European perspective, Oreopoulou, Giannou, Lakner *et al.* (2015) found by use of a survey, that food science and technology or engineering degrees were the predominant entry subjects. This reflects a better balance of all graduate opportunities, however there is agreement that food related degrees are the major source of new graduates.

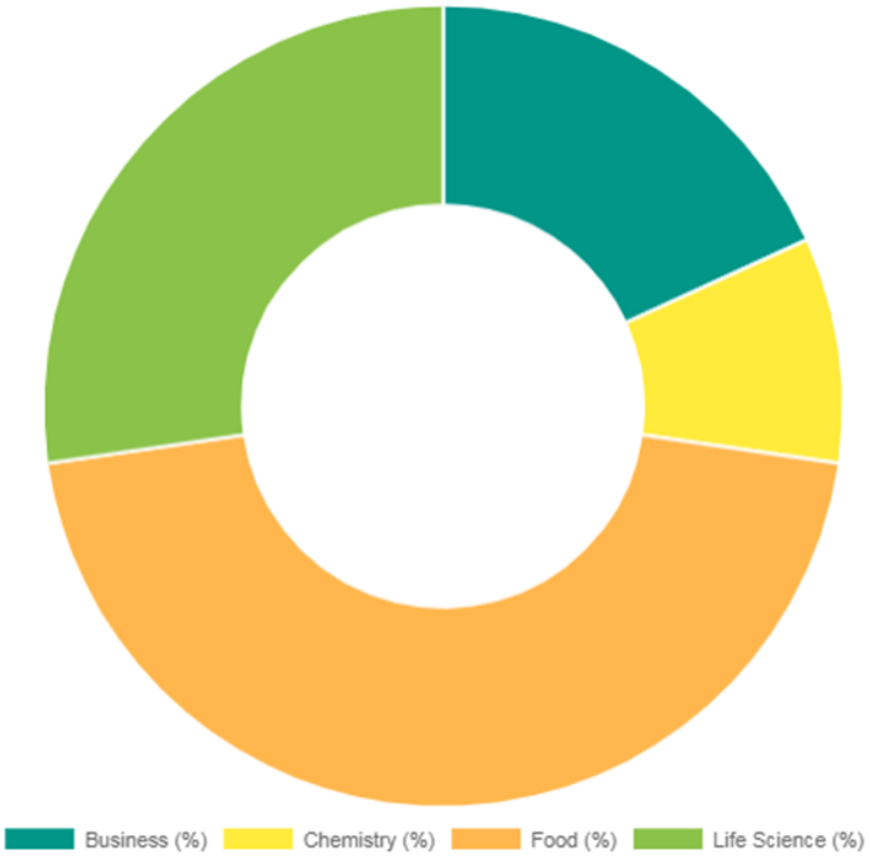


Figure 1.1 Proportion of candidates placed into food industry by degree type where 'Food' is 45% (Graduate Recruitment Bureau, n.d., section.3).

Key employers of food science graduates are manufacturers, producers and retailers. There are also roles in technical services with additional, occasional opportunities within UK government organisations (Prospects, 2018a) for developing food policy and enforcement processes, which may increase in light of Brexit.

For product development or food technology roles, a degree or postgraduate qualification in food science can be specifically required by employers (Graduate Recruitment Bureau, n.d., National Skills Academy for Food and Drink, n.d.-b). Other roles may be suitable for those possessing broader science or engineering based degrees.

LeGrand, Yamashita, Trexler *et al.* (2017) recently referred to the assertion made by Weller, Robbins, Elmore *et al.* (2015) that worldwide opportunities "outstrip available well-trained applicants", and students holding a degree in food science "often receive multiple internship and job offers" (p.118), which has been supported by media over many years (Fletcher, 2006, Food and Drink Federation, 2018). In light of this and possible reputational challenges for the sector to overcome, food industry recruiters must work hard to secure the best graduates. Clarity in job advertisements or specifications are pivotal to attract these discerning candidates.

However past research in general industrial recruitment noted an "extensive and confusing range of definitions" (Jackson, 2010, p.29) used for graduate competencies, and urged for better 'profiling' of industry's requirements of the modern graduate. The range of terms and descriptions used in naming and describing graduate roles in the food industry can be confusing to the experienced, let alone to a final year undergraduate seeking their first position. There is a real demand for food science graduates and efforts to improve processes to secure ideal candidates is a necessary undertaking for employers.

1.3 FOOD SCIENCE HIGHER EDUCATION

Degree providers offer food science courses across the UK (The Complete University Guide, n.d., UCAS, n.d.), and have a duty to provide the quantity and calibre of graduates essential to support this large, complex and evolving industry. High quality degree courses comply with the appropriate framework issued by the Quality Assurance Agency for Higher Education (QAA) (n.d.) for subject specific knowledge and understanding. Information is provided in the

QAA benchmark statement (2016) for ‘Agriculture, horticulture, forestry, food and consumer sciences’ with regard to technical and scientific skills with separate subsections provided for each degree type. However reference to aspects of competencies that would be described as transferable skills, such as ‘communication’, are only found in the ‘generic skills’ section for all courses (Table 1, Quality Assurance Agency for Higher Education, 2016). The QAA state, “it is not possible to specify a precise core subject knowledge that is common to all the subjects covered in this Statement” (p.12), which suggests although providing a sensible list, it is too general to be of targeted use to food science students.

The pressure to provide graduates of suitable calibre for employment is heightened in technical fields by the demands and pace of innovation and technological development. This was exemplified by the Wakeham (2016) ‘Review of STEM Degree Provision and Graduate Employability’, highlighting that this pace of change creates additional burden on both HE and industry to match the future demand for the number and skills of STEM graduates. This supports earlier findings in agri-food specific work by the Food Research Partnership (2010), known as the ‘Beddington Report’, which includes a call for greater professionalism in the future. It is agreed this burden and pace necessitates higher education institutes (HEIs) to “keep pace with the times, and adjust where possible to changing professional needs” (Perera, Babatunde, Zhou *et al.*, 2016, p.2), and is applicable for food science education.

There are many calls for graduates to be able to start their first jobs ‘work ready’; possessing a wider set of competencies than discipline specific

knowledge. The latest Confederation of British Industry (2017) or 'CBI' Education and Skills Survey, asked employers for the top three factors desired in graduates. 'Attitudes and aptitudes for work' (no definition given) was found to be most desirable by employers compared with 'degree classification' or 'subject' (although for the manufacturing sector, degree subject is comparably closer to the top). There is greater understanding of requirements to balance provision of subject specific content in a programme, with opportunities to develop broader skills (Bath, Smith, Stein *et al.*, 2004).

In 2015, the IFST launched a degree accreditation programme (n.d.-a), and as of October 2018, 36 first and postgraduate degree programmes are accredited from 17 HE providers across the UK. There are many other related degree courses on offer in the country (UCAS, n.d.), which have yet to gain accreditation. The current criteria for IFST degree accreditation takes primary reference to the QAA standard (2016), and thus to the 'generic skills' with respect to broader competencies.

There has been recent work published in the USA (Hollis & Eren, 2016) and Australia (Coorey & Firth, 2013), by food science degree educators tailoring programmes for better work readiness. Both utilise product development tasks as a vector to enhance the broader competencies desired by employers such as communication, problem solving and team work. European work coordinated by the ISEKI Food Association (see Chapter 2) have identified a selection of technical and "soft" skills that may be required in food scientists and technologists at varying levels of qualification on entry to industry (Flynn, Bejarano, Wahnstrom *et al.*, 2013a, Ho, Lindbom & Wahnström, 2011). However, there is no defined tool, model or guideline available to outline the

broader skills that make a desirable food sciences graduate, or define workplace ready skills. These broader work-related attributes can be grouped into the overarching term of 'employability' which will be discussed fully in the next Chapter.

1.3.1 Food science education to develop employability

The application of competency-based education for enhancing employability and developing professionalism is now a key part of curriculum design in HE (Mossop, 2012, Perera *et al.*, 2016), including food science teaching at UoN and elsewhere and is discussed further in Chapters 2 and 8. Joyner and Stevenson (2017) observe the 'trend' is to teach to enable students to perform well in specific career pathways. Frameworks or models can encapsulate employability-based or total competency requirements. However competency frameworks for graduate vocations can be used beyond curriculum development and degree course inclusion. They can improve a student's awareness of the desirable skills and behaviours for specific career pathways and thus inform choice and plans for personal development. Using the same approach, some employers use frameworks for in-job evaluation (Storey, Howard & Gillies, 2002, Miller, Rankin & Neathey, 2001), and to develop targeted selection processes for graduate recruitment.

1.4 FOOD SCIENCES EDUCATION AT UNIVERSITY OF NOTTINGHAM

Full time undergraduate bachelor's degree programmes at UoN are delivered by modular teaching, over two semesters per academic year, for three years. The Division of Food Sciences is part of the School of Biosciences, within the Faculty of Science at UoN. Curricula for food science degree programmes

(University of Nottingham, n.d.-b) are primarily designed to conform to both the pertinent QAA benchmark statement (2016) and internal UoN quality assurance standards (2017). Courses also meet requirements for the IFST degree accreditation scheme (n.d.-a). All teaching and associated assessments are structured by programme and module learning outcomes. Relevance and compliance is managed by the process of sector aligned quality assurance.

There are two core bachelor's degree programmes, BSc (Hons) Food Science and BSc (Hons) Nutrition and Food Science[2]. For both programmes, students can elect to take a one year industrial placement (between years two and three), 30-50% of students take this opportunity per cohort. There is also an option to extend into a '4th year' and graduate with an MSci integrated master's degree. Both options are identified on final degree certification and considered worthwhile opportunities to develop and refine many key competencies, the placement year in particular. However these options are not part of the core or compulsory BSc degree programme. Cohorts per year usually total 30-40. The teaching staff are a blend of academically cultivated researchers and those with industrial career experience.

1.5 TERMINOLOGY

To resolve any confusion in terminology when referring to degree education in other countries, a full degree course of study will be termed a 'course' or 'programme'. The term used to denote subsections of a course or programme will be 'module'. Some authors from regions such as the USA,

[2] See next page for title change information.

use ‘course’ to describe these subsections, but this has been replaced in the body of this thesis as required, with ‘module’.

At UoN, the name of one of the bachelor’s courses changed mid-way through the project. Originally named ‘Nutrition and Food Science’, the name was revised to ‘Food Science and Nutrition’ from September 2017 entry onwards. For simplicity the original name of Nutrition and Food Science will be kept throughout the thesis.

Following the review of literature, Chapter 2 outlines the journey of development of pertinent terminology; an important feature of this project. The use of the word ‘competency’ has commenced in this Chapter, but will be explored as part of this work.

1.6 AIMS AND SCOPE OF PROJECT

This project seeks to develop, test and disseminate a competency framework tailored to typical technical career pathways for graduates entering the food industry. The framework will aim to:

- Inform students intending to join the food industry as a technical graduate or ‘careers education’.
- Optimize food science degree courses to best reflect the needs of the food industry or ‘competency development’.
- Support recruiters and employers in providing consistent, accurate advertisement and selection criteria.

The researcher terms the challenge as the development of ‘oven-ready’ graduates. The use of terms ‘careers education’ and ‘competency

development' will be rationalised in the next Chapter. This project will provide to stakeholders in the UK food industry: educators, employers and the graduates themselves, a competency framework for the typical roles food sciences graduates are recruited to.

The study intends to have both theoretical and practical contributions (Holmes, 2017). In terms of theoretical contributions, the aim is to fill a novel gap in knowledge, by building and using an employability based competency framework for graduate vocations within the food industry. In terms of practical contributions, this study should support improved stakeholder delivery of targeted and tailored education and employment of graduates for the food industry.

The intention was to develop a competency framework using an inductive process (Creswell, 2014) with limited benchmark. A set of research questions are presented in the next Chapter, rather than a hypothesis on predicted outcome (Andrews, 2003).

This thesis aims to document the processes and associated results of the research undertaken to establish the nature of desirable competencies in food sciences graduates. The scope of the research is centred on food sciences HE and employment in the UK and the Republic of Ireland[3]. Reference is made to European and global contexts as deemed appropriate throughout the thesis. It is anticipated there may be applicability for other countries of study and employment; indeed UoN attracts an international blend of students, a

[3] When referring to 'UK employers' in future chapters this will include the Republic of Ireland unless stated otherwise. Please note some industry statistics or employment data such as that included in this chapter may be UK specific.

number of companies involved in the project are multinational and the ability to work in worldwide context is, “particularly attractive to employers competing on a global stage” (Li, 2017, p.200). The prevalence of global food industries in the supply chain (Carruth, 2006), impacts on daily and strategic interaction within the food industry, exemplified by the increasingly universal use of the British Retail Consortium (n.d.) or ‘BRC’ Global Standard for Food Safety, to demonstrate operational compliance, and also a recent ISEKI article stating the need for a diversity of skills in a globalized sector (Flynn, Ho, Vieira *et al.*, 2017).

Nonetheless, as a primary task was to build a language tool to support a framework, the project scope was geographically restricted. The source of data for this project was therefore regulated to businesses operating and undergraduates studying within the UK and the Republic of Ireland. Applicability for possible extension will be discussed in later Chapters.

1.7 STRUCTURE OF THESIS

Chapter 1 has provided a background to the UK Food industry and the interrelationship between food sciences HE and the employment market for graduates into this sector. Key terminology used in the thesis has started to be clarified and primary aims and objectives outlined.

Chapter 2 presents relevant literature regarding outcome or competency-based education and the curriculum at degree level. It then seeks to outline and discuss pertinent viewpoints on defining and modelling employability and competency; their inclusion in undergraduate teaching, and in particular food science education. The project research questions and a diagram to follow

the development of terminology are presented. The overall approach taken to conducting the research and principal methods of data collection and analysis used are introduced in Chapter 3, and processes for involvement of stakeholders and ethical considerations confirmed.

Study A is presented in Chapter 4, where in partnership with the core stakeholder group and using a qualitative approach, the language or terminology for use in the project was defined. Chapter 5 describes processes undertaken to test the validity of the results of Study A, by involvement of students and employers (Study B). The process to build the overall competency framework by utilising an industry-wide survey (Study C) is described in Chapter 6. Details of methodology employed to design, conduct and analyse results are included. Limitations and implications of each study are discussed progressively in these Chapters.

Using a case study from UoN, Study D utilises the cumulative results from previous studies. Chapter 7 illustrates the process undertaken to establish the level of inclusion of characteristics of the competency framework within current food science undergraduate curricula. Implications of Study D are presented with associated plans for future refinement of teaching and learning activities at UoN.

As additional activities to the core project aims, Chapter 8 communicates the initial uses of the competency framework; firstly formal inclusion into a final year undergraduate module for ‘careers education’ is described and assessed by capturing student viewpoints. The creation of an open access, online tool is introduced and the possibilities of wider use in enlightening students are

discussed. Initial endeavours to refine UoN curricula following curriculum mapping in Study D are also presented.

Chapter 9 concludes the thesis by capturing the overall outcomes of the research undertaken, and summarising limitations and opportunities from the project. The impact of use to date at UoN is critiqued, initial usage at other HEIs introduced, and possible future opportunities for better preparing undergraduates for career development, job application and success in employment suggested. The future of degree study and employability is debated and areas for future research proposed. Finally possibilities for wider use of the project outcomes in the food industry with regard to employers, educators and students are suggested.

Chapter 2 Literature Review

2.1 INTRODUCTION

This project centres on identifying key graduate competencies for typical career pathways in the food industry and applying this knowledge to develop food sciences education. This Chapter comprises three main parts. Firstly, a study of some pertinent topics for teaching in HE and processes for curriculum review and development was undertaken. A review of relevant literature on graduate employability, competency development and approaches taken to establish requirements for a specific career pathway is also presented.

An introduction of available sources of information on food sciences degree competency development, and employability research and practice is conveyed, including available resources for food science careers education.

Finally, an explanation of the research questions is conveyed, followed by consideration of the development of associated terminology for the project.

2.2 MODERN HIGHER EDUCATION

2.2.1 Outcome-based education

Since the 1970s Rowntree (1982) explained that objectives for education should be established, with more than just 'content'; and recommended considering 'method' (what the professions dictate) and 'life-skill' (expectations for a person in society). He was articulating thoughts about how to establish what the student 'should be' at the end of a period of study,

> *"to set the student off in pursuit of an unnamed quarry may be merely wasteful, but to punish him for failing to catch it is positively mischievous."* *(Rowntree, 1982, p38)*

Spady (1994) is regarded as the instigator of outcome-based education (OBE) by his work undertaken from the late 1980s in US schools (Harden, 1999, Harden, 2007, Cobb, 2015). The main principle of OBE is to, "begin with the end in mind" (Frank & Danoff, 2007, p.642). Rather than just listing the knowledge a student needs to acquire it requires definition of what a student is required to be able to understand or do, and so learning outcomes (LOs) can be built that deliver this end result (Jerez, Valenzuela, Pizarro *et al.*, 2016). Teaching content, methods and assessment can then be developed aiming to fulfil these LOs (Lam & Tsui, 2016). Harden, a medical educator stated,

> *"Outcome-based education can be summed up as `results orientated thinking' and is the opposite of `input-based education' where the emphasis is on the educational process and where we are happy to accept whatever is the result." (Harden, 1999, p.8)*

The terms 'outcome-based' and 'competency-based' education can be interchangeable, where differences seem largely due to geographical location of publications (Kennedy, n.d., Morcke, Dornan & Eika, 2013), so 'OBE' will be used.

Within science-based subjects in HE, OBE is seemingly simple to grasp; traditional requirements were based on provision of specific content, attendance at practicals and passing examinations. OBE focusses on

understanding what the person is ‘able to do on graduation’ which is relatively comprehendible, LOs make this more explicit and thus more able to be verified. In some degree fields such as the arts, where greater emphasis is placed on creativity and the development of divergent abilities, construction of LOs may be initially challenging (Biggs, Tang & Society for Research into Higher Education, 2011). However OBE fits well into the structured philosophy of teaching food science, and it is the basis of current curricula for degree programmes in the School of Biosciences at UoN.

In the USA, Hartel and Gardner (2003) outline the transition of food science programme assessment to alignment with new LOs. Collating the typical terminology used in LOs, with sentence stems such as ‘Students will be able to…’, and terms including, ‘design’, ‘create’ or apply’, they have confidence in their use in interpreting, and including US national industry standards (Institute of Food Technologists, 2016). As OBE is internally driven by these LOs, they can be argued to work as a ‘competence model’ (Jerez *et al.*, 2016). Further exploration of competence and competency continues later in the Chapter.

2.2.2 Quality assurance in higher education

Beyond the dispersal of OBE into HE in the 21st century, other initiatives are in place to endorse the quality of degree study. The European Higher Education Area (EHEA) and associated launch of the ‘Bologna Process’ in 1999 with 48 participating countries (European Commission, n.d.), undertake collaborative work targeting quality assurance of degree programmes by building quality frameworks and understanding the needs of a changing labour market (Biggs *et al.*, 2011, Gómez, Aranda & Santos, 2016).

From a UK perspective the QAA (n.d.) carries out duties for the Office for Students[4] (OfS) and also asserts its position as an international leader in the field, informing policy for the Bologna process (2014). Most degree curricula conform to either an appropriate QAA benchmark statement (n.d.), or a professional competency framework / standard (outlined later), in addition to internal institutional quality assurance protocols (University of Nottingham, 2017). In the past three years the UK government has also launched the Teaching Excellence Framework (TEF), to assess the effectiveness of an institute's ability to deliver outcomes for students at graduate level (Office for Students, n.d.-c). Awards given at institute level since 2017, are bronze, silver or gold and applications at subject level have commenced. It appears national vigilance is increasing regarding degree standards and quality, a drive perhaps triggered by the sizeable increase in University tuition fees in 2012 (Coughlan, 2010).

2.3 THE TEACHING CURRICULUM

The Latin translation of curriculum as "racecourse" (Bobbitt, 1918) highlights destination and need for direction. Although reports of use of the term began in the 17th century by the University of Glasgow, formative development of curriculum design, testing and development was spearheaded by compulsory education[5]. Extensive research back to the 1970s can be found from primary

[4]The Higher Education and Research Act came into force in April 2017 and replaced HEFCE (Higher Education Funding Council for England) with the OfS (Office for Students).

[5] For this project compulsory education is defined as that undertaken before 18 years of age.

and secondary school educational practitioners and researchers, most notably in the USA starting with Bloom (1976) for learning, English (1978) for curriculum, then later for curriculum mapping, Jacobs (2004) and Hale (2008). While categorisation of curricula has developed over the years, so has the process of 'curriculum mapping' which is broadly defined as a procedure for collecting data about a curriculum (Jacobs, 2004).

OBE and detailed work on HE teaching curricula appears to have been initiated by the medical field, with Harden as a focal point of reference. Harden (2001b) published a short editorial on the learning environment and the curriculum. He considers the uncertainty in defining the curriculum and thus what others may include in associated review and development activities. He suggests, some see it as purely content (what is provided), most include something about learning and assessment, whereas others include wider experiences and influences, such as culture and values.

Understanding the 'curriculum model' informs an educator what to include in any curriculum mapping, review or development, some key examples from literature are included below, grouped by level of education or subject type where possible, to illustrate the variability in understanding of curriculum categories, curriculum maps and thus how to collect and process data during curriculum mapping.

2.3.1 Categorisation or structure of a curriculum

Firstly understanding how to establish different types of content in a curriculum is required. Figure 2.1 and Figure 2.2 have been constructed to compare some previous work on dividing and defining curriculum components.

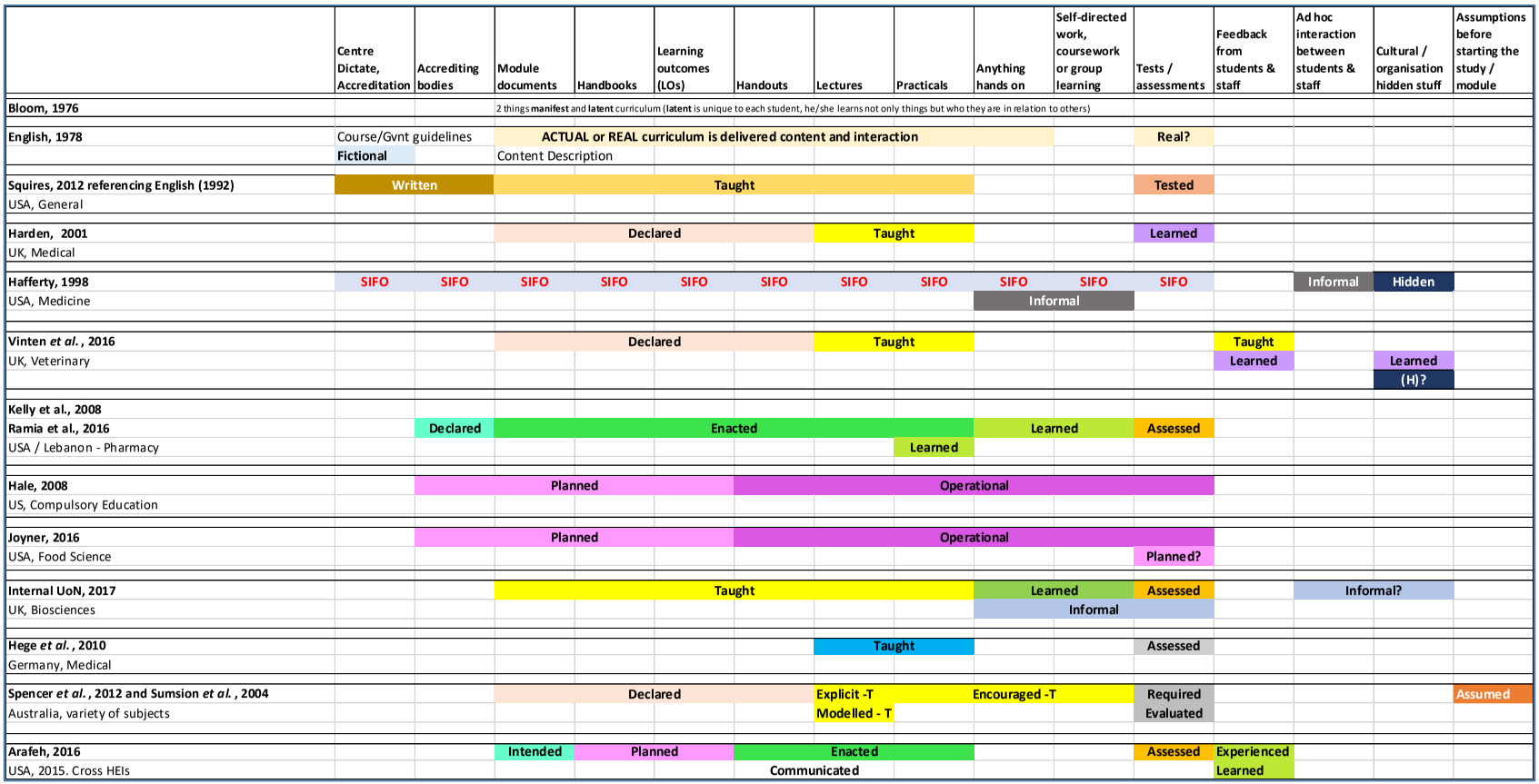


Figure 2.1 A comparison diagram of some previous work on categorising the curriculum (see Figure 2.2 for key).

Author	Category	Description of Categories
English, 1978	Fictional	Curriculum guide, not reality
	Actual	What is delivered by teachers
	Emphasis on working for desired curriculum to be the real or actual	
Squires, 2012	Written	Textbooks, industry or vocational standards
referencing English (1992)	Taught	Departmental plans, documentation & what is delivered
USA, General	Tested	Tests, assignments & any assessments
Harden, 2001	Declared	What it is assumed the student is learning
UK, Medical	Taught	What is presented
	Learned	What the student actually learns (links to what is tested)
Hafferty, 1998	SIFO	Stated, Intended or Formally Offered - 'this is what we do'
USA, Medicine	Informal	Ad hoc interaction between students and staff
	Hidden	Influences functioning at organisational structure/culture level.
Vinten *et al.* , 2016	Learned	As Harden, + 'hidden curriculum' as influences what is learned
UK, Veterinary	Declared	as Harden
	Taught	as Harden
Kelly et al., 2008	Declared	What it should be or planned
Ramia et al., 2016	Enacted	What is actually done in classroom e.g. syllabus
USA / Lebanon - Pharmacy	Learned	Coursework, assessments, formative, sumative, exams
	Assessed	As biosciences effectively
Hale, 2008	Planned	Learning expectations & assessments intended prior 'real time'
US, Compulsory Education	Operationa	Real time actual learning expectations & assessments
Joyner, 2016	Planned	What content and skills was intended or planned
USA, Food Science	Operationa	Actual content or skills the students are taught or learn
Internal UoN, 2017	Taught	Declared curriculum e.g. LOs & what is delivered or given
UK, Biosciences	Learned	Practised or tried by the student including group and SDL
	Assessed	Coursework, assessments, formative, summative, exams
	Informal	What is not formally on modules but believed developed
Hege *et al.* , 2010	Taught	Independently checked to avoid fictional
Germany, Medical	Assessed	Assessments independently checked to avoid fictional
Spencer *et al.* , 2012 and	Taught	Includes - 6 explicitly taught, encouraged and modelled
Sumsion *et al.* , 2004	Evaluated Assessed - Required needs to be demonstrated by student	
Australia, varied subjects	Assumed	Student arrives with previous schooling or finds elsewhere
Arafeh, 2016	No definitions given. All from Educator's perspective, except for,	
USA, 2015. Cross HEIs	Experienced and Learned is from the student's perspective	

Figure 2.2 Key to Figure 2.1, providing definitions to items categorising the curriculum.

The visual comparison is aimed to be supported by the use of colour coding for each study to highlight segregation of content where definitions appear

aligned in some way, however it is still difficult to tease any consistent threads or similarities between studies. For example, there are opposing views of how to define ‘taught’ or ‘learned’ and subsequently what curriculum material is included. This highlights the challenges in readily choosing appropriate categorisation of a curriculum and subsequent structure for mapping, and reference to the authors included in Figure 2.1 and Figure 2.2 are explored as this section continues.

2.3.1.1 Formative work by secondary educationalists

Development of compulsory education curriculum models and mapping has been driven by the USA. Bloom (1976) described affective outcomes of education in the 1970s with a ‘manifest’ and ‘latent’ curriculum, where latent is unique to each student and shapes not only learning but their understanding of their place in society. Latent curriculum has association with subsequent researcher’s aims to distinguish non-formal aspects of learning but it also highlights the importance of personal experiences, and thus gathering feedback from students being essential to understand true learning. Using English’s (1978) original terms of ‘fictional’ and ‘actual’, compulsory education curricula are now broadly divided between ‘planned’ / ‘intended’, including reference text, standards and materials that could represent reality (Hale, 2008), and then ‘operational’ comprising what actually happened. Operational can then be subdivided into ‘enacted’ and ‘assessed’; so what is delivered in the classroom by teachers, and measured by assessments respectively (Kurz, Elliott, Wehby *et al.*, 2010, Porter, Mcmaken, Hwang *et al.*, 2011).

2.3.1.2 The influence of medical education research

Harden's (2001a) Association for Medical Education in Europe (AMEE) 'Guide 21' is a core source of reference to categorise curricula, where he suggests there are three main aspects, the 'declared', the 'taught' and the 'learned' as illustrated in Figure 2.3.

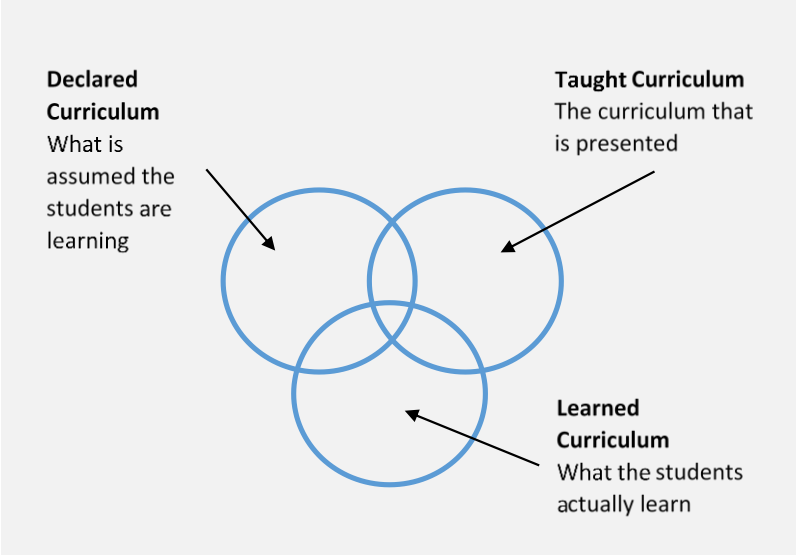


Figure 2.3 Reproduction of Harden's model of curriculum types (2001a, p.124).

The 'declared' curriculum references English's (1978) earlier description of the 'fictional curriculum', including programme quality standards, curriculum guides, module specifications, LOs and other formal material that is not direct teaching process. The 'taught' curriculum focusses on what is delivered to the students in person and this could include lecture material, practicals and coursework tasks. The 'learned' or 'tested' curriculum is described by Harden (2001a) as, "what the student actually learns" (p.124). This may include assessment material, reflection of student achievement as well as students' perception of what skills, abilities or knowledge they believe they now possess.

During the same period, Hafferty (1998) views the curriculum from an alternative perspective, with three parts, firstly the “stated, intended and formally offered and endorsed curriculum” i.e. “this is what we do” (p.404), which encompasses Harden’s declared and (possibly) taught sections. Next there is the ‘informal’ curriculum, referencing the more variable and unscripted part of routine teaching delivery by staff, connecting to Harden’s taught section. Finally a ‘hidden’ curriculum, discussed later in this section. Hafferty emphasises informal aspects of the curriculum to a greater degree than Harden’s model, believing they underpin and influence the formal inclusions.

2.3.1.3 Pharmacy education

In US pharmacy education Kelley, McAuley, Wallace *et al.* (2008) propose a model with four perspectives: ‘intended’, ‘enacted’, that which has been ‘learned’ or a student has experienced, and finally ‘assessed’. Figure 2.4 displays the concept map presented by the authors to illustrate the interaction of modules[6] and curriculum with external influences. This also illustrates the additional burden to comply with professional bodies in vocational education.

[6] Reminder for this project that module is the term used for a subsection of a course or programme (some authors use ‘course’ which has been replaced in the body of this thesis)

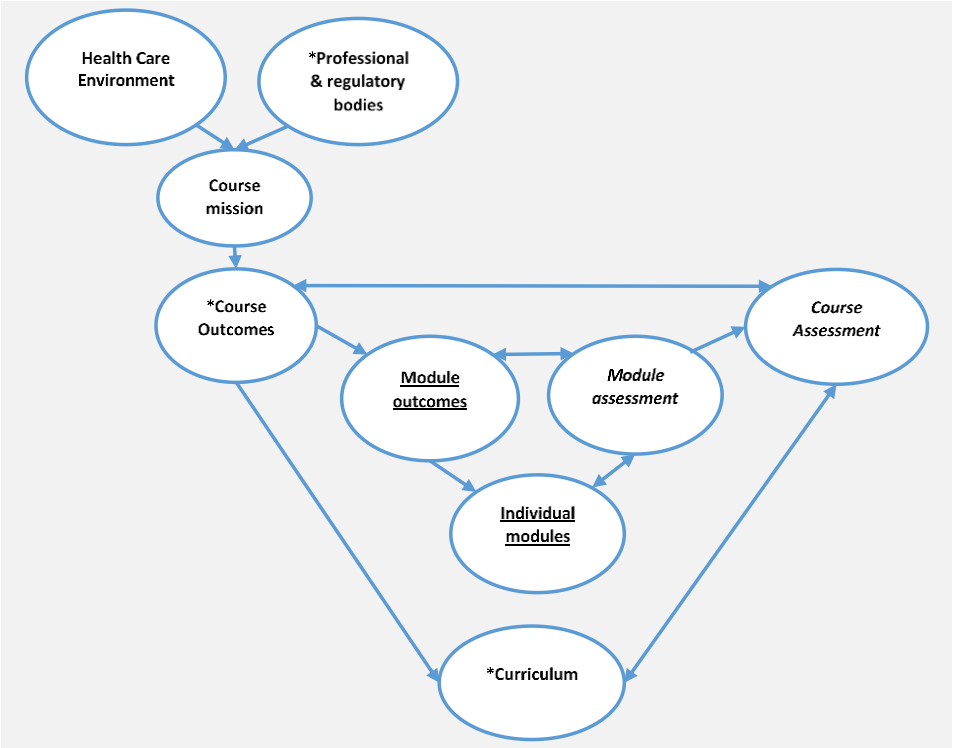


Figure 2.4 Adaptation of a concept map of course/module and curriculum with external influences in pharmacy education (Kelley et al., 2007, p.2). Key: * = designed or intended, underlined = enacted or delivered, italics = assessed. Terminology reflects this thesis (see footnote 6)

When exploring the personal and professional skills development in pharmacy curriculum in Lebanon eight years later, Ramia, Salameh, Btaiche *et al.* (2016) use the same model. In both cases there is divergence from Harden's principle that the 'learned' curriculum should include that which is tested, suggesting instead to include only what students experience and perceive they learn (Harden, 2001a, Kelley *et al.*, 2008, Ramia *et al.*, 2016).

2.3.1.4 Further Applied Approaches to Defining the Curriculum

Two Australian degree curriculum mapping studies in relation to graduate skills and capabilities use an expansion of 'taught, practiced and/or evaluated'. Spencer, Riddle and Knewstubb (2012) refer to Sumsion and Goodfellowe's (2004) desire to investigate with greater depth than

‘mechanistic’ approaches. ‘Taught’ is divided into explicit teaching and modelling. Additional criteria were added: ‘assumed’, that which a student should have before starting study, and also ‘required’ where a student needs to demonstrate a skill. However it appears ‘required’ is a subsection of ‘evaluate’ so should not be justified as a new category.

Additionally some curriculum designs have dimensions such as, ‘horizontal’ across the same level or year of study, and ‘vertical’ looking at a series of levels in the same topic (Hale, 2008, Spencer *et al.*, 2012).

2.3.1.5 Curriculum models within food sciences education

With regard to specifically published studies on curriculum models in the context of food science education, comparatively little can be found. There have been a few papers published on food science curricula and competency development but none with detail on the nature of the curriculum, beyond referring to content and assessment (Hartel, 2002, LeGrand *et al.*, 2017). However, Joyner (2016) in the USA outlines a cross institute study of food science degree courses in 2016 by mapping against LOs. She outlines that a curriculum is comprised of LOs, materials and assessments and draws on compulsory education’s categories of the ‘planned’ and ‘operational’ curriculum (Hale, 2008).

2.3.1.6 The hidden curriculum

Hafferty (1998) describes the hidden curriculum as a, “set of influences that function at the level of organisational structure and culture” (p.404). He further includes words such as ‘interaction’, ‘implicit’ and ‘latent’ which links to Bloom’s (1976) original observations. Mossop, Dennick, Hammond *et al.*

(2013) advocate the hidden curriculum can manipulate teachers and learners with regard to both formal and informal curricula, and in common with Ramia *et al.* (2016), suggest some competencies such as professionalism are influenced by hidden curriculum. Ramia *et al.* (2016) define it in more depth, as 'values', 'attitudes' and 'behaviours' influenced by the learning environment and role modelling, as opposed to formal teaching.

Vinten, Cobb, Freeman *et al.* (2016) suggest the hidden curriculum is part of Harden's 'learned' curriculum (Figure 2.3), intimating it is included in what the student finally acquires. As it is proposed to impact on curricula and thus final outcomes, this supports further the argument 'hidden' resides in the traditionally termed 'learned' curriculum (Ramia *et al.*, 2016). Hafferty (1998) outlines four key domains educators may wish to examine for influence on hidden curriculum, namely: policy development, evaluation, resource allocations and institutional slang. Whilst acknowledging Hafferty's work, Mossop *et al.* (2013) comment there is little offered on how to examine the domains, so use an adaptation of a 'cultural web' developed by business analysts, to look for elements of the hidden curriculum in veterinary education and their potential impact on the learning environment. Hafferty also suggests a critical step for altering the hidden curriculum is restructuring the learning environment, rather than adjusting the curriculum itself. Harden (2001b) provides a definition of learning environment as a, "manifestation of the curriculum" (p.335).

2.3.1.7 Summary of curriculum constructs

As illustrated above including in Figure 2.1, there is no single structure or model for categorising parts of a degree curriculum. Not only can the division of material change between researchers and studies, but also the nomenclature applied to categories generated, which can create confusion. For example in the field of pharmacy education, some studies categorise LOs as 'enacted', alongside lectures and practicals (Kelley *et al.*, 2008, Ramia *et al.*, 2016), whilst others classify LOs as 'declared' (Harden, 2001a, Vinten *et al.*, 2016). The other area of frequent difference observed is the substance of the 'learned' curriculum, as student experience, activities and perception (Kelley *et al.*, 2008, School of Biosciences, n.d.), or as assessment (Harden, 2001a). Kelley *et al.* (2008) exemplify where emphasis is made to select a model and associated language that is appropriate for use, has 'meaning' for staff involved and is used consistently.

Suitable categorisation of degree curriculum for this project are explored further in the next Chapter.

2.3.2 Curriculum maps

Hale (2008) defines a curriculum map as a, "succinct summation of planned and operational learning" (p.39). A map can be simple or as intricate as necessary for the scale and complexity of the task in hand and can be utilised to (Harden, 2001a, Hale, 2008, Joyner, 2016):

- Provide visual details of a current curricula including assessment.
- Demonstrate links between items or subsections of a curriculum.
- Provide a point of reference of past curricula contents.

- Track a student or cohort's learning journey.
- Manage teaching resource effectively.
- Support training and development of staff.
- Ensure any required accreditation criteria are included.
- Illustrate or explain the curriculum to others with transparency.
- Provide a point of reference for auditing or mapping.

When considering curriculum mapping it can be useful to visualise what the final map and interlinkages may look like before undertaking data collection and analysis. Maps may also help to coherently illustrate findings to stakeholders, or reflect on performance and possible improvements. Harden (2001a) likens a curriculum map to a road map and simply illustrates it as an extension of the curriculum model (Figure 2.3), with four facets: learning opportunities, in addition to the declared, taught and learned categories. Figure 2.5 presents Harden's original diagram, with the addition of arrows to suggest the how the facets could contribute to each other.

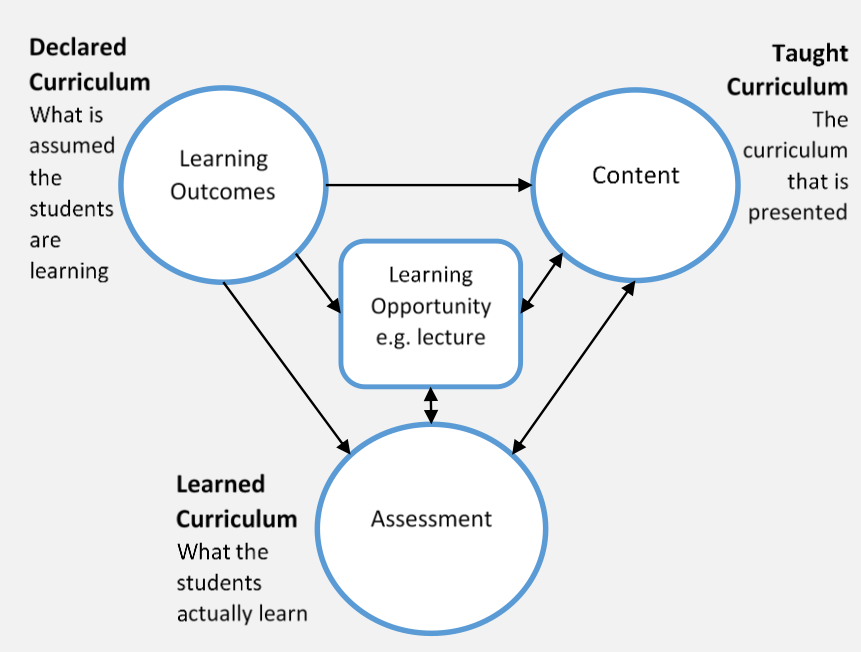


Figure 2.5 Adaptation of Harden's (2001a, p.125) simple curriculum map developed from his own curriculum types (see Figure 2.3). The researcher has amended the presentation and added arrows to the original diagram to suggest direction of contribution of the four facets.

However Harden (2001a) also describes a more detailed overview of a map with ten 'windows' adding categories such as the student, timetable, location and highlighting they in turn may have subdivisions and interlinkages across windows. As such the level of detail can be built to match the complexity of terminology used to define the curriculum and the intricacy of the module, modules, programme or programmes of study under scrutiny.

Internally at UoN, there is an online curriculum mapping system which provides academics with the ability to enter curricula information and any associated LOs or accreditation standards, to develop an interlinked map. Currently not in used for food science course, it is aimed for this system to be utilised in the project for curriculum mapping and presentation of results (Chapter 7).

2.3.3 Curriculum mapping

Researchers of curriculum models and descriptions share a vision for balance across components to provide the right amount and type of input (teaching and experience), to generate the required output (possession of knowledge and learning). The term 'curriculum alignment' is not employed in this review or project, but used to describe agreement or match between standards or intended content with that the students have an opportunity to learn (Squires, 2012). Curriculum mapping provides the ability to establish the level of this balance. For some degree courses, such as in pharmacy education, (Kelley *et al.*, 2008), there are formal requirements to undertake curriculum mapping by accrediting bodies in order to quantitatively assess the level of teaching and intended learning for each prescribed outcome.

2.3.3.1 The standards to underpin mapping

The development of approaches of curriculum mapping have been led by compulsory level and HE healthcare educators, the former championed in the 21st century by publications from Jacobs, Hale and associates (Jacobs, 2004, Hale, 2008, Jacobs, 2010). Beyond this foundation are some studies across a broader range of subjects in HE. The process undertaken for curriculum mapping is partly based on how the curriculum is categorised, which informs what stages are developed to best capture data.

Firstly the criteria for what to map against needs to be completely clear. In compulsory education there is usually a reference governmental standard (Hale, 2008). As introduced earlier, for HE there may be nationally agreed standards laid out for programme or subject areas, in the UK degree courses align to QAA (n.d.). In addition to this, vocational degree study such as those

for the medical profession, will have detailed mandatory competency frameworks (General Medical Council, n.d.) that educators are required to adhere to and map against accordingly. In modern OBE, the standards used are usually translated by an institute into LOs and cascaded into operational plans and use.

The simplest starting point is to map LOs (planned, intended or declared curriculum) against 'what is being done', the actual or operational aspects,

> *"Outcomes provide a 'yard stick' against which a curriculum can be judged. A failure to achieve the agreed outcomes almost certainly identifies a problem with the curriculum."*
>
> *(Harden, 1999, p.10)*

As Harden is a medical educator, the vocational nature of courses for these types of professions will align themselves closely to formal compliance against agreed outcomes and competencies. Other subject areas may use a more extensive set of criteria than LOs to map against, including additional criteria for professional compliance (Spencer *et al.*, 2012, Perera *et al.*, 2016, Joyner, 2016), but LOs usually remain at the heart of mapping.

There are many approaches used to gathering data or evidence on actual teaching and how to process and report the information and some examples are now considered.

2.3.3.2 Curriculum mapping in compulsory education

In compulsory education, Jacobs (2004) asserts, "making mapping work requires, patience, persistence and knowledge" (p.8). Advising dedicated and focussed work in preparation, she proposes four steps namely, material

gathering, action plan formulation, choosing templates or technology to use and 'planting seeds' with staff. Hale (2008) recommends Jacobs's Seven Step Review Process for the main activity, reproduced in Figure 2.6.

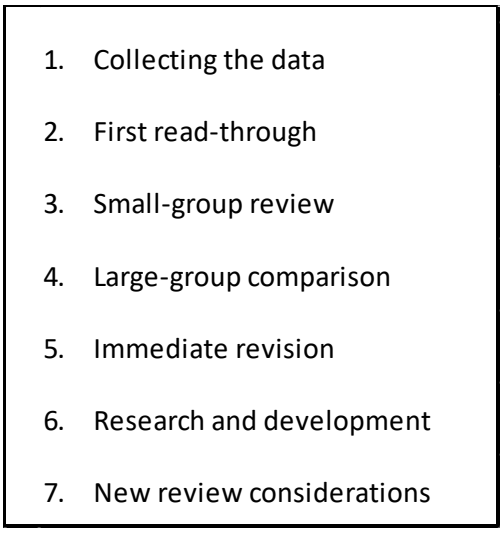


Figure 2.6 Reproduction of Jacob's Seven Step Review Process (Hale, 2008, p.166).

Steps three and four involve activities with quantities of staff larger than the usual HE course teams. But the approach of 'layers' or stages for data review with staff, to formulate agreement is of interest.

Perhaps understandably in the context of younger students, the voice of the student was not gathered in the mapping process. Both Jacobs and Hale as secondary educationalists, recommend the inclusion of an 'empty chair' in workshops or meetings to remind those present of the 'the student' (Jacobs, 2004, Hale, 2018), however in HE the ability to include the student in reality is more feasible. Results of examinations for qualifications are not included in most mapping processes, although there can be reflections of internal testing results (Hale, 2008).

2.3.3.3 Curriculum mapping in higher education

The necessity or value of undertaking curriculum mapping is introduced at the start of this section, and summarised as the evaluation of the balance of input against required outputs and additionally, the ability to audit curriculum for compliance to accreditation or vocational standards. Harden uses his detailed 10-window map diagrams to underpin 'mapping' of medical curricula, and an adaptation of his diagrams is included in Figure 2.7.

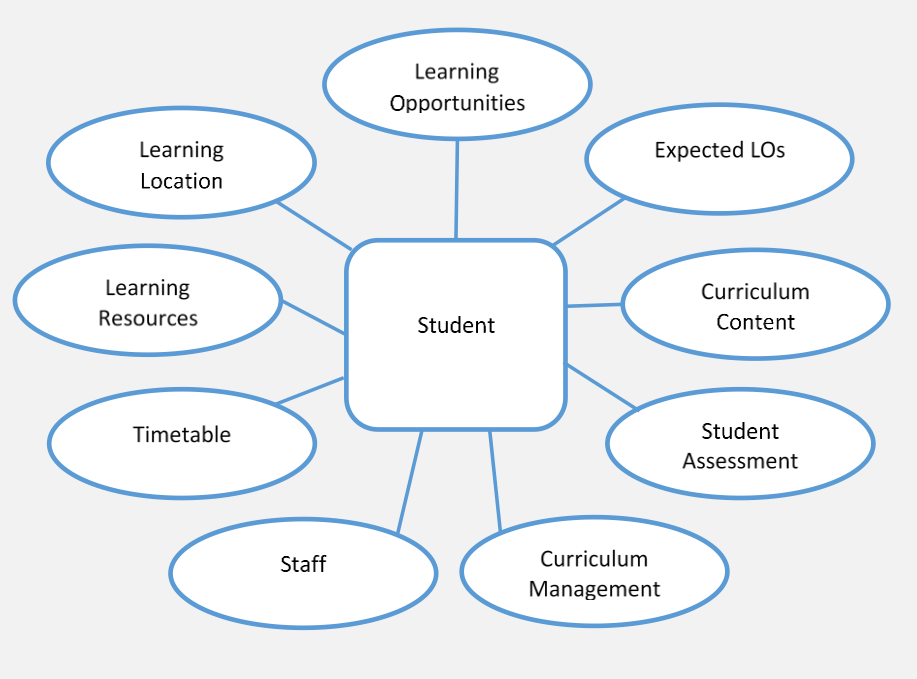


Figure 2.7 Adaptation of Harden's 10 window map diagrams, used to approach curriculum mapping (2001a, p.126).

Starting with '10 questions' in the 1980s (Harden, 1986) to undertake the process, this evolved to a nine stage method (Harden, 2001a). Firstly the needs, then scope of mapping are established. Links between the ten window types are anticipated before populating the windows, by agreed processes and choice of material. Next defining the format of the map, consideration of past, present and future and how users will access the construct are required.

Finally staff and students are introduced to the map, and responsibilities allocated for ownership and review. The level of detail assigned to setting up the map is perhaps too great for this project. Yet the suggestion of appreciating the past and future, as well as the present is sound, whereby mapping current status in any point in time, by staff in particular, will be influenced by reflections of past experience or performance. With regard to the future, this may not impact on the outcome of a mapping exercise but may generate requirements for future review.

Kelley *et al.* (2008) outline a model for mapping within US pharmacy education with five phases (Figure 2.8).

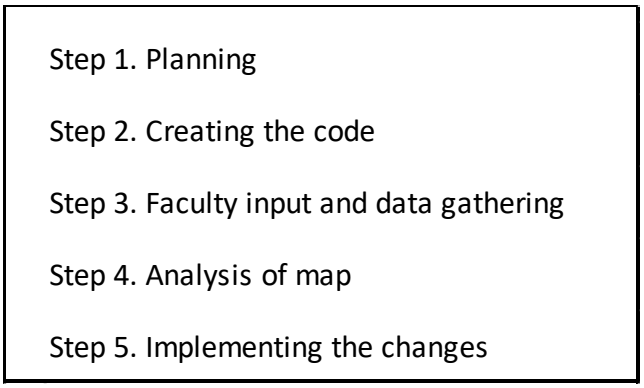


Figure 2.8 Reproduction of five phases of mapping (Kelley, 2008, p.3).

In creating the code, they describe agreeing 'metrics' for gathering data, such as the type of data (e.g. lecture, practical) and the level of relationship of the 'module' to the outcome (0-none to 3-direct relationship). Associated to Bloom's taxonomy (1976), a scale of inclusion is gathered, namely 'introduced', 'reinforced' and 'emphasized' (Kelley *et al.*, 2008). Arafeh (2016) also characterises level of delivery in, 'introduced', 'emphasised', 'reinforced' and 'advanced', with type of inclusion as 'implicit' and 'explicit'. The creation

and application of some type of metrics is an interesting consideration for mapping in the project. However, to include such categories would suggest that clear definitions for inclusions such as, 'introduced', 'reinforced' and 'emphasized' should be in place, to be able to apply the levels consistently. In addition understanding would be required on how to adjust results if an item is removed from the overall course curriculum in future during module adjustments, a likely occurrence. Is it appropriate to reduce the status by one level or does each stage require the previous, to perform correctly?

To establish compliance with learning objectives in medicine, Hege, Siebeck and Fischer (2007) collate data on a web-based tool (Hege, Nowak, Kolb *et al.*, 2010) from observations of teaching activities, exams and online student surveys. Work is firmly directed towards enacted, operational and learned curriculum and the use of a database to record and interpret data is of interest. However survey questions were not directly linked to specific elements (learning objectives) or parts of the course so could not support or challenge the data obtained from the main investigations. Arafeh (2016) focusses on mapping the LOs of four educational programmes against policy-oriented standards using a newly developed mapping tool. Limitations were noted that using predominantly LOs as evidence fails to capture the value of underpinning course content to deliver the LOs. Thus there needs to be an appropriate level of depth in mapping processes.

Including a variety of degree courses across Chile, Jerez *et al.* (2016) developed a set of criteria to explore the nature and application of LOs into syllabi, using the process of asking each institute to self-assess against criteria using a three point Likert scale. Data from 150 courses are analysed

by the authors. Although the aim of the study is a broad review of the national picture, remote self-evaluation by educators with no engagement with the authors, suggests a possibility of attitudinal responses, something prevented by personal sessions to review or agree consensus, as included in other studies. Lam and Tsui (2016) establish consensus from a rating process by four assessors on the type of inclusion of five pre-prepared subject LOs in 'modules' by objectives, assessment and content. This helps confirm reliability of responses.

Taking an alternative approach, Perera *et al.* (2016) co-ordinate self-mapping on four similar construction-based degree courses across the UK against industry standards using criteria of presence/absence, then three levels of breadth and an assessment of depth by 'time spent' in teaching. Results collated are adjusted, then 'ratified' into a desirable framework by an industry-based 'expert forum'.

2.3.3.4 Curriculum mapping centred specifically on transferable skills or broader competencies

Ramia *et al.* (2016) map personal and professional development skills from relevant external pharmacy standards against the 'declared' pharmacy curriculum, to use as a basis to review the 'enacted' curriculum from the viewpoint of staff. In completing additional mapping activities based on personal experience, fourth year students provide an additional enacted data source.

Spencer *et al.* (2012) map graduate capabilities within law and management curricula using a detailed code with descriptors and a six stage process. Quantitative data collection of declared curriculum starts with key word

searches of course documents, followed by completion of an online survey by subject coordinators, then 'coffee chats' to review and amend data based on supportive evidence from staff. The requirement of supporting evidence to justify inclusions takes learnings from Sumsion and Goodfellow (2004), where a similar process was undertaken with associated challenges of staff interpretation of inclusion. In both studies the use of consultation sessions are considered worthwhile, providing involvement of colleagues in agreeing final results (Spencer *et al.*, 2012).

Bath *et al.* (2004) describe central activities of a four stage mapping process of 'generic skills' in programmes as 'stocktaking,' which has appeal. Whilst appreciating mapping is a 'snapshot' of the operational curriculum, to understand more about the enacted and experienced curricula, student surveys were also included.

An institute-wide study at Queens University, Belfast (Tariq, Scott, Cochrane *et al.*, 2004) used a self-mapping tool developed for module coordinators to assess inclusion of 'key skills' and career management tasks. On completion of colleague briefings and explanatory workshops, module coordinators are required to look at whether skills are 'practised', explicitly 'supported' (this includes teaching) or 'assessed', and to what standard of proficiency (levels one to three). Data evaluation for degree pathways provides understanding of ability to develop these key skills. This study demonstrates a less austere approach, investing in developing detailed material and training of staff to facilitate ownership of self-mapping. Pilots elicit a requirement for staff to provide evidence of inclusion to avoid overly generous scoring (Tariq *et al.*, 2004). A similar self-mapping approach of the University of Glasgow's (n.d.)

graduate attribute list includes discipline-oriented versions, to assist staff. In both these studies, and for Jerez *et al.* (2016), it could still be argued robust data collection is compromised without some type of consultation or centralised adjudicating team.

2.3.3.5 Mapping of food sciences curricula

When mapping food sciences degree curricula, Joyner (2016) draws on compulsory education resources (Hale, 2008) by looking at the planned versus operational curriculum, then categorising findings at 'introductory', 'developing', 'mastery' or 'reinforce' levels (Bloom, 1976). Another study undertaken some years earlier (Morgan, Ismail & Hayes, 2006) utilises a committee to build information on food science curricula inclusion of the newly launched IFT core competencies (see latest version, 2016), which includes assessing level of mastery but this appears less robust in method. Joyner's (2016) process, influenced by Porter (2002), comprises the generation of LOs, curriculum coverage map generation, pre-assessment review and finally gap/redundancy analysis.

With respect to this project there were a number of considerations of interest from Joyner's study, firstly the use of a flexible approach to gathering information and gaining consensus from relevant staff members. This reflects the reality of modular teaching complexities and pressures. The stage of pre-assessment and grouping of course pathways was also pertinent to contemporary programme offerings. Finally the terminology and approach to gap/redundancy analysis is of interest. However the following aspects are considered absent from Joyner's study. The perspective or view of students with respect to inclusion of the listed competencies is not accounted for,

material was gathered from staff and also student's test results. In addition (and noted as a limitation by the author), detailed information on the quantity or type of teaching or activities pertinent to the competencies mapped was not collected, or whether inclusions were formal (explicit to students) or informal in nature.

2.3.3.6 Data analysis and presentation of mapping data

Although some studies report mapping outcomes by simply logging presence/absence, counting entries or highlighting gap/redundancy (Kelley *et al.*, 2008, Hege *et al.*, 2010, Joyner, 2016), some researchers aim to apply some quantifiable amount or 'sufficiency' of inclusion to outcomes (Tariq *et al.*, 2004, Arafeh, 2016). Perera *et al.* (2016) add an extra dimension of depth by logging 'time spent' for each element in a course which may have use in prescriptive development opportunities.

Within studies already discussed, non-parametric descriptive statistics are used to handle survey data from a three-point Likert scale (Jerez *et al.*, 2016), and a five-point Likert scale (Bath *et al.*, 2004). Ramia *et al.* (2016) and Perera *et al*. (2016) also apply distribution-free statistics for all stages of their professional skills mapping, however the latter utilise means and standard deviations for some aspects of the study.

In reporting data, a number of researchers use web-based mapping tools (Hege *et al.*, 2010), indeed as previously noted, UoN has an internal system available. Spencer *et al.* (2012) use software to generate heat maps, indicating confidence of inclusion by colour shading (Figure 2.9), and impact levels by size of data points. This type of illustration is noteworthy, however

as absence of inclusion is logged as a small data point it may erroneously suggest ‘inclusion’ to the reader of the map (small circle with ‘1’ in it).



Figure 2.9 Extract of illustration from Spencer et al. (2012, p.224). Size of data point reflects the perceived impact on the ‘taught’ curriculum and depth of shading reflects levels of confidence of inclusion.

2.3.3.7 An alternative view to curriculum mapping

Wang (2015) challenges the use of the term ‘curriculum mapping’ against accepted norm, by using the philosophical works of Deleuze and Guattari (1988) where the structure of a tree describes modernist thinking (a defined, repeatable structure) and that of the rhizome, post-modernist thought (sporadic, unstructured growth). Making reference to authors already introduced in this thesis, such as Jacobs, Hale and Harden, she argues that the currently held processes follow the tree structure, so merely ‘tracing’ a fixed route. Wang (2015) suggests, “higher education is an invitation for students to open themselves to losing the way” (p.1556), thus follows a more rhizomatic structure. The interest in this challenge to current norms, is largely due to the context in which Wang sets the work, by stating the ability to

change and adapt being more vital for the future. Personal qualities such as ‘adaptability’ and ‘self-understanding’ will be fundamental in importance, as opposed to current material or data that may not be considered correct in the future.

However the expression ‘mapping’ will be kept, to align with widely used terminology. Although cited in some later publications including Joyner (2016) and Wijngaards-de Meij and Merx (2018), there is no move as yet to embrace the change to a rhizomatic approach. This could be as core curricula (within science at least) is unlikely to be predominantly flexible and rhizomatic, largely due to technical content and QA requirements from national bodies (The Quality Assurance Agency for Higher Education, n.d.), employers or vocational standards (General Medical Council, n.d.).

2.3.3.8 Reflection on curriculum mapping literature review

There are a wide variety of processes used for curriculum mapping, usually created to supply specific requirements for a study. Nonetheless, mapping usually includes the following stages; establish how to categorise what is found (also perhaps how to quantify what is found), the mapping process itself and finally how to interpret and present data.

It is also important to consider stakeholders in curriculum mapping. There is a requirement to inform stakeholders clearly and in a timely fashion, ‘planting seeds’ (Jacobs, 2004) and ensuring terminology and process have significance or meaning (Kelley *et al.*, 2008). In capturing the latent curriculum’s ability to shape individual learning (Bloom, 1976), both Kelley *et al.* (2008) and Spencer *et al.* (2012) reflect it would have been advantageous to include the student view in their studies, a factor employed in other studies

(Bath *et al.*, 2004, Hege *et al.*, 2007, Ramia *et al.*, 2016). If there is to be integral competency framework development is it positive to have the engagement of wider stakeholders such as the employer (Perera *et al.*, 2016). However reflection on employers' desirability of key criteria in a model or framework should not be confused with the core curriculum mapping process itself; that should be centred with educators and users.

Some studies utilise self-mapping by staff to gather data, posing risk of bias if left unchallenged (Tariq *et al.*, 2004, Jerez *et al.*, 2016), however the involvement of relevant staff is important to gather the fullest evidence. A balanced approach is suggested to retain staff involvement, but include a requirement for evidence of content inclusion, or encourage collaborative agreement (Hale, 2008) using a review or consolidation process (Sumsion & Goodfellow, 2004, Tariq *et al.*, 2004, Spencer *et al.*, 2012, Lam & Tsui, 2016). The use of observations to avoid focus on the 'fictional' curriculum have also been undertaken (English, 1978, Hege *et al.*, 2007), however time and resource demands can create limitations (Arafeh, 2016).

There are a whole variety of methods to capture data inclusion beyond a binary approach to mapping a module or course. Many studies have logged the type of inclusion e.g. teaching or assessment (Sumsion & Goodfellow, 2004, Tariq *et al.*, 2004, Kelley *et al.*, 2008). Identifying levels of proficiency or competency such as Arafeh's (2016), 'introduced', 'emphasised', 'reinforced' and 'advanced', and a simpler version from Kelley *et al.* (2008) should be approached with caution unless there is very clear understanding of definitions, and how to secure evidence of attainment (Perera *et al.*, 2016). In aiming to provide numerical scales for mapping competencies, Perera *et al.*

(2016) also map ‘depth’ of inclusion using time taught as a parameter, which is of interest but may be more suited to ‘technical skills’ development e.g. a lab practical on electrophoresis for three hours. The inclusion of ‘explicit’ and ‘implicit’ inclusion is more suitable for the context of this project as it differentiates between formal and informal incisions (Arafeh, 2016). Employing surveys to help support unearthing of the enacted and experienced curriculum is also applicable (Bath *et al.*, 2004).

The use of a database or online tool has been investigated by a number of researchers, either using commercially available systems (Hale, 2008) or tools developed in-house (Hege *et al.*, 2007, Spencer *et al.*, 2012, Arafeh, 2016, Wijngaards-de Meij & Merx, 2018). Although data entry is usually manual and can be time-consuming (Wijngaards-de Meij & Merx, 2018), computers are a definite asset for highlighting links (Harden, 2001a). Benefits also include a reliable repository and format for reports. Hale (2018) asserts they increase staff engagement, whilst Wijngaards-de Meij and Merx (2018) observe resistance to usage from a HE perspective. Arafeh (2016) comments they enable an empirical approach, complementing outcomes auditing so may be a worthwhile consideration for the project.

Finally an important reflection from this part of the literature review is that curriculum mapping is usually a finite activity in most establishments not a routine undertaking. Educators do not plan to deliver the same course content year on year as there is constant movement in the learning environment (Hale, 2018). Bath *et al.* (2004) assert curriculum mapping is a static snapshot, which though unavoidable, needs to be appreciated and future

reviews planned (Harden, 2001a). Key findings of this investigative section will be considered in the curriculum mapping approach for this project.

2.4 CURRENT FOOD SCIENCES CURRICULUM MAPPING AT UON

Food science undergraduate teaching at UoN was introduced in Chapter 1. Within the School of Biosciences (n.d.) the following categories are in use for curriculum mapping purposes: 'taught', 'learned' and 'assessed' or 'TLA'[7]. Although definitions are not formally published, the 'taught' element is understood to include module/course material and staff delivered activities, 'learned' that which is undertaken by the student such as lab practicals, group tasks or self-directed learning. 'Assessed', is fairly self-explanatory but includes formative and summative items. The use of the term 'learned' here does appear to conflict with Harden's (2001a) view that 'learned' is what a student gains from the process and assessment outcomes. However the classification system is in customary use within Biosciences and some other UoN (2017) Schools for internally mapping course programmes and modules against stated LOs for the subject of study.

2.5 EMPLOYABILITY

The volume of literature produced in fields such as employability and competency is significant, especially during the last 20 years. The spirit of global education is inherent in the researcher's establishment (UoN) and the food industry is largely a multicultural workplace. However as the scope of

[7] TLA not to be confused for the purposes of this thesis with teaching/learning activity (Biggs *et al.* 2011).

the project is the food industry in the UK and Republic of Ireland, and the case study a UK based degree provider, literature presented in the next two subsections is predominately sourced from the UK (an arguably significant proponent of this field of research and application (Su & Zhang, 2015)), unless specific inclusions are deemed pertinent.

2.5.1 Defining employability

Although employability as a term was created at the start of the 20th century and has been discussed since the 1950s, focussed research and publication only gained momentum in the 1990s whereupon outputs were and remain prolific (Lees, 2002, Su & Zhang, 2015). Part of this reason is the universal and constant requirement for supply of a fit for purpose workforce. Needs and perceptions of what the term means are wide ranging, so Tymon (2013) advises caution in being too simplistic in defining employability as, "most authors agree that employability is complex and multidimensional" (p.845). In the researcher's opinion Yorke's definition of graduate employability (ESECT[8]) from 2004 still remains useful,

> *"a set of achievements, skills, understandings and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy."*
>
> *(Yorke, 2004, p.8)*

[8] ESECT, the 'Enhancing Student Employability Co-ordination Team' lead by Mantz Yorke was in place around 2000s by the (LTSN), then the Higher Education Academy, now Advance HE.

Phrasing aims to detail items underneath the overarching term of 'employability', denotes it is specific to particular career pathways and then ensures it includes success in both securing and performing in a job. The final phrase could initially be suggested as periphery but embraces contemporary views on the purposes of HE, revealing Yorke's stance as a scholar and emphasizing the graduate as a 'citizen' (Stephenson & Yorke, 2012, Cole & Tibby, 2013). Yorke's definition is still widely used as a baseline for debate and further development by researchers and educators (Lowden, Hall, Elliot *et al.*, 2011, Tymon, 2013, Cole & Tibby, 2013, Su & Zhang, 2015).

From an employer's perspective the Confederation of British Industry (CBI), a business member's organisation has supplied a 'voice' on employability since the 1990s and regularly conducts research on the subject of skills and employability. Their articles and the CBI 'Education and Skills Survey' reports[9] (2011, 2017) are regularly referenced (Lowden *et al.*, 2011, Stephenson & Yorke, 2012, Cole & Tibby, 2013). In collaboration with business, the CBI defined employability in 2007 as,

> *"A set of attributes, skills and knowledge that all labour market participants should possess to ensure they have the capability of being effective in the workplace – to the benefit of themselves, their employer and the wider economy."* *(p.11)*

[9] At the time of writing in 2018, the 11th CBI Education and Skills survey was complete but results not yet reported.

Hillage and Pollard (1998) have a broader dimension than Yorke's inclusion of success in occupations, by reinforcing an extra dimension of portability,

> *"The capability to move self-sufficiently within the labour market to realise potential through sustainable employment."* *(p.12)*

This particular viewpoint holds even more relevance today; the job market post-recession of 2008 and technological advances in a number of sectors pose challenges to job security (Coulter, 2016, Donald, Baruch & Ashleigh, 2017, Gallie, Felstead, Green *et al*., 2017). In addition job and occupational mobility is an increasing norm for early career graduates (Docherty & Fernandez, 2014).

Employability is also aligned to the concept of 'human capital'. The OECD (Organization for Economic Cooperation and Development, 2007), reference Adam Smith, the 18th century economist, who believed once an individual had gained skills and talents, they held 'capital' as a part of their person. The OECD (2007) provide a contemporary definition of human capital as,

> *" the knowledge, skills, competencies and attributes that allow people to contribute to their personal and social well-being, as well as that of their countries."* *(p.3)*

Although definitions suggest the terms are similar, alignment of human capital to employability is suggested where human capital is a determinant of perceived employability (Berntson, Sverke & Marklund, 2006), or different aspects of 'capital' (including human) are the construct of employability (Tomlinson, 2017). Another relevant term is 'capability', where a student may become more capable, whilst developing their employability (Yorke, 2004).

Employability as a term, is utilised by employers, careers advisors and educators, either in isolation or in partnerships along the workforce supply chain. However language used can vary between stakeholder groups. McQuaid and Lindsay (2005) urge avoidance of, “explanations of employment and unemployment that focus solely on either supply-side or demand-side factors.” (p.197).

The Dearing report (The National Committee of Inquiry into Higher Education, 1997) outlines ‘four key graduate skills’, namely: communication skills, numeracy, the use of information technology (IT), and learning how to learn. This high profile publication increased awareness that degree educators have a duty to provide more than a subject qualification for their graduates. Employability is now integrated into the rhetoric of modern HE provision. Indeed within UoN (2015) Global Strategy 2020, the explicit inclusion sits under ‘focus for action’ as follows,

> *“Growing external partnerships to support teaching and learning, research and student employability.“* *(p.7)*

Using this as representation of other degree providers it highlights two key points; firstly that HEIs can and do take responsibility for the broader development of a student beyond subject specific study. This is supported by Speight, Lackovic and Cooker (2013) who declare that,

> *“higher education is quite capable of doing “double-duty” in devising holistic curricula that both foreground academic disciplines and strengthen their relevance to wider graduate needs.”* *(p.113)*

The second point confirms that external partnerships such as with employers are pivotal in delivering modern HE. The employer can (aside from research) clarify what 'graduate employability' is, either generally or for specific career paths, and also support direct teaching activities or provide internships or placements (Hartel & Gardner, 2003, McQuaid & Lindsay, 2005, Speight *et al.*, 2013, Perera *et al.*, 2016).

Metrics for measuring University employability in the UK are now serviced by the Office for Students or 'OfS'[10] (n.d.-b), and include the Destinations for Leavers of Higher Education or 'DLHE' survey (Office for Students, 2016) and the National Student Survey or 'NSS' (Office for Students, n.d.-a). University employability ranking tables, a pervasive reality within academic reputation are published annually, e.g. the Times Higher Education (n.d.) Global University Employability Rankings and The QS World University Rankings (The Guardian, 2017). Higher ranking institutes make ready use of results for marketing purposes in relation to student prospects. Wider initiatives include the EHEA and the 'Bologna Process' (European Commission, n.d.) introduced earlier in the Chapter.

In addition to programme specific endeavours to enhance student employability, most Universities invest in a comprehensive careers advice service, and many provide optional supplementary University-wide employability award schemes such the Nottingham Advantage Award (Careers and Employability Service, n.d., Speight *et al.*, 2013) or University of Birmingham's, Personal Skills Award (n.d.).

[10] Previous online HEFCE (prior name of OfS) information has moved to the OfS website.

2.5.2 Employability models and frameworks

So what is encompassed when we describe employability?

When discussing employability the definition is the first consideration; but by far the most discussion lies in 'what is in it'. Fuller comparisons of employability models and frameworks have been undertaken in the past (Lees, 2002, Tymon, 2013, Artess, Mellors-Bourne & Hooley, 2017), however examples selected below are contextual demonstrations of employability constructs deployed within different stakeholder groups; chiefly educators, employers and students.

Hillage and Pollard (1998) authored a well cited Department of Education and Employment[11] research briefing, including a proposed framework of four main components of an individual's employability, shaped around the business concepts of production, marketing, sales and finally marketplace. A simplified version of the framework has been constructed in Figure 2.10 and the use of business terms should provide wider accessibility, and thus potential use beyond the educator, to workforce development and possible credibility with the student.

[11] The Department of Education and Employment (UK) was renamed in 2001 and at the time of writing is named the Department for Education.

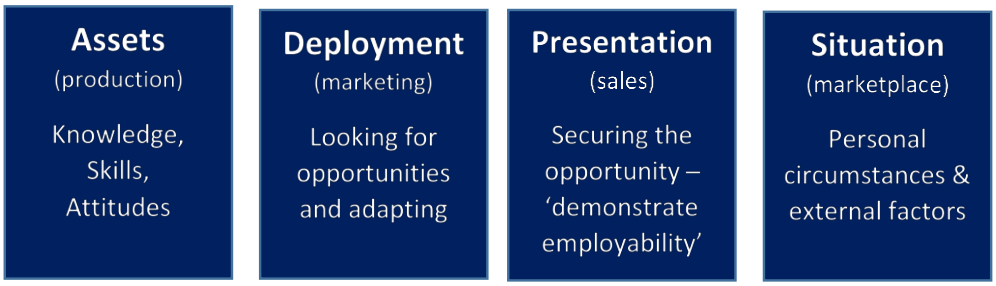


Figure 2.10 Simplified illustration of the employability framework proposed by Hillage and Pollard (1998, pp.2-3). An inter-relationship of the first three components is suggested.

Referencing this framework, McQuaid and Lindsay (2005) at Napier University, Edinburgh sought to build a framework focussed on factors influencing an individual's ability to move to 'being employable'. It comprises a model with three factors: individual factors (including employability attributes, skills, qualifications, health, demographic, job-seeking skills, mobility and adaptability); personal circumstances (including household circumstances, culture and social support networks) and finally external factors (including job market and available public support). It is emphasised the model was developed for use by both the 'supply-side' and 'demand-side' of employment, namely employers and educators.

Over a similar period Yorke and Knight (2004), as part of ESECT[8] developed the 'USEM model' (Figure 2.11), illustrating suggested 'influences' on employability. All aspects of Yorke's (2004) earlier employability definition are present, plus an extension of personal qualities and metacognition, where the latter encompasses, "self-awareness with regard the student's learning, and the capacity to reflect on, in and for action" (Yorke and Knight, 2004, p.5).

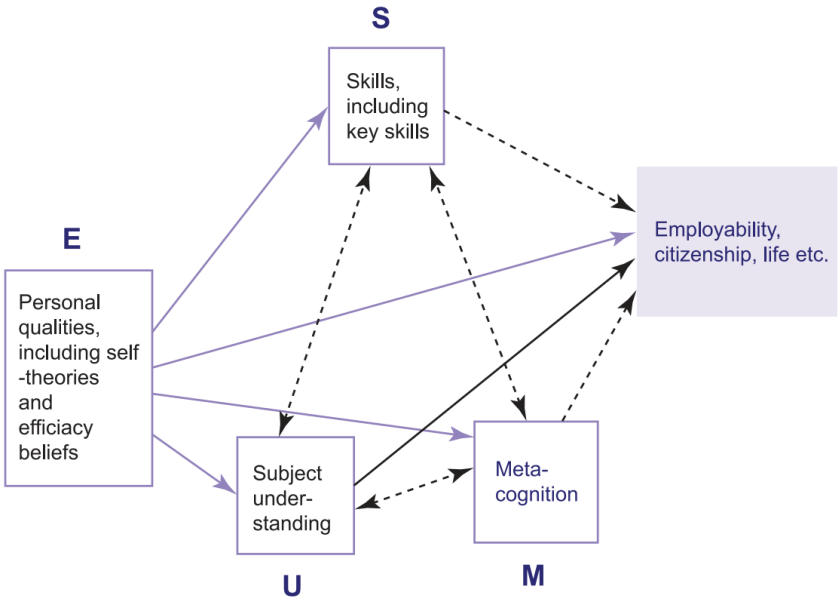


Figure 2.11 The USEM account of employability sourced from Yorke and Knight (2004, p.5). Main influences are shown here, with the pervasiveness of 'E' (personal qualities) highlighted by numerous arrows.

Susequent models have been published having roots in the USEM model. For example, Cole and Tibby (2013) convert the USEM model into a framework that could support degree educators in generating their own approach to employability. At a conference in 2017, Cole presented a published refinement of the original framework, and as shown in Figure 2.12 (Higher Education Academy, 2015, Cole, 2017).

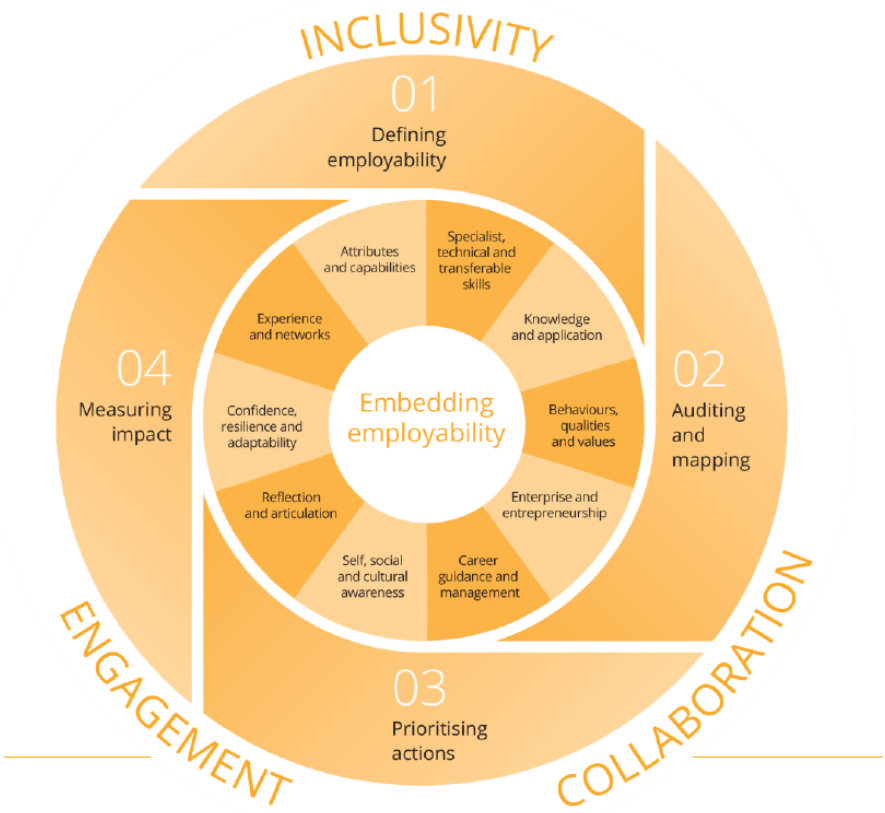


Figure 2.12 The framework for embedding employability sourced from Cole (2017) and the Higher Education Academy (2015). The diagram now includes in the central ring factors that may be included in employability.

These frameworks are clearly targeted at educators alone within the employability stakeholder group. However the addition of the 'factors' in the 'central ring' (Figure 2.12) is of interest.

Dacre-Pool and Sewell (2007) at the University of Central Lancashire acknowledge the significant amount of 'scholarly work' underpinning the USEM model, but argue it does little to support explanation to a 'non-expert', such as the student. They suggest a new 'Key to Employability' model, alternatively titled by the mnemonic 'CareerEDGE', tracing the direction of the lower elements (Figure 2.13).

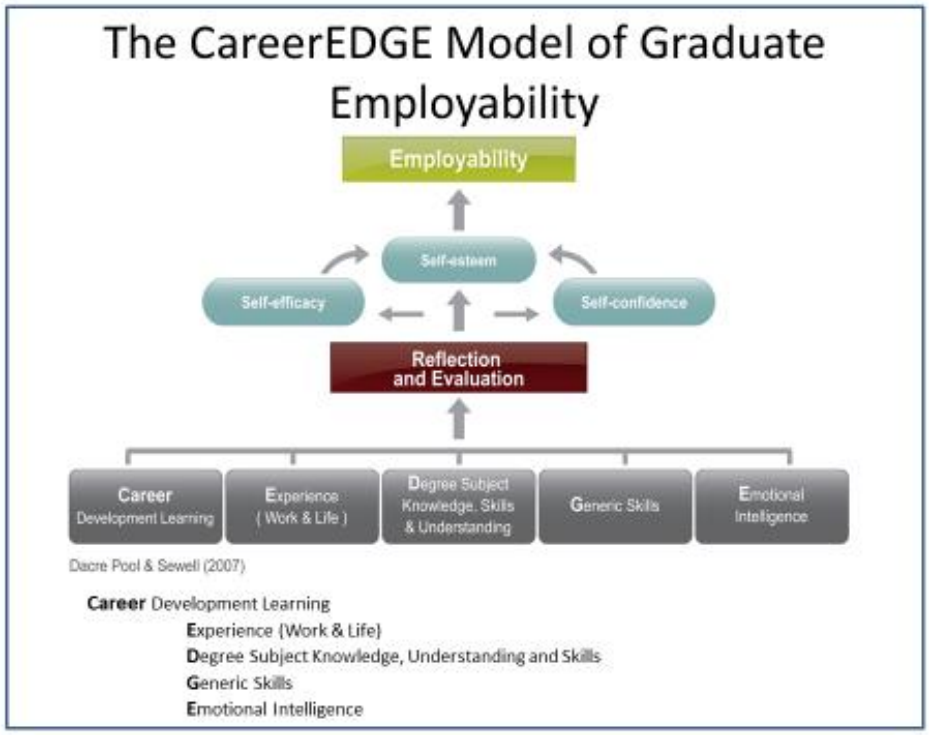


Figure 2.13 'Key to Employability' CareerEDGE model, latest image supplied with kind permission from Lorraine Dacre-Pool (2018).

A supplementary student questionnaire has been published (Dacre Pool, 2017), and a number of universities have utilised the CareerEDGE system within their internal web portals (Dacre Pool, 2018). The model was aimed to be understood by a broad range of stakeholders, but in particular students, academics and career advisers.

Tomlinson (2017) has very recently suggested a different approach, by replacing the graduate employability concept with a 'Graduate Capital Model'. Believed to be a more dynamic approach to "assisting graduates entry into the labour market", it is built on five forms of capital namely: human (discussed previously), cultural, social, identity and psychological.

With a firmly student-centric approach there are a number of student careers advice publications available to guide the individual and careers support services. Some have developed illustrations to aid understanding such as the 'I Brand' employability model (Trought, 2012) illustrated in Figure 2.14, from 'Brilliant Employability Skills'.

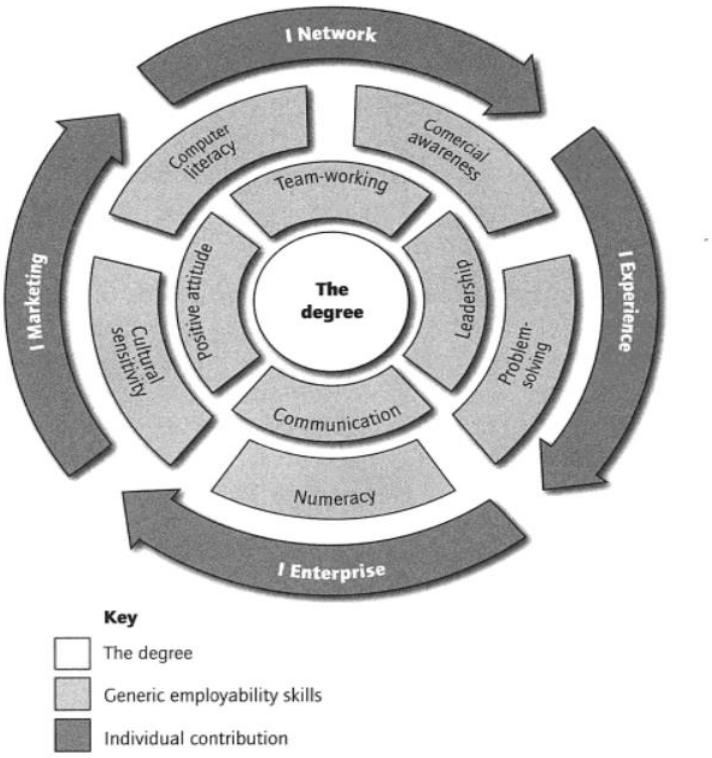


Figure 2.14 The I Brand employability model taken from 'Brilliant Employability Skills' (Trought, 2012, p.xxiii).

Having similarities to Hillage and Pollard's (1998) straightforward terminology, it divides the model into three layers, the degree, skills and the individual contribution. The simple model highlights to the student, the need for personal engagement and 'effort' in career development.

There are other publications that do not define employability or provide frameworks or models, but simply discuss or list 'employability skills'

especially in business derived or student-facing publications (Confederation of British Industry, 2011, Sumner, 2012, Su & Zhang, 2015, Suleman, 2018). The CBI (2011) define 'employability skills' to the student as, an "essential precondition" for the development and use of the "specialist or technical skills" needed for a job (p.11). As demonstrated in the earlier examples, employability embraces more than 'skills'. Aspects such as behaviours, beliefs, attitudes or dispositions are not skills, and one would suggest 'precondition' is not either. The information presented thus far would suggest that provision of some type of list may be a useful way to present a part of an employability framework or model but it would not be correct to suggest 'skills' encompasses all that makes a person employable or to group all aspects as 'skills'.

Only recently the Higher Education Academy[12] supported a review of recent literature with respect to employability (Artess *et al.*, 2017). Conclusions suggest movement away from, "discussion of employability as a list of skills and attributes towards a more subtle discussion of 'identity" (p.40). Already explicitly outlined by Tomlinson (2017) in his Graduate Capital Model, the spirit of this assertion also appears encompassed in Cole and Tibby's (2013, 2017) framework (Figure 2.12), with inclusion of factors such as self, social and cultural awareness and also reflection. However in CareerEDGE there is a greater assertion of importance of 'self' as well as reflection (Figure 2.13) which supports aspiration of nurturing personal identity (Dacre Pool & Sewell, 2007). For the I Brand model, the outer layer alludes to 'self' (Trought, 2012).

[12] Higher Education Academy changed name to Advance HE in 2018

Further facets of interest in these approaches to cultivating employability (except perhaps the I Brand model), are 'in job' and career- or self-management skills (Su & Zhang, 2015, Tomlinson, 2017). However, the I Brand Model provides detailed support for an individual on the type of 'skills' development they may wish to consider e.g. teamworking (Figure 2.14), and thus bridge the gap between employability model breadth and prescriptive competency lists (Confederation of British Industry, 2011, Sumner, 2012), something likely to be more palatable to a student.

Looking to the future, in a recent book chapter, Holmes (2017) introduces a 'manifesto' to approach research in the field of graduate employability, emphasising the requirements to consider differences between employability and employment, and justify where any work on the former provides impact on the latter. It also encourages research to provide practical implications for stakeholders.

2.5.3 Employability in the context of this project

From the literature review, the term employability appears to have been interpreted in a variety of scopes and forms by researchers, educators and employers. It is worth noting, intellect is not discussed explicitly within this type of literature or this project but the researcher suggests it will have relevance to individual employability. However consensus is evident that employability includes the ability to possess and use job specific knowledge and skills, as well as wider transferable elements and attitudes to secure a job and for success in the workplace. There appears to be intangible inclusion of 'personality' beyond named attributes. Understanding varies however, when discussing other aspects such as identity and also whether employability has

a societal context. Yorke's (2004) definition quoted earlier, largely holds true with respect to the breadth of inclusion and context and can remain useful to underpin the project.

Material selected as examples for this review included reference to terms such as: 'skills', 'attitudes', 'knowledge', 'behaviours', 'abilities', 'competencies' and 'understandings', however at this stage they shall be grouped as 'competencies' and will now be explored. It could also be proposed that competency development and 'being competent' are enablers of employability, helping to address job requirements (Suleman, 2018). Models reviewed do not include this explicitly, but CareerEDGE (Dacre Pool & Sewell, 2007) and Hillage and Pollard's framework (1998) have some association to the terms, for example 'generic skills' underpinning 'employability' in CareerEDGE (Figure 2.13). Consideration of practical implications to stakeholders of any final outputs will be made throughout the project (Holmes, 2017).

In summary employability models have significant use as personal development tools for the student masses, broadly at an institutional level, and as a useful reference point or touchstone for further more detailed work. However it is suggested they are too general for a student to undertake targeted career and personal development, or for educators to approach curriculum enhancement. Useable constructs should be developed to match employer requirements for a subject area, or vocation and as this is the aim of the project, further discussion will follow.

2.6 COMPETENCY

The terms competency or competence are included in the design or description of many employability or professional development models and materials. Firstly an understanding of the terminology used is expedient.

2.6.1 Competence versus competency

The terms competence and competency can be found included in a number of literature sources and seemingly inferring the same meaning. For example in the books 'Competency in Healthcare' (Storey *et al.*, 2002) and 'The Bases of Competence' (Evers, Rush & Berdrow, 1998), the two terms are used seemingly interchangeably throughout.

A Chartered Institute of Personnel and Development (CIPD) publication observes the confusion of terminology used (Miller *et al.*, 2001). It explains the UK uses 'competence' to define requirements to perform to good practice and whilst acknowledging the "father of competency" (p.2) as Boyzatzis (nd), continues that the USA use 'competency' to differentiate 'exemplary' from 'good' performance. However it states competency is an underlying characteristic of a person. Current resources from CIPD (n.d.) accede that the terms are widely used interchangeably.

An article 'competence versus competency' published by Teodorescu (2006) highlights that dictionaries define them as the same thing but in citing a different source for each of the two definitions, does little to improve understanding. In defence of Teodorescu's assertion, online dictionaries from Oxford and Cambridge University disagree, the former using the same definition for both, "the ability to do something successfully or efficiently"

(Oxford University Press, n.d.), whilst the latter supplying differentiation where competency is “an important skill that is needed to do a job” and competence, “the ability to do something well” (Cambridge University Press, n.d.).

2.6.1.1 Exploring competency

Parry (1998) describes competency as a characteristic that, by itself or in combination with others should allow a person to perform a given role, or that will affect part of a person’s job. Another definition of competency with respect to adult skills (Organization for Economic Cooperation and Development, 2016) is the, “capacity to generate appropriate performance” (p.96). Competencies are commonly used to develop a list, possibly prioritised, of the type of skills, knowledge or behaviours that are ideal for a role, outcome or task. They are deemed useful for activities such as recruitment, succession planning, personal development and career planning (Miller *et al.*, 2001, Vazirani, 2010). An example could therefore be outlining the ‘ideal profile’ for a graduate role (Perera *et al.*, 2016). Spencer and Spencer’s definition (below) progresses earlier work by Boyatzis in the 1980s (Vazirani, 2010) for an objective use of the term competency,

> *“..underlying characteristic of an individual that is causally related to criterion-referenced effective and/or superior performance in a job or situation.”* *(Spencer & Spencer, 1993, p.9)*

This definition supplies the requirement for context when using the term and shares the use of ‘underlying characteristic’ with other authors (Spencer & Spencer, 1993, Miller *et al.*, 2001).

2.6.1.2 Exploring competence

Teodorescu (2006) links to previous writers on ‘competence’ such as Gilbert’s (1996) association of delivering ‘worthy outcomes’. The CIPD (n.d.) describe competence as concerned with ‘effect’ and ‘output’. Competence is pertinent in establishing occupational standards for fields such as medical, healthcare or veterinary education where discrete tasks can be assessed in students before graduation, and where OBE is embedded in teaching (Storey *et al.*, 2002, Cobb, 2015). Competence is also considered directly useful for in-job performance tracking and goal setting (Spencer & Spencer, 1993).

2.6.1.3 Exploring their uses

At this stage the researcher proposes an adaptation of the Cambridge (n.d.) and CIPD (n.d.) definitions as follows,

> *Competency is ‘a skill or attribute needed to do a job’*
>
> *Competence is ‘the demonstrable ability to do a job or task’*

Teodorescu (2006) has an alternative viewpoint as a creator and advocate of ‘competence models’. These are more unusual and do not include lists of skills, knowledge and other competencies to achieve a job or role. Instead they include statements of what results or processes demonstrate competence for specific roles, teams or organisations. Woodruffe (1993) has a similar view but still confuses terms in his own article. After accepting interchangeability of term usage, the CIPD (n.d.) suggests the human resource’s viewpoint that competencies can be more about the, “behaviour that lies behind competent performance” (para.9). Ellis (nursing lecturer) and Abbott (healthcare professional) (2011) debate the situation in context of

practice and after reviewing sources such as CIPD guidance, they conclude that, “competence therefore describes what a person does and competency describes how they go about it” (p.90). This aligns with Teodorescu’s (2006) assertions and the concepts of OBE in vocational education, yet most models and frameworks are prefixed with ‘competency’ (Storey *et al.*, 2002, Vazirani, 2010, Perera *et al.*, 2016).

As past literature demonstrates elements of confusion, there is a suggestion that future articles may follow suit. A recent study emphasises there is still debate on the definition of competency, that it varies dependant on field and some argue it is linked to a task whilst others more based on a role type (Gómez *et al.*, 2016). Furthermore it argues some competencies can be categorised as generic, others specific to an occupation, and thus may generate misunderstanding of which term suits a set of attributes, for example. This may go some way to explain Ellis and Abbott’s (2011) perhaps contextualised rationale of ability (competence) as a separate term, to ‘how’ or behaviours (competency) in their definitions outlined above.

CIPD (n.d.) include the following statement on their website,

> *“..the term 'competency' is preferred … except when specifically referring to the use of occupational standards (that is, an 'outcome-based' approach) in which case the term 'competence' is used.” (para.10).*

Reflecting on the review above, the most appropriate use of terms were chosen. This project aims to consolidate the ideal ‘competencies’ for a food sciences graduate to possess in order to perform well in a given role in the

food industry. The environment of use will generally be before they have commenced employment, so 'competence' may be assessed but not against real tasks and duties (except perhaps on industrial placements).

2.6.2 Competency in association with other terms

Authors of employability literature included earlier do not always include the terms 'competence' or 'competency' (Knight & Yorke, 2004, Dacre Pool & Sewell, 2007). However terms they have used within their models are aligned to some of the items included here, suggesting arguably the same 'base material'. Interchangeability between employability and competency constructs appear dependant on author and use. Suleman (2018) has recently suggested 'employability skills' and 'competence' are, "two sides of the same coin" (p.267), where the former is the acquisition of skills, the latter mobilisation of these skills resources in the workplace. An ISEKI (2007) report on food studies programme design to the EHEA, included an explanation of the difference between competence and learning outcomes to avoid confusion.

With respect to competency, there are numerous combinations of words used as descriptors of competency contents. Previous authors have undertaken comparisons before (Vazirani, 2010, Yip, 2017), however some selected examples of interest are tabulated in Table 2.1.

Table 2.1 Examples of terms used within description of 'competency' in previous works.

Source of reference	Suggested context	Terms included in definitions
Begun and Malcolm (2014)	Educational (healthcare)	values, traits, knowledge, skills
Storey *et al.* (2002)	Educational (healthcare)	knowledge, skills, abilities and behaviours
Gómez *et al.* (2016)	Educational (general)	Knowledge, skills, attitude
Cobb (2015)	Educational (veterinary)	knowledge, attitudes, skills
Johnston, Wiedmann, Orta-Ramirez *et al.* (2014)	Educational (food science, USA)	skills, knowledge, abilities
Jones and Warnock (2014)	Educational (general)	skill, and your level of ability in that skill
Spencer and Spencer (1993)	Management, business	motives, traits, self-concept, knowledge, skills
London School of Economics and Political Science (2013)	Management, business	knowledge, skills, behaviours
Woodruffe (1993)	Management, business	behaviours underpinned by ability and desire
Teodorescu (2006)	Management, business	skills, knowledge, attributes and behaviours
Parry (1998)	Management, business	knowledge, attitudes, skills
Aldred and Richardson(2018)	Human resources, business	behaviours and attributes (underpinned by performance in skills)

In nearly all cases the inclusion of skills and knowledge is made, posing reference to abilities and understanding in some form. The only omissions are Woodruffe (1993) and the employee or human resources orientation of the CIPD (n.d.), both centring on behaviours with an underpinning of ability or

skills. The author suggests the use of words such as attitudes and behaviours could be grouped; they are much more about the person and their choices, or more likely to influence ability or competency as suggested by Woodruffe and the CIPD.

Another term to relate with competencies is 'learning outcomes'. Jerez *et al.* (2016) suggest literature does little to explain the differences and linkages, so complete a review of past usage. They summarise that LOs are confined to more limited educational spaces such as a module or activity, whereas competencies are used "in a broader and more holistic sense". This appears aligned to the use of terms in studies reviewed in this Chapter. He suggests both need to be integrated into competency-based curricula.

2.6.3 Competency model versus competency framework

Competency models and competency frameworks are both found in literature, but it is important to consider if they actually differ. Some sources keep to the use of either 'framework' or 'model' but do not enlighten the reader on the rationale for the choice.

The CIPD suggested in 2001 (Miller *et al.*), that the term 'model' derives from the USA, and UK organisations use 'framework', evidenced by their current website advice (CIPD, n.d.) for employers on building 'competency frameworks'. Examples in the UK defending this view include: Department of Trade and Industry's (DTI) 'Corporate Social Responsibility (CSR) Framework' (2006), the student work-based learning competency framework by the Universities of York and Sheffield (Jones & Warnock, 2014), and finally UoN's (2018) staff performance competency frameworks. A recent study on construction-based UK degree programmes undertook course mapping

before ‘ratifying’ a competency ‘framework’ with an industry expert forum (Perera *et al.*, 2016).

Teodorescu (2006) based in USA uses ‘model’ throughout her paper, but includes ‘framework’ and ‘model’ in an inserted table. Gomez *et al.* (2016) based in Spain and Chile, keep to the term ‘model’ throughout their article on assessment of competencies in HE, as does Vazirani (2010) from India and Spencer and Spencer (1993) in the USA, with regard to organisational workplace performance. Conversely American authors Matthews and Brueggemann (2015) published ‘Innovation and Entrepreneurship: A Competency Framework’. In relation to healthcare from both USA and UK, reference to both ‘models’ and ‘frameworks’ are used interchangeably within the same publications (Begun & Malcolm, 2014). This suggests authors may choose to term their constructs without geographic rules. Finally Woodruffe (1993) is an example of where competency ‘lists’ are commonly presented, avoiding the use of either term.

Some researchers have chosen to use both terms in a phased approach. Homer, Griffiths, Brodie *et al.* (2012), in Australian maternity services education describe the development of a competency model, then an educational framework released to educationalists to deliver the model requirements. An interesting internationally contributed informal debate was found within ResearchGate (2014), whereby academics from a number of disciplines have discussed the differences in the terms within educational research, and seem generally aligned. In essence they agreed the model is the final ‘output’ whilst the framework is the guide or procedure for creating or developing it. Rycroft-Malone and Bucknall (2010) concur that within the

realms of evidence-based learning, the framework is the guidance system and can be extensive and flexible, with a more specific and narrow scope for the model.

Some researchers choose to define the framework as the developmental stage and the model as the final results, but equally some use a single term and others both interchangeably. The use of the terms framework or model from other literature will be understood as similar in meaning unless otherwise stated. However 'competency framework' will be used by the author as the descriptor within this project.

2.6.4 Use of Competency frameworks or models in education

It is well established that competency-based measures promote development of appropriate professional training requirements (Perera *et al.*, 2016). The QAA (n.d.) provides subject benchmark statements for degree courses by subject type, outlining knowledge, understanding and skills for educators to observe. Some vocational degree educators have ensured alignment of the QAA to their professional standard such as the Engineering Council (n.d.), whilst others use a combination of requirements to meet a QAA benchmark and also accreditation body standards for graduate registration such as Dietetics (British Dietetic Association, n.d.). Finally some professional pathways (predominantly medical) use only accreditation standards generated by their professional body, such as the General Medical Council (n.d.). For the purposes of this review, all can be termed competency frameworks. It is also worth suggesting at this stage that employers tend to assume that upon graduation student's education complies with required statements and standards. Degree providers usually develop locally suited

frameworks or curricula to ensure teaching is compliant to their associated standard and/or quality statement.

Collaboration with stakeholders for developing competency frameworks for healthcare education is advocated by Storey *et al.* (2002), with a caveat there is risk of imposing an agenda of 'training' rather than education. Use of such frameworks may also restrict the individual's personal career, worth considering when structuring a course with a known breadth of job opportunities. Healthcare educators are also developing 'interprofessional education' (IPE) competency frameworks spanning countries including UK, Australia and USA (Thistlethwaite, Forman, Matthews *et al.*, 2014), but warnings are made that uniformity should only be encouraged where genuine advantage is evident. In veterinary education, Vandeweerd, Cambier, Romainville *et al.* (2013) acknowledge the wide use of competency frameworks, but conclude from reviewing a number of formats that one single useful document to cover all the stages of the veterinary professional's development and working life may not be feasible.

Competency frameworks in relation to 'generic' or 'employability' related competencies can be presented as tables (Jones & Warnock, 2014, The Quality Assurance Agency for Higher Education, 2016), diagrammatically such as Figure 2.15, or simply in the format of lists; for example the CBI (2017) annual Education and Skills Survey use lists of 'work relevant skills' (defined as attitudes, skills and knowledge) to seek employers' satisfaction levels in new graduates.

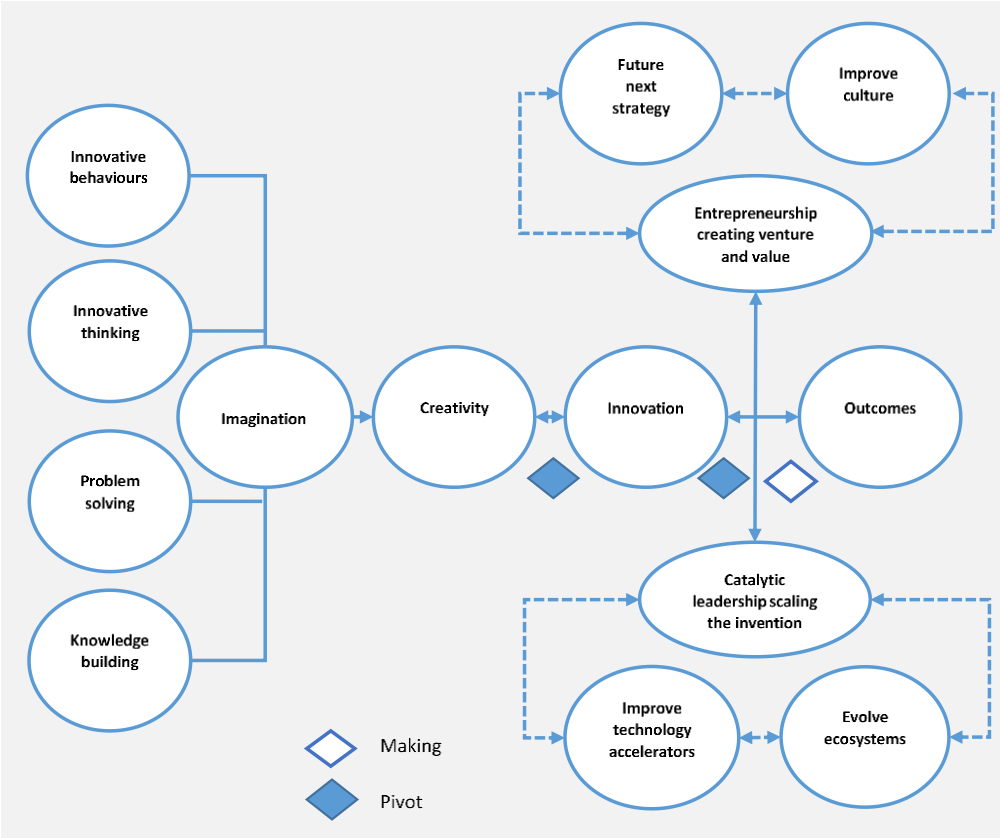


Figure 2.15 Reproduction of an illustration of the dynamic interaction of 12 innovation and entrepreneurship competency categories (Matthews & Brueggemann, 2015, p.5).

With regard to studies with less vocational or detailed outcomes, there may be other factors or constructs that may be closely aligned or in conflict with the benchmark statement or competency frameworks. Professional body accreditations, such as the relatively new IFST degree accreditation (n.d.-a) (section 1.3), are becoming more prolific in qualification assurance and perhaps marketing.

Finally consideration needs to be made that unlike employability based paradigms, competency frameworks or models are widely used in staff recruitment and professional development and assessment (Vazirani, 2010, Chartered Institute of Personnel and Development, n.d.). Competency-based

interviews are commonly utilised for graduate selection with a competency profile for a job or role (Spencer & Spencer, 1993). The understanding of and preparation for this by the student will be explored in Chapter 8. The use of competency frameworks 'in job' is not within the scope of the project, however as students may be tested against work-based frameworks once employed, it is prudent to be mindful of them. The CIPD (n.d.) outlines their use for managers as,

> *" a starting point to define shared expectations of skills and performance, but can be applied flexibly depending on the context of the job and individual worker development levels and aspirations"….."Competencies can represent the language of performance management."* *(para.4)*

2.6.5 Use of competency frameworks, models and terminology in this project

From reflecting on the literature reviewed, emphasis of both practical applicability and engagement with stakeholders are acknowledged to be fundamental factors in this project, when shaping details for typical career pathways. The dangers of creating confusion by use of terms is now evident, so careful selection of a vocabulary will be factored into the project. Looking wider than HE, there are alternative approaches to consider when developing competency frameworks, and choice of methodology for the project will be outlined in Chapter 3.

The initial definition of competency outlined earlier, is 'a skill or attribute needed to do a job'. The aim of the project was development of a 'competency framework' to support employability of food sciences graduates,

where competencies could comprise knowledge, skills and either behaviours or attitudes. Clarification of how terms will be reviewed and evolve during the project is introduced at the end of this Chapter.

2.7 EMPLOYABILITY, COMPETENCY AND THE FOOD INDUSTRY

There is currently minimal specific career and competency development information available for food sciences graduates entering the UK industry,[13] a situation that has been significant in the materialisation of this project. A wider review was undertaken and the majority of research focussing on food science careers can be found in the USA or from a pan-European perspective, and reflections on material presented in this section will be undertaken throughout the project.

2.7.1 Non-European perspective on food science graduate competency

Food science degree providers in the USA refer to the IFT Undergraduate Education Standard (2016) and apply for formal accreditation under this standard. The IFT aim is to, "enhance excellence in food science education" (pp.7-8), and the standard currently comprises five groups of 'competencies' (Figure 2.16) with a number of 'outcomes' underneath. Four groups of the standard cover technical scientific content, whilst the final group, 'success skills' has seven sections, containing 14 outcomes listed in Appendix I, and are suggested most aligned to student 'employability', although related publications rarely use this term.

[13] Although the scope of the project is the UK and the Republic of Ireland, this section does make reference to specific material based in the UK

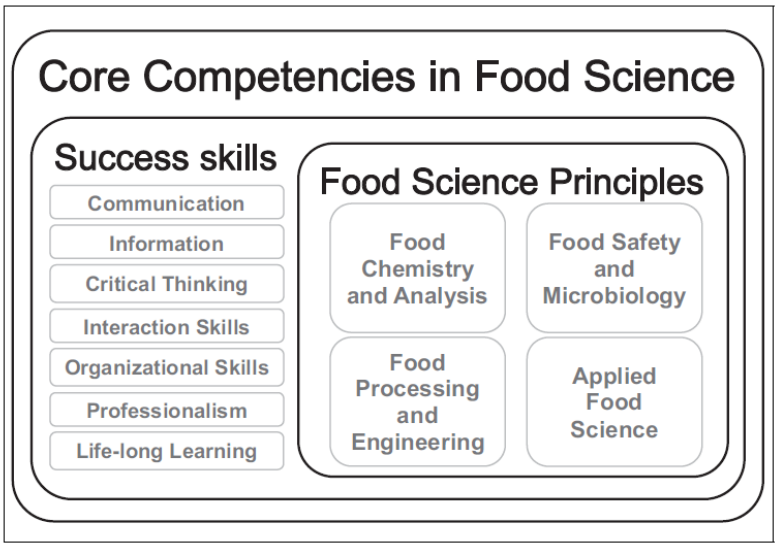


Figure 2.16 Illustration of the current version of the US-based IFT Undergraduate Education Standard taken from LeGrand et al. (2017 p.119).

The IFT standard appears to be broadly comparable to the corresponding UK QAA statement (2016) for 'food science', and the 'generic skills' in the QAA statement are summarised in Table 2.2.

Table 2.2 Matrix of seven 'generic skills' headings from the current UK-based QAA standard (2016, pp.18-22).

5.6.1	Intellectual skills
5.6.2	Practical skills
5.6.3	Analytical and data interpretation skills
5.6.4	Communication skills
5.6.5	Digital literacy and social media skills
5.6.6	Interpersonal and teamwork skills
5.6.7	Self-management and professional development skills

Educators in the USA have published a number of articles in relation to graduate skills development and curriculum assessment using the IFT standard as a basis. Research is usually undertaken using the whole IFT

standard rather specific areas (Hartel & Gardner, 2003, Bohlscheid & Clark, 2012, Joyner, 2016). A summary of a selection of such studies explicitly using the IFT standard is summarised in Appendix I, detailing outcomes specific to 'success skills'. For example, Purdue University (Morgan *et al.*, 2006) use a survey with their Industry Advisory Board to review desirability of outcomes in the IFT standard. Overall, success skills' core competencies outcomes score the "highest". Other work focussing on more general development of 'success skills', includes Hollis and Eren's (2016) initiative to provide students with a sense of employer expectations, and LeGrand *et al.* (2017) looking at development of these skills during specific teaching activities in a Vietnamese course. Hartel (2003) stresses the importance of partnership between academics and the industry they serve, such as consulting with employers, and this view is supported in a recent study by Joyner and Stevenson (2017).

Hartel also co-authored a book 'Careers in Food Science: From Undergraduate to Professional' in 2008 (Hartel & Klawitter). It seeks to provide a US food science undergraduate student (or aspiring student) with information on opportunities in the industry, job application skills and success tips for the world of work. There are examples of different career pathways in small chapters provided by representatives from US industry and in general the style seems inspirational to a student audience. Surprisingly only a few authors have cited the book, indicating minimal current use in teaching development or curriculum review. This may be because there is no accompanying competency framework to use or supporting lists of desirable competencies. Shewfelt (2012) references the book in his own publication focussed on food sciences' graduate school level (postgraduate) careers.

This is noteworthy as the authors (2008) stress throughout the book, and particularly in chapter ten, the value of postgraduate study or 'graduate programs' before commencing employment, something not commonly desired of graduates in the UK.

From an Australian perspective there is much to be found on employability related education over recent years (Barrie, 2007, Jackson, 2010, Judd, Knight, Lovell *et al.*, 2015), in fact more than from the USA, but little literature specific to food science. However in developing 'work readiness' and student 'capabilities' within their food science degree curricula, Coorey and Firth (2013) draw upon a 'skills demand survey' released in 2011 by the Food Technology Association of Australia (FTAA), an industry members-based organisation (n.d.) holding a list of endorsed educational establishments.

2.7.2 European perspective on food science graduate competency

There is no European educational standard equivalent to the IFT, for food sciences courses. From reviewing university websites (outside of the UK) national degree accreditation appears general and not discipline specific. However a number of multinational initiatives have been undertaken over recent years by the previously remarked on, ISEKI-Food Association or 'IFA' (n.d.). They provide a platform for the industry and other stakeholders and support relevant research and development of useful support tools for all 48 member countries to share (primarily European, however other countries can join). Commonly termed as 'ISEKI' with regard to studies and projects (Ho, 2018), they take reference from the EHEA and Bologna Process (ISEKI-Food Association, 2007), and have provided reports on subjects such as outlining a

desire to provide material to ensure European food degree systems are comparable in standard and coverage.

Previous ISEKI schemes since 2009, such as 'TRACK_FAST' and 'Food 4' have undertaken research on food industry 'skills' requirements involving academics from a number of institutes. A comprehensive three section report, 'Knowledge and skills requirements for careers in the food industry' was published (Ho *et al.*, 2011), incorporating a Canadian skills study and general skill standards produced by the UK Food and Drink Sector Skills Council[14] (Improve, 2008); an extract of the latter is included later (Table 2.4). In the ISEKI report, Section I - 'non-sector specific skills' in the report is most aligned to personal and professional competencies, however it does not have a graduate specific focus. Using this report as a basis, subsequent ISEKI studies include: establishing employers' desirable skills by 'brainstorming workshops' (Flynn, Wahnström, Popa *et al.* (2013b) with results in Table 2.3), gaining profiles of European food scientists and technologists by employer questionnaires (Flynn *et al.*, 2013a), an employer–employee skills development survey (Mayor *et al.*, 2015), and undergraduate student self-evaluation of skills development by an online survey (Flynn *et al.*, 2017). Scope is wider than graduate level employment, with the exception of the latter two studies.

[14] A different body to the council of the same name noted in Chapters 1 and 9

Table 2.3 Reproduction of basic list of 'non-sector skills' or 'soft skills' (not graduate role specific) generated from ISEKI brainstorming workshops. Items are grouped into five sections (Flynn *et al.* 2013b, p.249).

Fundamental skills
Communicating
Managing information and computer literacy
Using numbers
Thinking and solving problems
Providing leadership
Managing personnel
Personal management skills
Demonstrating positive attitudes and behaviours
Being responsible
Being adaptable
Learning continuously
Improving own performance
Teamworking and interpersonal skills
Working with others
Participating in projects and tasks
Communicating with others
Business skills
Business planning and strategic management
Sales and marketing
Finance and resource management
Customer service
Corporate social responsibility (CSR)
Entrepreneurship
Pedagogical skills
Learning and assessment

Operational terminology in publications are 'knowledge, skills and competencies', however 'skills' as a term has been stated as used universally for all three (Flynn *et al.*, 2013b). The 'non-sector skills' have been rephrased as 'soft skills' (Flynn *et al.*, 2013a).

Outcomes of the ISEKI work will be discussed as pertinent through future Chapters. An interesting observation from results of the employers' workshops (Flynn *et al.*, 2013b) were that 'soft skills' are ranked highly by

employers especially ‘communicating’, however within the limited scale of the study, there are suggestions geographical region could influence skills most desired by employers.

A study was also undertaken by Oreopoulou *et al.* (2015), investigating the effect of subject of degree study on the type and level of role undertaken as a food scientist or technologist. One of the latest initiatives linked to ISEKI is the Erasmus funded ‘European FooD-STA Centre’ (n.d.), a virtual platform with physical hubs in eight countries partnering academia with industry, aiming to provide more specific recognition for professional skills. Conducting a training needs survey with industry (largely SMEs) in 2015, they have produced leaflets indicating some key role competencies and recommendations (European Food Studies and Training Alliance, 2016, European Food Studies and Training Alliance, 2018). A database, accessible to IFA members of the ISEKI work has been launched, however information or guidance on ‘soft skills’ for food scientists has yet to be added.

The UK has engaged with ISEKI schemes; however there appears limited application of publications from ISEKI into UK HE. Perhaps this is because outputs are not focussed on graduate employment, or as yet on particular career pathways to appeal to university student development and career advisors. The use of the term ‘soft skills’ is generally avoided by the researcher believing it affects the perception of the value of ‘non-technical’ competency development (Hurrell, Scholarios & Thompson, 2013).

2.7.3 A UK perspective on food science graduate competency

As noted earlier, UK degrees are subject to compliance with the pertinent QAA benchmark statement (2016). The ‘generic skills’ section for the

standard pertinent to food science degrees has already been presented in Table 2.2. Since 2015, the IFST degree accreditation scheme (n.d.-a) has been open to UK institutes. As introduced in the previous Chapter, accreditation application is underpinned by the associated QAA statement plus additional questions, however it does not have a list of competencies akin to the IFT version (2016) in the USA. This is perhaps because the QAA statement is fairly comprehensive on content, though it is generalised to a considerable number of courses, and thus career pathways.

The UK government 'High Level Skills for Food' report (Food Research Partnership, 2010) provides little detail on skills requirements in agri-food graduates, but highlights a difficulty in comparing data sources and recommends to government and data collection bodies agree clear, common metrics in future. Utilised in ISEKI's 'Non-Sector Specific Skills' (Ho *et al.*, 2011), the UK Food and Drink Sector Council [15] produced 'Performance Standards' for different sectors of the industry in 2008 (Improve). This includes 'Technical, Quality and Product Development' split into five technically driven facets, although these standards are not graduate specific. However the overarching section titles 'business and people' has a subsection of 'people' which appears to encompass some of the types of non-technical competencies under discussion. Table 2.4 lists the contents of this subsection and the details of one of the further subdivisions 'working with others'. This indicates the lists appear to include choices of criteria dependant

[15] As previous footnote, at the time of writing a different UK Food and Drink Sector Council has been was launched in 2018

on the level or role of a person, such as separate requirements for understanding of a 'skill' and a being able to demonstrate the 'skill'.

Table 2.4 Summary taken of UK Food and Drink Sector Council performance standards (Improve, 2008), subsection A2 - 'people'.
The detail under 'working with others' illustrated as an example (not graduate specific).

A2	PEOPLE
1	**Own performance**
2	**Working with others**
PL.201S	Work effectively in food manufacture
PL.202S	Work effectively with others in food manufacture
PL.203K	Understand how to work effectively in food manufacture
PL.204S	Communicate effectively
PL.205K	Understand how to communicate effectively
PL.206S	Organise and run meetings in food manufacture
PL.207K	Understand how to organise and run meetings in food manufacture
PL.208S	Develop productive working relationships with colleagues
PL.209K	Understand how to develop productive working relationships with colleagues
PL.210S	Develop and manage relationships with external organisations in food manufacture
PL.211K	Understand how to manage relationships with external organisations in food manufacture
3	**Learning and assessment**
4	**Leadership**
5	**Personnel**

One of the core aims of the NCUB Food 4.0 Initiative (2015) introduced in the previous Chapter, is to grow the 'talent pipeline'. However specific research on what desirable competencies to nurture in future 'food talent' is excluded from the remit of this initiative.

With respect to academic research, a sparse amount was found in relation to employability. However there are studies on development of specific competencies in relation to food science teaching, for example Paxman, Nield and Hall (2011) at Sheffield Hallam University published work seeking to

increase confidence and motivation by active learning. The authors do use the term ‘competency’ generally, but in relation to self-perception of general confidence to undertake a task. Little was found specific to food science graduate employability from a UK academic perspective.

2.7.4 Graduate roles and careers education for food science students in industry

At this stage it is worthwhile reflecting that ‘employability’ can take a number of meanings and forms as discussed earlier in this Chapter. The predominance of the review to date has centred on development of ’generic’ or employability-based student competencies for their intended workplace, namely ‘competency development’. An additional facet of employability is providing students with the means to choose and successfully apply for the right role upon graduation, or ‘careers education’ (Yorke & Knight, 2004, Dacre Pool, 2017), sometimes embedded in curricula (Weston & Wayte, 2014, Beaumont, Gedye & Richardson, 2016). Both of these aspects are included in the project aims (section 1.6) and so are considered below.

It appears that neither USA nor UK competency or accreditation systems currently recognise possible variation in desirable competencies dependant on the types of career pathways into the food industry (IFT, n.d.-a, QAA, 2016) For the UK QAA statement (2016), requirements for ‘generic skills’ is addressed to students of all degrees in agriculture, food science, nutrition, consumer science and rural environment, which incorporates a significant range of career types and nothing specialist for food science routes. The European FooD-STA work (n.d.) is aiming to develop more recognition of ‘skills’ for particular professions linking to past ISEKI studies presented

earlier, so in future material may be generated, specific to graduate entry roles.

There is limited clear information in any country on typical technical graduate roles in the food industry. In the USA, Hartel and Klawitter's book (2008), does outline ten different career options for graduates, presented in a discursive manner over separate chapters. Otherwise, only limited open resources for tailored careers advice and development could be found. The IFT website (n.d.-a) has limited resources, and some university websites have statements of graduate destinations (Oregon Stage University, n.d.). Job availability appears generally serviced by the IFT website and commercial web-based advertisement companies such as 'Indeed'. There is also a more informal IFT student branch (n.d.-b), 'IFTSA' with some careers related blogs, discussions and news held on their website.

The UK provides a number of websites (from government organisations) to advise students of all ages and aspirations of the options in the food industry (Table 2.5).

Table 2.5 UK career websites for food careers advice, predominantly government organisations*.

Source	Web link (checked December 2018)
National Skills Academy for Food and Drink	https://tastycareers.org.uk/
Food and Drink Federation (FDF)	http://www.tastesuccess.co.uk/
Prospects [16]	https://www.prospects.ac.uk/careers-advice/what-can-i-do-with-my-degree/food-science
Institute of Food Science and Technology (IFST) *not a government organisation	https://www.ifst.org/career-development/career-information

These resources include certain well known graduate entry roles such as 'New Product Development Technologist' (NPD) and 'Quality Assurance Auditor', and some provide descriptors of each role. The FDF (2011) also published a qualifications map which lists possible aspirational role titles for different entry qualifications to the industry. These resources do not include graduate roles that are less frequently recruited, such as 'Sensory Technologist'. The National Skills Academy (n.d.-a) also launched a subscription based job specification and training needs tool in 2017 for businesses called 'Blueprint'. The researcher has viewed sections of the tool and can confirm it contains technically based skills for roles at a number of levels in the food industry.

UK food industry graduate roles have a range of titles and descriptors which can be confusing to applicants and possibly prevent suitable candidates

[16] The contents of the information for food science on this website was updated at the request of the researcher in 2016/7.

applying for an ideal position. This project aims to provide clarity to stakeholders by providing a clear list of types of jobs and their typical titles.

2.7.5 Careers support and education for food science graduates before project commencement

Excluding advice from staff within students' own institute there are currently the following points of careers support for food science undergraduate students in the UK:

- IFST Student Launchpad events (n.d.-d) for undergraduate students to attend with their institute of study during autumn.
- Current job advertisements from industry publications such as Food Manufacture (n.d.) and recruitment agencies and websites such as CPA, FMCL, Graduate Recruitment Bureau (n.d.) and Indeed.

In summary there is limited easy access advice for food science students on the range of graduate career pathways and what competencies may be desirable for each route.

2.8 APPROACH TO PROJECT

As has been demonstrated there are pervasive themes within modern HE to increase perceived value in degree education, whether by ensuring curricula and teaching meets desired subject targets or outcomes (Harden, 2001a, Office for Students, 2018), or by enhancing the employability of graduates (Hillage & Pollard, 1998, Yorke & Knight, 2004, Suleman, 2018), with 'competency development' and 'careers education', used as enablers. From a food sciences education perspective some countries and institutes (Hartel &

Klawitter, 2008, European FooD-STA, n.d.) are working towards understanding more about what is desired in graduates for entering industry roles, but little cohesive material is yet available, and careers support material is limited.

2.8.1 The research questions

Embracing findings from the literature review, the proposal was made to fill a novel gap in knowledge and develop a 'competency framework' comprising the desired set of items for specific career pathways or roles using a 'common language' (Evers *et al.*, 1998). Curricula will then be mapped against this framework to establish inclusion of items in current teaching of food science degrees at UoN. The outcomes of the project are also hoped to support understanding of careers and role profiles for food sciences undergraduates across the UK and the Republic of Ireland.

It is accepted that there is no ideal model or framework type to directly utilise for this project. The work is aimed to be largely exploratory, involving stakeholders and iterative processes, and thus requires adaptability.

At this stage it is worth a reflecting that HE provides a unique opportunity for a person to develop a broad cognitive ability associated with their chosen field; they are not attending a long and prescriptive training course. However excellent HE teaching practitioners are aware of the responsibility of providing graduates with the competencies required for their destined profession. They have awareness of the desired behaviours inherent in a person with a successful career in their field. The final competency framework is not aimed to be directly transposed and drive the overall technical course agenda, but more to shape the content and allow both academics and students to be

mindful of what is important to learn and develop over the period of degree study. No single construct can currently supply all the requirements for a qualified and employable food sciences graduate (Vandeweerd *et al.*, 2013), however the competency framework is aimed to complement and likely overlap with the pertinent QAA benchmark statement (2016) and IFST degree accreditation (n.d.-a). From this new framework a curriculum can be developed that embraces the desirable competencies, either as explicit training and learning inclusions or as general philosophies to be embedded into the 'ways of working' throughout the degree period.

As outlined in the aims of Chapter 1, the study intends to have both theoretical and practical contributions (Holmes, 2017) and fill a novel gap in knowledge for food science graduate education. Based on the literature review the following research questions for this project were proposed:

> *Question 1. What are the key competencies desirable and required for food science graduates to be successful in their career in the food industry?*
>
> *Sub-question 1a. What is the universally understood language of the terms to define the key competencies?*
>
> *Sub-question 1b. What are the typical roles food science students undertake after graduation?*
>
> *Sub-question 1c. What do employers believe are the key competencies for a food science graduate?*

Question 2. Using a case study at University of Nottingham, do current vocational degree courses provide these competencies?

Sub-question 2a. How are the key competencies included in course teaching at University of Nottingham?

Sub-question 2b. What recommendations to curricula design may be made for the future?

2.8.2 Approach to project terminology

At the start of this section, the intention was shared to develop a 'competency framework', aiming to support student 'employability' and engender clarity in graduate career opportunities for wider stakeholders. Sub-question 1a exemplifies the importance laid on correct and consistent use of terminology in this project. However, as demonstrated in this Chapter, there are an assortment of terms and associated definitions used in previous research and applications (Sumsion & Goodfellow, 2004, Suleman, 2018). In a number of instances the development of such terms is part of the journey and thus cannot be defined ahead of time, although a number of yardstick statements for this project have been included earlier in the Chapter. Competency as defined in this Chapter as 'a skill or attribute needed to do a job', is presented as integral to employability, and at this stage, embraces knowledge, skills and either behaviours or attitudes.

When considering any future applications of a competency framework, the two significant uses will be 'competency development' and 'careers education'. 'Competency development' encompasses any type of teaching or experience that enables enhancement of a particular aspect of a person's

competencies. Alternatively, ‘careers education’ concentrates on provision of support for choice of a career pathway but also for successful applications, including effective articulation of competencies both in writing and speech.

Figure 2.17 has been created to trace development of competency framework terminology and classification during the project journey over successive chapters. Progress will be considered on completion of each relevant chapter. The diagram also highlights the use of terms associated with the curriculum mapping study undertaken to address research question 2.

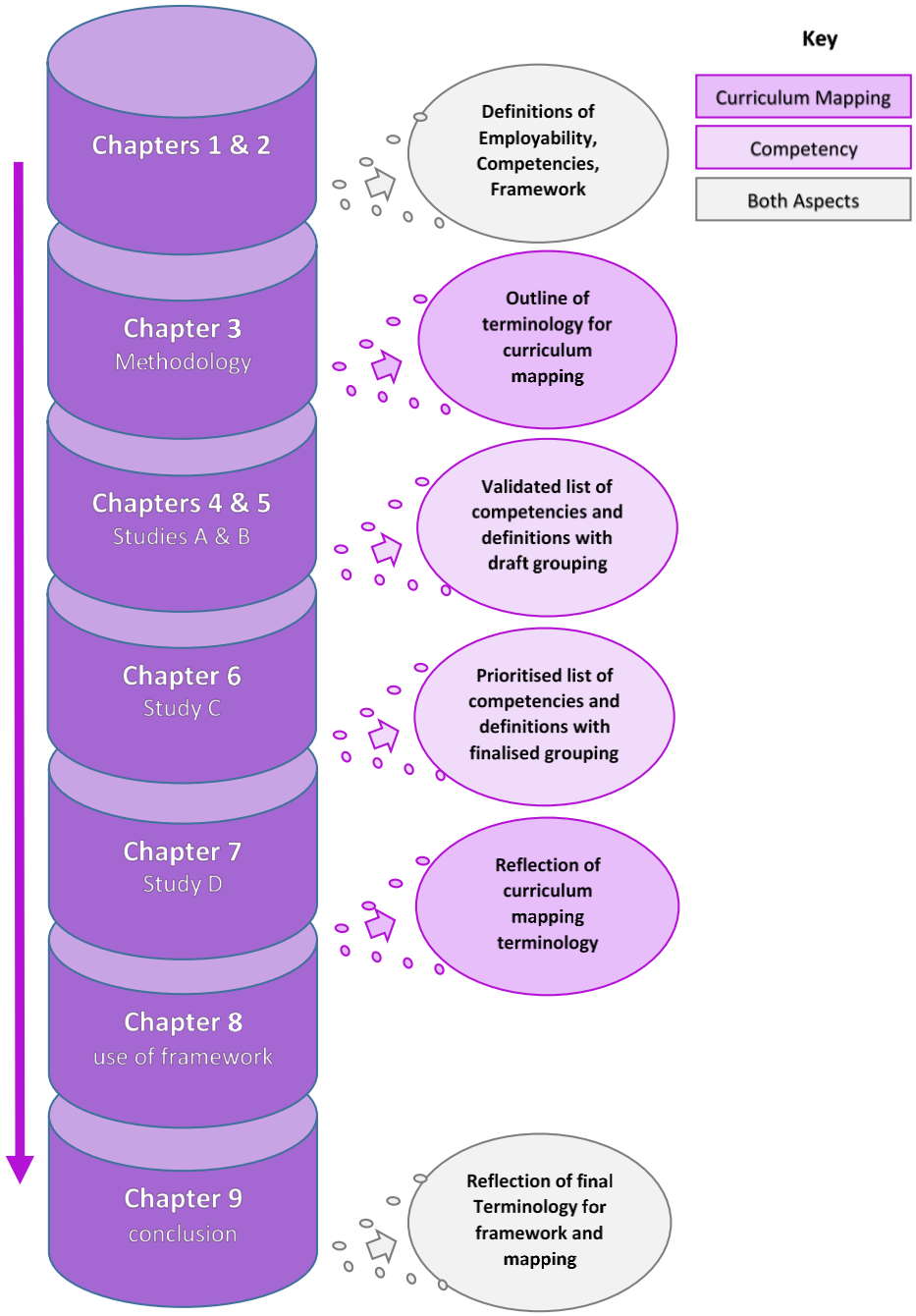


Figure 2.17 Diagram to illustrate the development of terminology and classification during the project.

Chapter 3 Research Design and Methodology

A ‘competency framework’ outlining desirable qualities for typical roles undertaken by food science graduates in the UK[17] food industry is required. This Chapter will explain the rationale for methodology choice, ethical considerations to achieve this goal, and use of the resultant framework.

The framework will be created based on a ratified ‘common language’ for defining the types of competencies, identified and agreed by a representative stakeholder group. The group will also support definition of graduate roles typically undertaken in the industry. Using the formulated material, wider industry will be engaged, to establish the importance of each competency for each role. This can then allow academic teams leading food science teaching and students undertaking those courses, to understand the key criteria important for different graduate pathways in the food industry. Curricula can then be developed to include competencies from, and link to these model pathways.

3.1 DESIGN OF PROJECT

Initial considerations to establish what industry may desire in a food science graduate may suggest the use of quantitative research; there have been many broader industry or employer surveys in the recent years that have taken this approach (UK Commission for Employment and Skills, 2015 & 2018, Confederation of British Industry, 2017, Shury, Vivian, Kik *et al.*, 2017). However when initially exploring the project research questions outlined in the previous Chapter, the first asks,

[17] For the industry survey (Study C) scope included the Republic of Ireland

Sub-question 1a. What is the universally understood language of the terms to define the key competencies?

Addressing sub-question 1a would require exploration of a more open and qualitative nature. As the project design was developed it seemed sensible to consider a mixed methods approach.

3.1.1 Mixed methods research approach

Creswell (2014) presents a framework for research approaches that require consideration of philosophical 'worldview', design and methods. He proposes worldviews as a, "general philosophical orientation about the world and the nature of research that the researcher brings to the study" (p.6). He notes others refer to them as paradigms, epistemologies, ontologies or broadly conceived research methodologies. Of the four worldviews in his model, he suggests a 'pragmatist' worldview to be open and not to rely on precedents. It focuses on the research problem and is prepared to choose from a range of approaches to address a given problem. This is the philosophical underpinning for 'mixed methods' research, and the 'what works' approach to answering research questions is most aligned to the philosophy of this project (Cohen, Manion & Morrison, 2011).

Mixed methods research is defined by Braun and Clarke (2013) as, "the combination of different methods of data collection and / or data analysis within a single study, frequently comb[in]ing qualitative and quantitative approaches"(p.333). The initial inception of mixed methods research in the mid-20th century was based on the idea that mixing qualitative and quantitative data neutralised faults in either approach or provided triangulation opportunities (Symonds & Gorard, 2010). Latterly mixed methods research

was redefined as a 'third paradigm' (Creswell & Plano Clark, 2011), following quantitative, then qualitative research. Creswell and Plano Clark (2011), outline three basic mixed methods models in use today: 'convergent parallel' where both type of data collection are performed simultaneously, 'explanatory sequential' where qualitative data is collected to support a prior quantitative stage and finally 'exploratory sequential' in which the qualitative data is collected as a basis for subsequent quantitative analysis. All of these models are subject to adaptation or increased complexity to meet the needs of the researcher, but the principle remains there that is significant input from both qualitative and quantitative methods. Additionally, mixed methods research is considered a common research process for the social sciences (Symonds & Gorard, 2010).

Arguments have been made that true mixed methods research requires inherent 'mixing' of both qualitative and quantitative data within one inquiry stage (Greene, 2008), and thus much research does not conform to this principle. Argument has also been made for replacing 'mixed methods' and other paradigms with a universal classification of 'research' (Symonds & Gorard, 2010). It is suggested here that, selecting appropriate data collection and handling methods for each stage, may require more consideration and scope than discrete qualitative or quantitative research. If appropriately selected approaches are used, mixed methods research offers the flexibility to design tailored and effective projects.

3.1.2 Specific research design applied to the project

The project is most closely aligned to the Exploratory Sequential Mixed Methods design, illustrated below in Figure 3.1 whereby Studies A and B constitute the main qualitative phase. Drawing from such findings, subsequent

Studies centre on gathering largely quantitative data, supported by selected qualitative components.

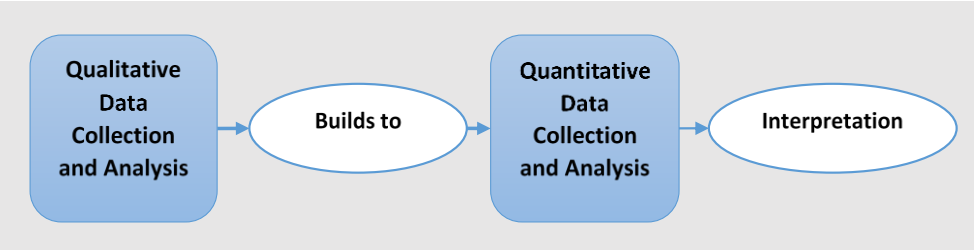


Figure 3.1 Reproduction of exploratory sequential mixed methods diagram, taken from Creswell and Plano Clark (2011, p.69).

A more detailed description of the constituents of each of the Studies presented within this research is provided in Table 3.1. Undertaken sequentially, it illustrates the blend of qualitative and quantitative components within a number studies undertaken in this research.

Table 3.1 Project plan to address research questions in order of Chapters.

	Research Question or sub-question addressed	Qualitative Components	Quantitative Components
Ch 4, 5 & 6	Q1. What are the key competencies desirable and required for food science graduates to be successful in their career in the Food Industry?		
Chapter 4 - Study A Chapter 5 - Study B	Sub-question 1a. What is the universally understood language of the terms to define the key competencies?	Semi–structured interviews Thematic Analysis (TA) Online stakeholder focus group Testing validity by student group interviews & 2 industry representatives	N/A
Chapter 6 - Study C	Sub-question 1b. What are the typical roles Food Science students undertake after graduation?	Survey of job market Stakeholder discussion	N/A
	Sub-question 1c. What do employers believe are the key competencies for a food science graduate?	Thematic analysis of free text responses from survey (limited)	Industry online survey: Principal component analysis -PCA Descriptive data analysis
Ch 7, 8 & 9	Q2. Using a case study at University of Nottingham, do current vocational degree courses provide these competencies?		
Chapter 7 - Study D	Sub-question 2a. How are the key competencies included in course teaching at University of Nottingham?	Interviews with module convenors & categorisation (quantitative) Thematic analysis of free text responses from Graduate online surveys.	Analysis of module mapping data. Employer desirability data converted from Study C. Frequency distribution from graduate online surveys.
Chapter 7 Chapter 8 Chapter 9	Sub-question 2b. What recommendations to curricula design may be made for the future?	Trial teaching inclusion Student questionnaire review Student group interview	Interactive online tool

For example research question 2 was addressed by a survey within Study D where for the student perception aspect, core quantitative data analysis from the graduate survey was supported by brief thematic analysis of the additional open-text questions provided. Braun and Clarke (2013) argue that mixed methods research is often, "conducted within a 'Realist' framework" [18] and thus rarely includes 'big Q qualitative research' " (p.333). They would deem Study D, 'small Q', whereby qualitative questions reside in a largely quantitative form of data collection. This argument is made where mixed approaches can convert qualitative data in some way (content analysis or some form of thematic analysis) into a numerical representation. However concerns may arise that data be 'subsumed' by the quantitative component of the study. This could be the case in a number of aspects of this project such as the module mapping aspect of Study D. However Studies A and B are clearly discrete qualitative activities with a 'big Q', validating the project design of exploratory mixed methods research.

3.1.3 Use of qualitative data within the study

Once outcomes or claims are generated from research it is good practice to perform some type of testing or quality assurance to establish if the output is fit for purpose for the intended audience or wider population. Approaches to test the validity and reliability of research are centred primarily on processes well-placed to handle quantitative material. Braun and Clarke (2013) concur with Goodman (2008) to describe validity, "as work showing what it aimed to demonstrate" (p.280). Reliability is concerned with examining the stability of

[18] For the purposes of this discussion realism can be said to have intersections with pragmatism (Montague, 1909)

the study and whether an accurate representation of the population has been made (Golafshani, 2003, Creswell, 2014).

Researchers have subdivided or grouped these constructs to assist the process of testing them, particularly with regard to validity in quantitative studies. For example, Frankfort-Nachmias and Nachmias (1996) outline three basic kinds of validity: content, empirical and construct, whereas Goodman (2008) describes two key areas: construct, and external with the latter split into ecological and population validity. However both Creswell (2014) and Golafshani (2003) note validity does not have the same connotations in the 'naturalistic setting' of qualitative research. Braun and Clarke (2013) assert testing reliability using routine quantitative methods is not appropriate.

In understanding the naturalistic and discursive nature of qualitative research, alternatives for testing these types of studies have been proposed. Largely based on the work, 'Naturalistic Enquiry' by Lincoln and Guba (1985), debate has progressed to redefine the concepts of reliability and validity (Golafshani, 2003). Overarching terms include 'trustworthiness' (Lincoln & Guba, 1985), supported by Elo, Kääriäinen, Kanste *et al.* (2014) and Braun and Clarke (2013), and also 'rigour' (Davies & Dodd, 2002) supported by Cypress (2017) and Thomas and McGilvy (2011). In appreciating the need for practical application of any of these constructs for testing methods or results, Creswell (2014) suggests bypassing traditional compartments and moving directly to using 'validity strategies' and 'qualitative reliability procedures' to assess the accuracy of findings drawn from work (Table 3.2), including that of Lincoln and Guba (1989). Mossop (2012) warns they can be subject to interpretation, however they provide useful tools for a researcher to consider.

Table 3.2 Possible qualitative validity strategies and reliability procedures collated from Mays and Pope* (2000, p.51) and Creswell (2014, pp.201-204).

Possible Validation Strategies
Member checking (*alternative term used, respondent validation)
Triangulation
Present negative/discrepancies
Clarification of researcher bias
Use of rich-thick descriptors to report findings
Inclusion of external auditor
Spending prolonged time in field
Use of peer debrief (independent person to talk to participants)
Possible Reliability Procedures
Check transcripts for obvious mistakes
Prevent drift in codes during coding activity
Team co-ordination of code use
Cross check of codes used by different researchers OR if a single researcher 'intercoder agreement' established by an external check

Considering qualitative research used in the food industry for example sensory evaluation, this project is essentially conducting a form of ‘consumer research’ with the subjects being the employer or student. Lawless and Heymann (1999) assert to ensure reliability in structuring a session such as a consumer group, information must be somewhat “representative of the larger consuming public” (p.326), and thus valid. In addition the colloquial phrase for ensuring production is undertaken within agreed standards is quality assurance, and this is also appropriate to this project.

With respect to the ability of work to be used in other contexts, termed as generalisability (Mossop, 2012, Creswell, 2014) or transferability (Braun & Clarke, 2013), this is agreed to be of limited value in qualitative research but if applicable it will be considered.

An additional factor to consider in qualitative research is 'reflexivity' (Mays & Pope, 2000) or the, "sensitivity to the ways in which the researcher and the research process have shaped the collected data" (p.51). McNarry, Allen-Collinson and Evans (2019) comment on possessing a 'reflexive gaze'', and appreciating the potential impact of the researcher on aspects including, participants and data analysis. Mindful of limiting this effect, approaches have been consciously designed (Guba & Lincoln, 1989) to minimise personal bias such as the construction of interview processes or strict notetaking to ensure transparency of data collection and analysis (Mossop, 2012). However as the researcher has experience as both employer and educator in the food industry (and student many years ago) the risk of bias if managed sufficiently, is suggested to be countered by the benefit of wide and deep experience as a stakeholder accompanied by commitment to gather a full, relevant and contemporary viewpoint throughout the project.

In conclusion the terms 'validity' and 'reliability' will be used alongside a collective term of 'rigour' as used by Davies and Dodd (2002) for the quality assurance work conducted during the project. Some of the strategies and procedures outlined by Creswell (2014) will be included as appropriate and considered when reviewing success of the project at later stages.

3.2 METHODS USED FOR DATA COLLECTION AND ANALYSIS

Development of the competency framework is essentially an integration of studies A, B, and C. There are many previously used approaches to developing such a framework for degree courses; only recently Suleman (2018) has published a review of such methodologies. However examples of studies thought attractive in relation to this project during initial stages are included below.

Su and Zhang (2015) develop an employability model for the School of Economics and Management at a Chinese institute by a literature review to "frame the competency model first", interviews to develop 'indicators', followed by an employers' questionnaire with subsequent principal component analysis (PCA) to generate five factors or 'key competencies'. It is difficult to elucidate details of some of the methodology, however the use of stakeholders, developing a draft lexicon (Lawless & Civille, 2013), then wider engagement and use of mixed methods is appealing. Velasco (2012) also uses PCA to analyse survey data, with recent graduates as participants suggesting inclusion of these stakeholders may be beneficial. Kavanagh and Drennan (2008) use students as stakeholders but operate a variety of group sessions to gather data.

From a food science perspective in the USA, Johnston *et al.* (2014) and recently Joyner and Stevenson (2017), engage US industry experts by a modified Delphi approach (see later in Chapter) to generate content or consolidate information when developing a competency framework, or define module content respectively. Noting the vocational nature of the subject, involvement with industry (Hartel & Gardner, 2003) is believed to be critical, to define "what students know and are able to do as a result of food science

education”(p.32). The ISEKI project activity (section 2.7.2) on ‘soft skills’ takes a nonlinear approach to understanding desirable competencies for food industry roles, but a number of their studies use an collated list of ‘skills’ or a language (Ho *et al.*, 2011) as a benchmark for their surveys and workshops. Employers and ‘graduates’ are included in scope (Flynn *et al.*, 2013a, Flynn *et al.*, 2013b, Mayor *et al.*, 2015, González-Martínez, Ho, Cunha *et al.*, 2015). Overall it seems customary to use surveys and/or more detailed interviews or group sessions to engage with employers. However to qualify the nature of graduate opportunities or ‘roles’, reviewing pertinent careers guidance, job advertisements and specifications seems sensible (Bennett, 2002).

Taking reference from the most suitable aspects of previous studies the approach taken for studies A, B and C is illustrated in Figure 3.2. Method choice will be outlined in this Chapter or detailed processes in Chapters 4, 5 or 6 respectively. Study D comprised the curriculum mapping exercise, with literature relating to the subject included in the previous Chapter. Choice of methodology is presented in this Chapter, followed by detailed procedures in Chapter 7.

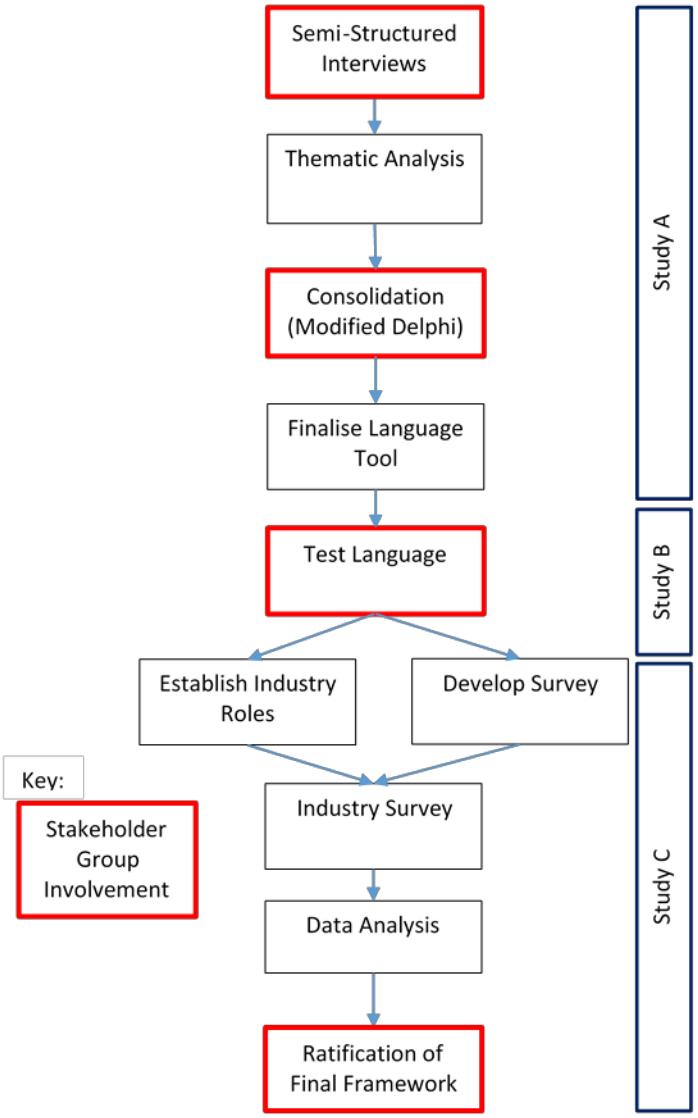


Figure 3.2 Overview of approach taken for Studies A, B and C in the project.

3.2.1 Stakeholder engagement

3.2.1.1 Project stakeholder group

A range of stakeholders were secured as representatives of the broader reality of the food industry. As already outlined, involvement with the employer was believed critical to success (Hartel & Gardner, 2003), so the

voice of the 'demand-side' of the supply chain (McQuaid & Lindsay, 2005) was required to ensure project validity.

A purposive stratified method of sampling (Braun & Clarke, 2013, Creswell, 2014) was undertaken to ensure that diversity of representation was included in the project stakeholder group. Stakeholders in food industry employment of technical graduates were identified as outlined in (Figure 3.3) and included: employers (Flynn *et al.*, 2013b, Perera *et al.*, 2016), a recruitment consultant (Enz, Renaghan & Geller, 1993), a UoN careers advisor (Dacre Pool & Sewell, 2007), and recent graduates (Bohlscheid & Clark, 2012, Su & Zhang, 2015). Graduates with two to three years' work experience were included in the group as they were now able to draw on the own experience of graduate competency requirements.

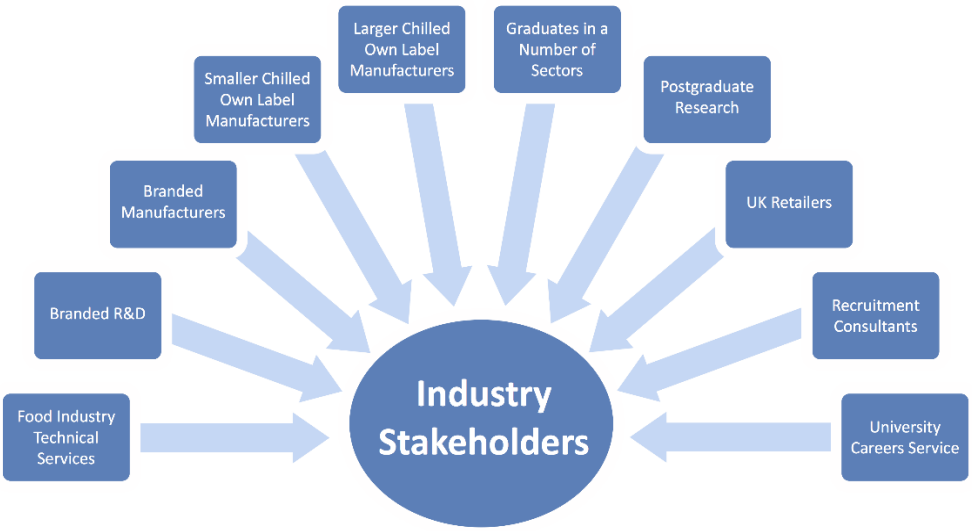


Figure 3.3 Illustration of the range of stakeholders selected for the project.

In total 12 stakeholders (at least one from each part of Figure 3.3) were secured for the project. These were convenience sampled (Braun & Clarke, 2013) from existing industry contacts known to the researcher, or in the wider

network of the Division of Food Sciences at UoN, and aimed to represent a range of perspectives on the subject; seven employers from a range of business types, three recent graduates from typical initial pathways and two representatives from the careers and recruitment sector (Table 3.3). For circumstantial reasons, three of the employer stakeholders (TEC, BRM-1 and RET) were replaced by suitable alternatives before commencing Study C.

Table 3.3 List of stakeholders for the project.

Employer, services or recent graduate	Areas of industry	Stakeholder reference
Employer	Larger chilled own label manufacturer	LCO
Employer	Smaller chilled own label manufacturer	SCO
Employer	Branded manufacturing companies / R&D	BRM-1
Employer	Branded manufacturing companies / R&D	BRM-2
Employer	Retailer (Technical area)	RET
Employer	Postgraduate research supervisor	PGR
Employer	Technical services and R&D in food industry	TEC
Recent Graduate	Larger chilled own label manufacturer	RG-LCO
Recent Graduate	Retailer (technical Area)	RG-RET
Recent Graduate	Postgraduate research	RG-PGR
Services	University Careers and Employability Service	CES
Services	Recruitment consultant	REC

Stakeholder group involvement commenced in Study A (Chapter 4) with semi-structured interviews (Brinkmann & Kvale, 2015, Davies, 2007, Keats, 1999, Frankfort-Nachmias & Nachmias, 1996), data analysis and group consolidation of results in the form of a modified Delphi technique (Johnston

et al., 2014, Sobaih, Ritchie & Jones, 2012). The group then ratified outcomes of Study B (Chapter 5) and agree the scaffold to use for Study C (Chapter 6). A far wider set of industry stakeholders participated in the survey of Study C and graduates (UoN alumni) were specifically targeted during curriculum mapping of Study D (Chapter 7).

3.2.1.2 Wider stakeholder considerations

The project stakeholder group included representation of those who 'employ' graduates or those who are recently employed graduates. There is of course a wider remit of those with "some interest in or knowledge of" development of high quality graduates (Enz *et al.*, 1993). The educator cannot usually offer an employer's perspective, except perhaps in research careers, but have pivotal role in subsequent curriculum review or development against the framework (Chapter 7).

Engagement of students during appropriate stages is fundamental; the project outputs are primarily designed to support their curriculum development and careers education. One project intention or outcome was to provide students with useful profiles of types of technical roles undertaken by graduates entering the food industry, a tool to assist them in selecting individual career pathways and subsequent personal development plans. Whilst students are critical stakeholders in the overall project, as they are unaccustomed to industry (aside from placement) they cannot contribute to framework construction as data gathered would be largely conjecture. However undergraduates can participate in validity testing for Study B (Chapter 5) and provide feedback on any teaching inclusions (Chapter 8).

Harden (2001a) suggested educational stakeholders as those already mentioned, plus: administrators, accrediting bodies, examiners, educational

researchers and potential students or the public It was also considered useful to involve industry associations or accrediting bodies at certain stages as outlined in later Chapters. For seeking a wider employer view by the use of surveys, Su and Zhang (2015) target certain employers from the sector commonly recruiting their graduates. However for this project a broader opinion of all types of food science graduate employers were sought for the survey (Chapter 6).

3.2.2 Interviews

An interview is usually a face-to-face, interpersonal situation, aiming to gain answers pertinent to a study (Frankfort-Nachmias & Nachmias, 1996). Study A required a 'phenomenological' process (Barrie, 2007) to gather perception of stakeholders on the type of competencies they may desire in a food sciences graduate. Participants had a personal investment in the subject matter and the ability to explore understandings and perceptions was valued so the use of one-to-one interviews seemed ideal (Braun & Clarke, 2013). Interviews have been used before, at primary stages of framework or terminology development (Mossop, 2012, Su & Zhang, 2015). A clear footing for the interview was required to be balanced with the ability of participants to express their thoughts on terms and definitions freely without interference by the interviewer, so the choice of a semi-structured or focused interview was made (Frankfort-Nachmias & Nachmias, 1996, Golafshani, 2003). The interview process with basic script and guidance questions were developed before a full scale pilot study with a colleague (Cohen *et al.*, 2011). After subsequent revisions, interviews were performed with audio recording and brief additional notes taken by the interviewer as contingency (Creswell, 2014). The process was iterative, reflecting on raw data from initial sessions

and undertaking partial thematic analysis, to enable future interviews to be adjusted in focus until 'saturation' was achieved (Braun & Clarke, 2013, Vinten *et al.*, 2016). Further contextual details are presented in Chapter 4.

3.2.3 Data analysis of interviews

Interviews were transcribed verbatim (Barrie, 2007, Brinkmann & Kvale, 2015), checked and choice of methodology for analysis is outlined as follows.

3.2.3.1 Thematic analysis

Thematic analysis (Braun & Clarke, 2013) is a method to identify "patterns of meaning across a data set in relation to a research question" (p.175), and was chosen to examine the transcripts from the semi-structured interviews in Study A. Simply described, data is inspected, assigned to 'codes' forcing the researcher to make judgements and then after further review, 'themes' may be identified (Denzin & Lincoln, 2000). An inductive approach was taken to data evaluation (Frankfort-Nachmias & Nachmias, 1996, Braun & Clarke, 2006), so coding was created from transcript material and any adjustments to future interviews made part way to ensure further exploration and any additional probing was included later. Denzin and Lincoln (2000) quote Miles and Huberman (1994) saying "coding is analysis" (p.781), which highlights the nature of inductive coding, whereby in finding themes in data and starting to code, the interpretation is already progressing. The process of thematic analysis coding was supported by NVivo™ software (Mossop *et al.*, 2013, QSR International, n.d.) and conducted with reference to processes suggested by Braun and Clarke (2006), and Barrie (2007).

For validation purposes (see Table 3.2), the code list was cross-checked by an independent party as a triangulation process (Bell & Opie, 2002,

Golafshani, 2003, Mossop *et al.*, 2013), and an 'external auditor' (Creswell, 2014, Vinten *et al.*, 2016) coded a sample transcript which was compared with the original coding by the researcher.

3.2.3.2 Consolidation

Once thematic analysis was completed, a consolidation process to refine and complete the output was designed, centred around 'respondent validation' or 'member checking' (Mays & Pope, 2000, Creswell, 2014). Whilst there are potential flaws in the use of this process for validation such as risk of enhancement of original data, memory loss or contextual changes (Sapsford & Jupp, 2006) later consolidation stages were included to support Study A. The method utilised also had a dual purpose in providing a collegiate modus to this consolidation process.

Stakeholders were involved in a process characterised as a modified Delphi technique. Sobaih *et al.* (2012) provide a typical process diagram (Figure 3.4) and state the classic Delphi technique is ideal to achieve consensus amongst experts, should be iterative in nature and linked to a research question.

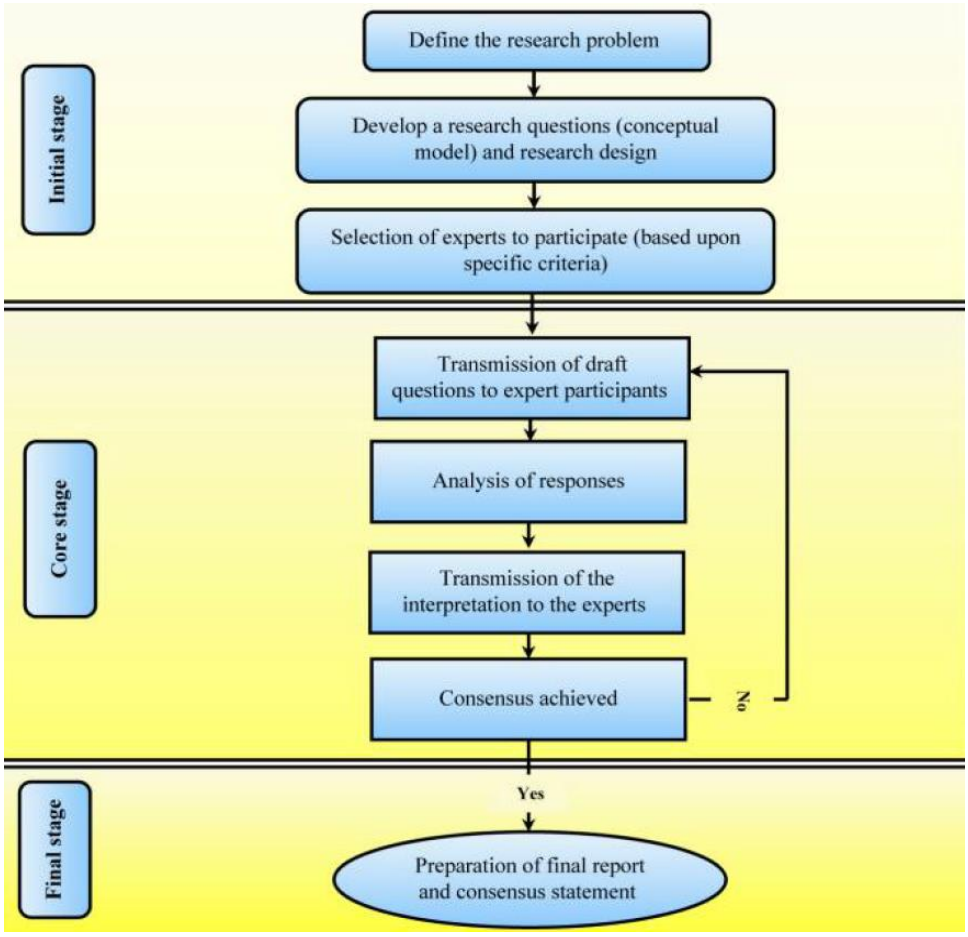


Figure 3.4 Typical Delphi process taken from Sobaih et al. (2012, p.891).

Modifications have been made to a classic Delphi process by a number of researchers (Bok, Jaarsma, Teunissen *et al.*, 2011), including two studies by food science educators (Johnston *et al.*, 2014, Joyner & Stevenson, 2017), although for both it is not clear that 'formal consensus' was reached by the experts, a grouping of experts' responses was undertaken. However some modified approaches to Delphi technique can serve to involve the project stakeholder group together in an iterative, controlled process without the time constraints and logistical challenges of a central single face-to-face meeting (Cohen *et al.*, 2011, Sobaih *et al.*, 2012). The initial stage for this part of Study A comprised of a preliminary report to all stakeholders for consideration, noting key findings from the thematic analysis and further

queries still remaining. The core stage was an online focus group using a simple forum created for purpose within UoN e-learning platform (n.d.-d). Using an iterative process, topics highlighted for review were raised, debated and consensus gained for all parts of the report. Necessary amendments were made and the final version was then ratified by stakeholders in a meeting (Cohen *et al.*, 2011).

3.2.4 Group student data collection

To gather feedback from student cohorts, a combination of surveys (see later) and group sessions were employed in the project. The format of a 'formal field group interview' was chosen for group sessions, so named as conducted at the participants' location, and arguably advantageous as in a natural social setting, in this case a place of study (Denzin & Lincoln, 2000, Bloor, 2001, Heide & Simonsson, 2015). The format should facilitate discussion of directed topics but enable participants to build on comments made, framed by a level of moderation to allow an open forum for all participants (Linville, Lambert-Shute, Fruhauf *et al.*, 2003). In field-based group interviews the facilitator has a more prominent 'leading' role asking participants specific questions based on their experience with a 'phenomenological' stance (Creswell & Plano Clark, 2011), rather than the more observational position of a formal focus group (Frey & Fontana, 1991, Wang, 2010). This suited the aims and nature of each session. Group interviews with undergraduates were included in Study B (Chapter 5) at three universities and also at a later stage at UoN alone, to reflect on recent teaching inclusions (Chapter 8).

Mindful that group sessions are naturalistic, not natural, and processes should not be left unplanned (Bloor, 2001), careful preparation was undertaken for each one.

3.2.4.1 Process consistency

Group interviews were planned to be conducted with as much consistency as practicable. Flat rooms suitable for small group discussion and feedback were arranged for each venue. Cohorts invited to all sessions were in their final year of study of food sciences bachelor's degrees so were in pre-existing social groupings (Bloor, 2001), and included a varying proportion of students who had been on an additional year-long industrial placement. Final numbers of students per session were likely to vary dependant on availability, but it was decided to include all who expressed interest in participation.

Processes for disseminating (before and during sessions) and recording information were kept as consistent as possible for Study B. Session resources prepared for each interview comprised material such as: a written protocol with time plan, key objectives and questions, introductory material and students' table resources (Linville *et al.*, 2003, Krueger & Casey, 2009). Notes made by the facilitator were immediately displayed using paper media (A3 posters and flipcharts) mindful that they draw attention to the facilitator, but on balance considered the most effective way for students to consider each other's feedback (Krueger & Casey, 2009). To provide 'strength of agreement' (Linville *et al.*, 2003) of data gathered, each session was also recorded either by audio recording or using an additional note taker (Bloor, 2001). This also afforded opportunity to gather unfocussed unplanned data (Franz, 2011).

3.2.4.2 Facilitators

The facilitator role for the sessions was conducted by the researcher for Study B (Chapter 5), and by a prepared colleague in a later session described in Chapter 8. Design was considered to ensure the correct level of reliability

was maintained. One of the key characteristics of a successful group session facilitator is the ability to remove personal bias from what occurs (Foddy, 1994, Greenbaum, 2000). The planned use of resources aimed to ensure a purposeful approach to sessions and a list of key phrases (see Appendix II) were memorised for inclusion where appropriate in the active part of the session, to prevent personal lead or influence on discussions (Vaughn, Schumm & Sinagub, 1996, Krueger & Casey, 2009). Examples of 'pre-session strategy' considerations (Krueger & Casey, 2009) included handling group dynamics and inter-participant influence, in addtion to selecting processes to capture confirmation to the recording modus, of non-verbal agreements such as mutual nodding or 'show of hands' (Frey & Fontana, 1991).

3.2.5 Surveys

Surveys for data collection were used at a number of stages where a large sample size and geographical spread of target participants precluded usage of interviews or group discussions (Table 3.1). General considerations for development and use of surveys in the project are summarised below.

3.2.5.1 Choice of online survey

The choice was made to conduct online surveys for Study C and D. Initial factors considered were fitness for purpose, in addition to cost, time or resource in development, launch and collating survey results. Designing and building a survey now arguably takes similar time for both online and paper questionnaires. The cost is no longer prohibitive to developing an online survey with a number of free access, easy to use tools such as Survey Monkey™ (https://www.surveymonkey.co.uk). Considerations may be required regarding limitations in scope of features available in free software.

However costs of paper surveys such as printing, follow up communications and postage make it a 'higher cost method' than electronic contact and web-based surveys (Dillman, Smyth & Christian, 2014).

There are also specific advantages in utilising online surveys. Data can be easily downloaded into proprietary software such as spreadsheets and statistical analysis packages, negating collection of completed forms and manual entry requirements (Jackson & Furnham, 2000, Braun & Clarke, 2013, Online Surveys (formerly BOS), n.d.). Branching logic and routing features offered in contemporary survey software can ensure only questions pertinent to the individual are presented (Bradburn, Sudman & Wansink, 2004, Brace, 2013), reducing the presence of needless sections for the participant to handle in a paper questionnaire. Software also allows for personalisation of text, using information provided by the participant to potentially enhance survey engagement (Aldridge & Levine, 2001, Brace, 2013). The provision of mandatory questions (completion required before proceeding) ensures key questions are answered in online surveys, something that can be problematic in paper versions.

A key driver in completion rate of surveys is convenience to participate. To fully capture convenience, survey software and content developed should be fully compatible on personal computers and also hand held devices such as tablets and mobile phones (Brace, 2013, Dillman *et al.*, 2014, Maloshonok & Terentev, 2016). Most good quality online survey software now have the ability to recognize the mobile device and browser type and then to optimize the display accordingly (Online Surveys (formerly BOS), n.d.).

Mixing self-administered attitudinal surveys (i.e. online or paper) with any interview type survey (i.e. phone or face-to-face) should be avoided (Klausch,

Hox & Schouten, 2013). However in the past, a mix of both online and paper-based versions have been provided (Organization for Economic Cooperation and Development, 2016) aiming to accommodate low rate of familiarity with computers with sections of the target population to generate most success (Dillman *et al.*, 2014). However target populations in this project are considered highly familiar and comfortable with using computers, as either undergraduate students or employees in the food industry (line managers, recent graduates or recruitment consultants) and thus required to have sound IT proficiency levels to conduct day-to-day duties (Bradburn *et al.*, 2004).

Reviewing recent literature it was decided to utilise online surveys for the project in order to reach the target of UK-wide participants and supply them with format that was simple to use and submit. Online Surveys™ (https://www.onlinesurveys.ac.uk[19]) currently accessible in UoN, was selected as was anticipated as having the robustness, practicality and required features for this project. As an exception, a paper-based questionnaire was utilised to gather student feedback from teaching motivated by the requirement for capturing additional open comments during a specific classroom session. Specific details for this activity are provided in Chapter 8.

3.2.5.2 Survey structure

It was understood for the nature of this project, that a series of repetitive questions would be required in the surveys to assess competency desirability or inclusion. To limit survey length and avoid fatigue, additional questions were kept to the minimum (Bradburn *et al.*, 2004) by the use of routing, to divert the survey according to answers provided. The main content pages

[19] On commencing the project, Online Surveys™ was known as Bristol Online Surveys™.

were structured by a series of numbered subpages as illustrated in Figure 3.5. Surveys generally comprised an introduction, informed consent process, basic demographic questions, the main body of the survey and a conclusion with final opportunity for general comment. All surveys were designed to be completed in one stage (could not be saved part way). The use of a progress bar was initially avoided by heeding advice that they only encourage participants during short surveys (Brace, 2013). Progress bars would also cause confusion with surveys containing routing and options to repeat sections (Brace, 2013). Feedback gathered after inclusion of a progress bar in the pilot survey for Study C, supported the decision to omit it (see Chapter 6). Aligned to such suggestions, intermittent feedback can be more encouraging than constant information (Conrad, Couper, Tourangeau *et al.*, 2005), text comments were encouraging and varied on different pages.

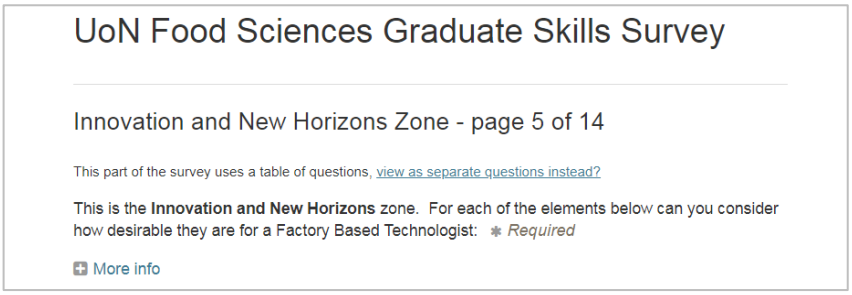


Figure 3.5 Example of the subpage structure of survey with numbered subheadings and 'More info' icon.

3.2.5.3 Anonymity

The use of a single URL (uniform resource locator) web link was considered the best opportunity to harness significant survey responses. For Study C in particular, the URL permitted industry contacts to forward the survey to relevant colleagues for participation by snowballing (Sapsford & Jupp, 2006). In addition, by design complete anonymity was therefore feasible, and survey

response rates can be improved when anonymity is assured (Jackson & Furnham, 2000). Bohlscheid and Clark (2012) utilise unique URLs or login requirements in a food science graduate survey, noting the advantage in tracking survey completion, something the use of a single URL cannot provide. However for this project, suitable survey demographic questions provided sufficient levels of categorisation, so the provision of anonymity was considered a more welcome option for potential participants.

3.2.5.4 Survey questions and format

Introductory text provided the participant with the background and aims of the survey and specified the criteria of who was suitable to participate. It also provided clear instructions on how to proceed (Cohen *et al.*, 2011). Supporting demographic questions were included in surveys to identify features of the participants using fixed response 'radio button' lists, a format that minimises the number of 'clicks' per question (Bradburn *et al.*, 2004, Braun & Clarke, 2013, Maloshonok & Terentev, 2016).

In project surveys for Studies C and D, it was planned for a significant number of competencies or items to be included for participant consideration by identical fixed responses, whereby they would be asked to state some form of importance or significance for each of them. The use of ranking for a large number of samples is considered difficult and potentially unreliable by authors such as Alwin and Krosnick (1985), Bradburn (2004) and Dillman *et al.* (2014). Correspondingly, ranking can be perceived by participants as harder work and less satisfying than attempting rating questions (Krosnick, 1999).

Use of rating scales for questions provided the participant with the ability to score each item discretely and the researcher, the ability to compare data quantitatively. It is an approach routinely used for assessing perceptions and

opinions (Cobb, 2015). Due to the number of questions to include, there was a risk of survey fatigue, however the use of numbered subpages aimed to focus and encourage the participant (Figure 3.5). A Likert scale is commonly employed for this type of attitudinal question, traditionally having a bipolar, symmetrical 'agree-disagree' scale with a neutral point in the centre (Brace, 2013). Krosnick (1999) has undertaken extensive examination of Likert scales and argues reliability and validity can be improved by use of a scale with labels including words as opposed to symbols or numbers. Choice between unipolar and bipolar scales should be directed by suitability to the construct being measured. The usual recommendation for a reliable unipolar scale is five or seven points considering participants' ability to discriminate and cognitive burden (Dillman *et al.*, 2014, Krebs & Bachner, 2018).

This project used modified unipolar five-point Likert scales with descriptive text labels, tailored to each specific Study undertaken (Chapters 6, 7 and 8). Use of similar scales in other academic studies include those to industry employers (Jones & Warnock, 2014) and to students (Bath *et al.*, 2004). Within the field of food sciences, an employer survey in 2006 (Morgan *et al.*) applies this type of scale, while Bohlscheid and Clark (2012) use them for surveys to graduates and their employers, and latterly Flynn *et al.* (2017) for European graduates.

The selection of ascending or descending order of scales was considered and there are conflicting thoughts in research and views. Betts and Hartley (2012) outline from their experience and others, subjects tend to naturally choose the first 'left hand' option in a closed question and suggest a number of reasons, including primacy effect (Maloshonok & Terentev, 2016). Dillman *et al.* (2014) refer to their previous research in 2009, whereby no difference was found in

responses to a web survey when questions were presented with the most negative or most positive category first, whilst Bradburn (2004) suggests putting the lower lever on the left. Krosnick (1999) has extensively studied 'order effects' on both horizontal and vertical rating scales and broader associated complexity of psychology of choice influence (Howe & Krosnick, 2017). It is commonly agreed rotating or flipping order of scale presentation within a specific survey is to be discouraged (Betts & Hartley, 2012, Dillman *et al.*, 2014) even if it does reduce pattern answering (Brace, 2013). Hege *et al.* (2007) switch scale direction between the two parts of the online student evaluation which may prove to stimulate students or create confusion. Brace (2013) asserts 'research' has shown order does have an effect but "does not say which order gives the best representation of the truth" (p.117). Taking all previously tested formats into account and understanding no finite option was preferable, ascending order was used for surveys in this project. Adjustment by variation of scale presentation could have been undertaken, however the consistency of data collected across the population for each survey was favoured to absolute accuracy. Detail of scales utilised for each survey can be found in relevant Chapters (6, 7 and 8).

At the end of each subpage questions with free text or open responses were included, to allow the participant to provide optional qualitative information, which may guide and inform closed responses (Converse & Presser, 1986).

Consideration of simple, accessible, unambiguous phrasing in the survey was made, and care was undertaken to avoid combining questions or use of connectives to ensure clarity of purpose (Converse & Presser, 1986, Bradburn *et al.*, 2004, Cohen *et al.*, 2011, Brace, 2013). Some employability based surveys aim to explore both current quality of graduate intake and

future desirability when assessing graduate employability (Kubler & Forbes, 2006). However for this project, context in surveys remained focussed on a single premise to reduce complexity using either, 'what is desirable' or 'what was included'. Explanatory text was provided at regular intervals by use of the 'more info' collapsible text box option (Figure 3.5) (Online Surveys (formerly BOS), n.d.). Due to the targeted nature of participants (food industry employees, graduates and students), confidence was sufficient to use an 'audience design' (Brace, 2013), including standard terminology used in graduate recruitment and food industry matters.

Brace (2013) outlines a number of potential issues to be aware of when using Likert type scales namely: order effect (see earlier), acquiescence (choosing the 'positive' answer), central tendency (avoidance of extremes) and pattern answering (ticking in a pattern on a page). The provision of consistent survey data in each Study, rather than absolute accuracy was considered the priority, so the first three issues were 'managed' as opposed to eliminated. The label definitions were readily available throughout the survey to encourage accurate use of scale. Choice of scale format in each survey aimed to reflect participants' likely electronic device of completion and thus create clarity for the user. With respect to pattern answering, flipping of scales was avoided (as already discussed) however to limit possible effect, dividing the total core questions into smaller numbered subpages and varying text headers aimed to encourage interest.

3.2.5.5 Development and launch of surveys

Successful survey design (Jackson & Furnham, 2000), "will depend upon the survey being comprehensive, user-friendly, succinct, unambiguous and relevant" (p.9), and consensus by survey methodologists suggests the

inclusion of a pilot survey to test and refine the final product (Foddy, 1994). The inclusion of a pilot stage may have prevented González-Martínez *et al.* (2015) adjusting their question scales part way through their investigation. Appropriate 'informal pilots' (2013) were performed as an integral process of survey development for Studies C and D (Chapters 6 and 7). Provision of a pilot questionnaire for participants to complete included aspects pertinent to the Study and suggestions from literature on areas to test namely: reliability, validity and absence of errors (Foddy, 1994, Brace, 2013, Braun & Clarke, 2013). Surveys were refined and finalised using a synthesis of feedback provided from the pilots. Launch of surveys for Studies C and D were largely by electronic issue of a single URL, accompanied by carefully constructed introductory messages to target participants (Jackson & Furnham, 2000, Aldridge & Levine, 2001). When survey launch methods were by electronic means, the requirement of a paper version of the survey was not developed. Past studies have refined surveys after launch, reissuing a new version midway (Flynn *et al.*, 2013a), however any possible benefits of improving data accuracy in latter stages was thought to compromise overall consistency. Target populations such as employers and students were understood to have access to the internet. Reminder communications were sent electronically at frequencies appropriate for each Study (Frankfort-Nachmias & Nachmias, 1996, Jackson & Furnham, 2000).

3.2.5.6 Data collection

Data from surveys conducted during studies C and D were downloaded from Online Surveys™ directly into spreadsheets for inspection and analysis. Data from paper based questionnaires employed in Chapter 8 (see earlier), were manually entered into a spreadsheet for simple evaluation.

3.2.6 Survey data analysis

The type of data obtained from questions in surveys undertaken during the project was ordinal; even though a rating scale was used, there was no proven equal distance between the scale points (Cohen *et al.*, 2011). The use of parametric tests with no evidence of equal intervals can be a found in literature (Waple, 2006, Hege *et al.*, 2010), but generally this should be avoided. Non-parametric statistical methods were applied to survey data analysis for this project (Kemp, Hollowood & Hort, 2009, Dillman *et al.*, 2014).

Specific details on the structure and design of surveys and subsequent statistical treatment of data for Study C (industry) and Study D (graduate) can be found in Chapters 6 and 7 respectively.

3.2.7 Curriculum mapping

The examination of UoN's undergraduate courses against a given framework or model was the purpose of Study D. Usually termed 'curriculum mapping', a review of literature on this subject was undertaken (section 2.3) to inform choice of methodology. To summarise findings, curriculum mapping usually requires prior understanding of how the curriculum will be categorised. A suitable process is chosen and if required, methods in place determined to quantify what is found and establish how to categorise what is found. Data collected are analysed and presented in a format best suited to reflect status and identify areas for development.

The initial requirements to frame curriculum mapping for this project were drafted following consideration of the literature review. Criteria used for mapping was the competency framework created in earlier studies of the

project. The scope was focussed on understanding the level of inclusion of elements in the framework in food science degrees at UoN.

There were numerous influences on the design of the curriculum mapping process for the project. Reflecting on Perera *et al.*'s (2016) use of an expert forum, it was decided to include the employer's perspective to the Study by adding a desirability factor to each item in the finalised framework. Past research also highlights the benefits of capturing the student voice to fully appreciate the enacted and learned curriculum (Bath *et al.*, 2004, Hege *et al.*, 2007, Kelley *et al.*, 2008, Spencer *et al.*, 2012, Ramia *et al.*, 2016). Involvement of teaching staff in course content analysis was integral to improving value to data collection beyond paper audits, and provision of supporting evidence and thus data reliability (Sumsion & Goodfellow, 2004, Tariq *et al.*, 2004, Spencer *et al.*, 2012, Lam & Tsui, 2016).

3.2.7.1 Curriculum categories

Choice of data to gather and the process of selection was finalised after a careful consideration of previous studies. Kelley *et al.* (2008) explains categories and the 'code' chosen for mapping should to facilitate the process by having meaning for staff involved, and be consistently used. As no clear single model was found from literature, the School of Biosciences internal categorisation 'TLA' system (taught, learned, assessed, section 2.4) was adapted for the mapping exercise. Although a fairly simple system, it was anticipated engagement of module convenors would be greater when using familiar vocabulary supported by enhanced definitions.

A suitable adaptation of 'TLA' was developed, mindful enhanced granularity of data collected could provide more effective differentiation. Collating learnings from the literature review such as assessing 'confidence' of inclusion

(Spencer *et al.*, 2012), discriminating between 'explicit' and 'implicit' inclusion (Arafeh, 2016) and levels of relationship to outcomes (Kelley *et al.*, 2008), a system of coding inclusion types in each module with associated numeric scale was developed.

3.2.7.2 Curriculum mapping process

The plan was to map each core module discreetly, for ease of application in both degree programmes and for flexibility in any future adjustments (Joyner, 2016). Whilst no formal review horizontally (over a single year) or vertically (progression during degree programme) was undertaken, the impact of the broader student journey during the three core years of study was planned to be included in some form. Remote paper based reviews by the mapping team were avoided in preference to one-to-one sessions with the appropriate module convenors (teaching staff).

The methodology was developed by the mapping team embracing approaches taken by a number of researchers including Kelley *et al.* (2008), Hale (2008) and Joyner (2016), and the final process selected is illustrated as a flow diagram in Chapter 7. Mapping protocol was issued in advance to module convenors, to provide opportunity for prior exploration of their module, reflection of content against the criteria and possible evidence for 'formal' inclusions (Sumsion & Goodfellow, 2004, Mossop, 2012). Hale (2008) suggests time should be provided during plans for review stages, to increase the reliability of any mapping exercise. To this end regular reviews were planned in the initial stages (Joyner, 2016) and after final data collation. After module mapping was completed, progression was undertaken by a larger team that included course directors.

Finally it was intended to use the UoN curriculum mapping system for recording purposes and to illustrate outcomes by heat maps (Hege *et al.*, 2010, Spencer *et al.*, 2012, Arafeh, 2016, Wijngaards-de Meij & Merx, 2018). Fuller details of the processes taken for curriculum mapping are outlined in Chapter 7.

3.3 TERMINOLOGY

As outlined at the end of the previous Chapter, it is necessary to trace the appropriate use of terminology during the project journey and a diagram was presented to support this endeavour (Figure 2.17). At this stage it has been confirmed for curriculum mapping in Study D, the code to be applied to categorisation of module inclusion will be based on the School of Biosciences (n.d.) 'TLA' system of 'taught', 'learned' and 'assessed', so and updated version of the diagram is presented (Figure 3.6).

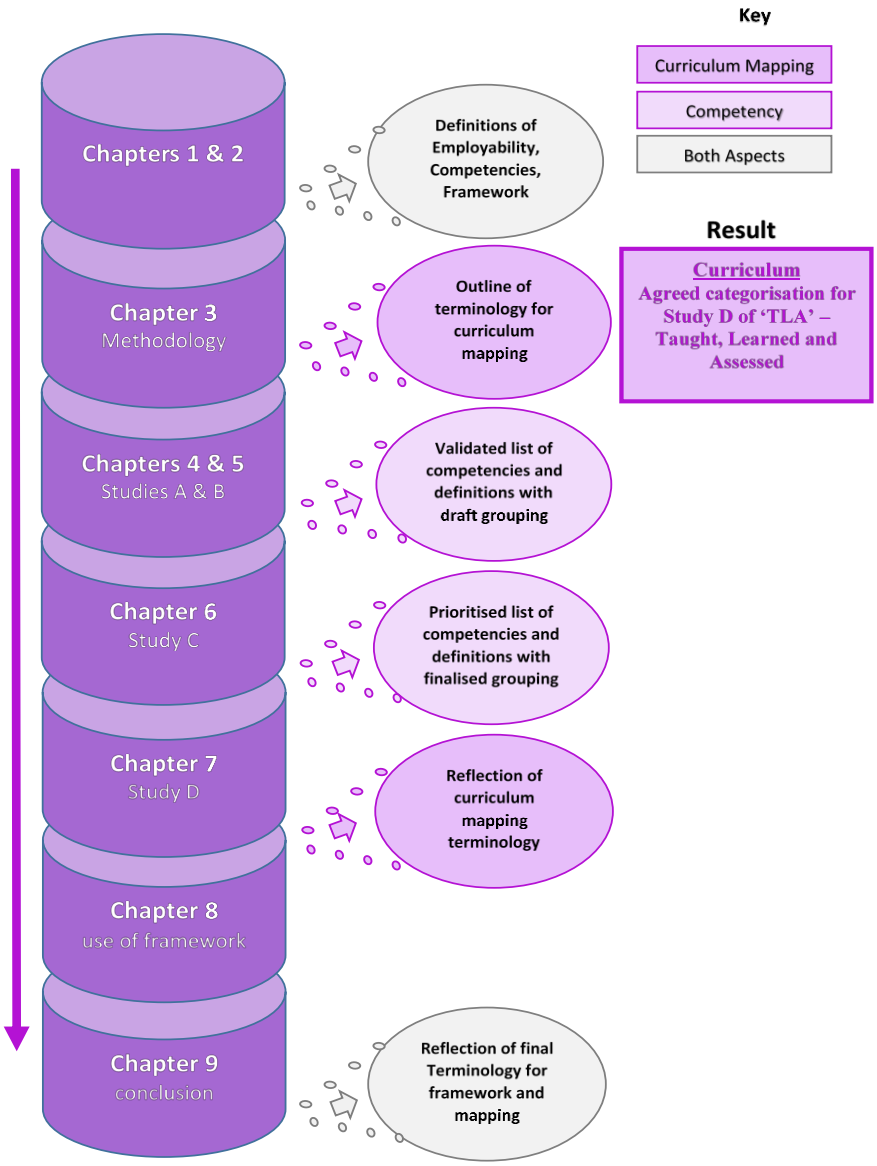


Figure 3.6 Diagram to illustrate the development of terminology and classification during the project, updated for Chapter 3.

3.4 ETHICAL APPROVAL

The project centres on attitudes and experiences from a variety of UoN students and staff, in addition to external participants such as students and staff at other institutes, as well as alumni and members of the food industry. Care was required to review potential impact of the research on those involved in the project. All plans for confidentiality, provision of information,

obtaining informed consent, data collection, analysis and dissemination of results were considered in advance of each stage, with reference to the latest versions of UoN Code of Research Conduct and Research Ethics. Sequential ethical approval was sought for project activities from the School of Sociology and Social Policy (n.d.) (approval codes SSP01-SB1516/06 and BIO-1718-0002). Examples of approved information and consent forms can be found in Appendix III. Activities that required consideration and approval are summarised in Table 3.4.

Table 3.4 Activities requiring ethical approval during the project

Study	**Activity**
Study A	Semi-structured interviews (industry)
Study B	Student field group interviews (multi-institute)
Study C	Online survey (industry)
Study D	Online survey (UoN graduates)
Chapter 8	Classroom questionnaire (internal)
Chapter 8	Student field group interview (internal)

Relevant approved participant information was provided at the start of each pertinent stage (online or in-person), to enable capture of informed consent before any activities commenced. Participants were aware they had the right to withdraw from an activity at any time. All paperwork associated with ethical approval and participant informed consent were retained throughout the project.

3.5 CONCLUSION

The researcher has undertaken the majority of the design, execution and data analysis of this project; where work has involved others it is stated in the

relevant Chapters. A significant amount of data obtained is empirical (Cohen *et al.*, 2011), posing risk to misinterpretation or subjectivity by the researcher. However in contemporary qualitative research there are many methods to address reliability by use of a systematic approach (Denzin & Lincoln, 2000) and inclusion of checks that can provide confidence in validity of results. These have been considered and included throughout this Chapter and the project. Considering reflexivity (Braun & Clarke, 2013, Creswell, 2014), the inclusion of the stakeholder group within the project allowed for a collaborative approach to decision making and progression of the framework development (Studies A, B, C). Academic team involvement supported key decision making in Study D.

In order to address project research questions, the initial use of qualitative research provided the refinement and relevance to the proposed language tool for use in quantitative research to develop the final framework. It was clear from early stages, the result of this mixed methods project would be a tailored tool, not one that is immediately transferable into other professions or degree subjects (Denzin & Lincoln, 2005). But it was imperative this tailored product would still be fit for purpose and valid for the context of food sciences degree education in the UK, so thought was given to the rigour and quality of design and execution at each stage of the project. Considerations of the generalizability of methodology developed in the project, to other subject areas or careers will also be made in subsequent Chapters (Creswell, 2014). With an aim to demonstrate confidence in choices, limitations and strengths identified in the studies undertaken will be clearly critiqued as appropriate.

Chapter 4 Study A - Construction of the Language Tool

4.1 INTRODUCTION

Chapter 2 introduced concepts and understandings of graduate employability, competency and past methodology employed to build models or frameworks to guide students, employers and educators. The overarching aim of this project is to provide such a framework to advise students, employers, and additionally, to shape degree course content. The first stage, Study A, starts to start to address research question 1, specifically,

> *Sub-question 1a. What is the universally understood language of the terms to define the key competencies?*

This Study included the stakeholder group in activities, in order to increase the validity and credibility of the project. Study A was undertaken to find commonly used terms industry stakeholders use to describe desirable graduate competencies, and the associated definitions they apply to them. The importance of terminology consistency in the project has been introduced in Chapter 2. Using the qualitative research approach described in the previous Chapter, a 'common language' (Spencer & Spencer, 1993, Evers *et al.*, 1998), or tool to outline ideal competencies for food science graduates was constructed. Once checked for validity (Chapter 5), this tool will underpin production of a competency framework outlining the types of competencies desirable in typical roles for food science graduates (Chapter 6). It is important to reiterate at this stage the scope of this Study does not include all the specific scientific and technical aspects of HE training in food science degrees as outlined in the QAA subject benchmark statement (2016) for food

sciences courses. It is focussed on the associated competencies or attributes an employer may desire in graduates to underpin these technical abilities.

4.2 APPROACH

As introduced in the previous Chapter, the work was exploratory in nature, so a qualitative approach was chosen for the first Study, aiming to establish, in detail, the perceived competencies required of food sciences graduates (Davies, 2007, Braun & Clarke, 2013, Creswell, 2014). In addition the Study sought to find the definitions participants associated with these competencies. The overall process for Study A is illustrated in Figure 4.1. Once the stakeholder group was selected, the process involved stages of preparation by the researcher to develop the appropriate materials for conducting the research. This was followed by individual stakeholder involvement in the form of 'semi-structured' or 'focussed' interviews (Frankfort-Nachmias & Nachmias, 1996, Keats, 1999, Davies, 2007, Brinkmann & Kvale, 2015). Thematic analysis (Braun & Clarke, 2013, Brinkmann & Kvale, 2015) was performed on the resulting data, then using a modified Delphi group engagement activity (Sobaih *et al.*, 2012, Johnston *et al.*, 2014) findings were consolidated. The use of similar combinations of methods has been conducted to build competency frameworks, exemplified by work from Bok *et al.* (2011) comprising a focus group for data collection, transcription, coding and finally generation of consensus by a modified Delphi procedure using an expert panel.

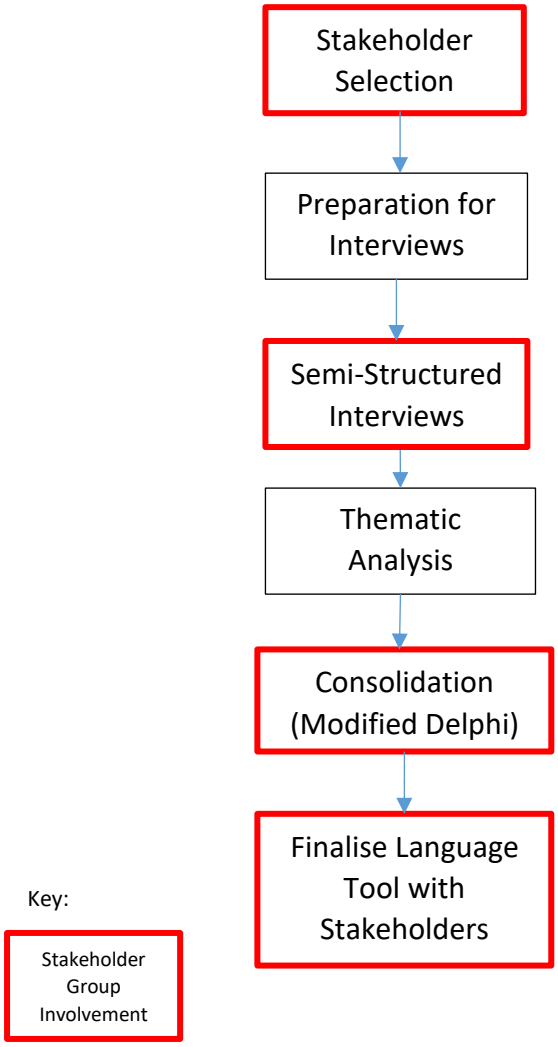


Figure 4.1 Overview of approach taken for Study A.

4.3 METHODS

The Study was conducted between September 2015 and July 2016. The required ethics approval (section 3.4) was obtained for the process and materials used for the Study. Stakeholders selected as described in section 3.2.1, were directly involved in the semi-structured interviews, consolidation and finalisation stages of this Study.

4.3.1 Preparation for interviews

A guidance tool was constructed for use in the qualitative interviews which provided a range of prompts as opposed to a complete or prescriptive list. Discrete documentary analysis was undertaken, to establish a range of terms used to articulate skills or desirable competencies for a graduate to possess. A core representative list or 'lexicon' was then constructed (Lawless & Civille, 2013). Tariq *et al.* (2004) consult a range of 'background materials' when building a module auditing tool and recently Gomez *et al.* (2016) conducted a literature review to choose the competencies to include in a survey of students after completion of a placement year.

Information sources included a range of material; student careers guides, government body and HE material as well as industry publications on graduate competency, many mentioned previously. Currently accessible books for students were inspected for example, 'Brilliant Employability Skills' (Trought, 2012). The 'four core skills' from the 'Dearing Report' were included (The National Committee of Inquiry into Higher Education, 1997), and a report from one of the annual CBI (2011) Education and Skills Surveys to employers. As there was no institutional-wide employability student competencies at UoN, a tool recently developed for undergraduate students in the School of Biosciences (n.d.) was included.

During the documentary analysis, no food industry specific lists or models for graduate employability competencies were identified. As referenced in the literature review, European ISEKI projects have included some 'soft skills' in their broader review of food scientists and technologists (Flynn *et al.*, 2013b), however no final model or list was published at the time. As 'communicating

skills' and 'working with others' were items prevalent in articles, they were factored into considerations (Flynn *et al.*, 2013b). The book on food science careers from the USA (Hartel & Klawitter, 2008) does not contain any accessible reference material or models of graduate skills.

Data was collated in a spreadsheet and groups of skills or competencies were gathered aiming to construct a list of standardised vocabulary or a 'lexicon' of terms for supporting interviews. This lexicon was designed to support and prompt the interviewer during these sessions.

4.3.2 Semi-structured interviews

The aim of the interviews was to ascertain from participants the types of competencies or attributes they most desire in food science graduates and how they would describe those terms. Section 3.2.2 explained the choice of a semi-structured or focused interview. The interview process and script were developed, using the support of a combination of internal documents and externally sourced references (Keats, 1999, Davies, 2007) for key aspects including the introduction, explanation statements and a range of suitably probing questions or phrases to use.

A structured list of questions or ordered list of terms were not used, as this may have restricted the participants' outputs. The aim was inductive, (Mossop, 2012, Brinkmann & Kvale, 2015), to gather the subjects' experience of the topic and not to complete a defined task list. The lexicon constructed was used to support the script as required but not to restrict open suggestions from participants. The script was designed to ask participants to verbally list the competencies they valued in a graduate and then to probe items in the

participants' 'own list', sequentially with simple feedback loops to allow the participant to talk freely about a specific term or group of terms (Keats, 1999).

A few weeks before starting interviews, the script and the lexicon were tested in a full scale pilot exercise interviewing a colleague with a general understanding of the topic, adhering to the planned timing of one hour supported by audio recording and transcription. Reflecting on this exercise the material was refined as deemed appropriate, an example being that of adding variety to wording of questions.

Participants were asked to talk about the attributes they believed essential for a graduate to possess to be successful in the type of roles they employed. The researcher logged a list of these attributes. Then they were asked to define the attributes on the list they had generated. If this was initially difficult the interviewer provided assistance, but did not suggest a solution. Once the participants had discussed all the competencies they had listed, additional items from the lexicon were raised by the interviewer. As appropriate, a participant's choice of terms and definitions for these new items were captured. Later interviews were adjusted in areas of focus until 'saturation' was achieved (Braun & Clarke, 2013). All interviews were audio recorded and additional notes made by the interviewer, predominantly to capture and track the participant's initial list during the interview.

4.3.3 Thematic analysis

Section 3.2.3 introduced the inductive approach to coding data and finding threads or groups, and for this Study as the aim was to generate a "rich description of the data set" (Braun & Clarke, 2006) as opposed to interrogation of one particular aspect. Spencer and Spencer (1993) create a

'competency dictionary' by coding of findings, which is a process aligned to the aims of this Study. The procedure was developed with reference to literature (Barrie, 2007, Denzin & Lincoln, 2000), but largely aligned to Braun and Clarke's (2006) suggested phases of thematic analysis (Figure 4.2).



Figure 4.2 Reproduction of Braun and Clarke's (2006, p.87) suggested phases of thematic analysis.

Raw data was fully inspected to make sense of the data and understand the broader messages in the material (Creswell, 2014). The coding process was supported by NVivo™ software and all data resided in the created 'project' for simplicity, future reference and auditing purposes. Transcripts were reviewed and corrected as necessary before uploading to NVivo™, in addition to the hand-written notes from each session, so all material could be directly coded in the 'project'. Material from initial interviews was reviewed and initial codes or nodes[20] were created in a list to collect the data. Thematic analysis was then used to examine these transcripts in full (Braun & Clarke, 2013). Where

[20] Codes in NVivo™ are termed nodes.

information was found associated with relevant attributes, it was copied into the relevant node in the nominal list and new nodes were created if any new categories were found in the raw data. The code list was cross-checked by an independent party (colleague 'a') as a triangulation process and any necessary amendments made. It was permitted for the same material to be copied into a number of nodes at this stage to ensure comprehensive use of the data set.

To support the aim of gaining the desired breadth and quality of material, the transcription and thematic analysis commenced as soon as the first few interviews were completed. Breadth and quantity of material gathered for types of competencies was assessed, using the lexicon as a guideline for coverage. Subsequent interviews ensured any gaps found were targeted in later parts of the session, to provide more data if possible.

Once all data was uploaded and initially coded, focus moved to consider how different nodes or areas may combined to form an overarching item or element (Braun & Clarke, 2006). No pertinent material was abandoned without prior consideration of reassignment or consideration in the later consolidation process. Using the basis of 'underlying intent' (Spencer & Spencer, 1993), groups or clusters of refined elements were identified and given provisional names.

At this stage, for quality control or validity purposes one of the interview transcripts was analysed by an independent party or 'external auditor' (Creswell, 2014), experienced in qualitative research using the same coding system established for the Study. A final review of the analysis and construction of a report completed the thematic analysis.

4.3.4 Consolidation process

Choice of consolidation methodology (section 3.2.3) comprised construction of a preliminary report to share with stakeholders (interviewees) as a form of respondent validation (Mays & Pope, 2000), followed by a modified Delphi process (Sobaih *et al.*, 2012) in the form of an online forum to achieve consensus and thus the final language tool.

The report divided the elements into a number of groups highlighting aspects where there remained lack of agreement or clarity in particular competencies and was sent to stakeholders in advance of the next stage. An online focus group comparable to a modified Delphi technique (Johnston *et al.*, 2014) was held over a period of five days, using a simple forum construct created for purpose within the UoN e-learning platform (n.d.-d).

The aim of the five day forum was to ratify competency names and definitions already drafted in the report and also debate any terms or definitions that were yet to be determined. On the first four days, items were posted for each 24 hour period. Information on material gathered was included for each topic, alongside a specific question for discussion for the stakeholder group. Only minimal facilitation was required by the researcher. At the end of each session the material against each posting (discussion thread) was analysed by the researcher on a discrete basis, and if a clear action or agreement was generated in the material a conclusion was posted at the end of the discussion thread and the topic ‘closed’.

4.3.5 Finalisation process

Final data was reviewed alongside relevant literature on competency frameworks (Parry, 1998, Miller *et al.*, 2001, Johnston *et al.*, 2014). Supported by relevant literature (Parry, 1998, Evers *et al.*, 1998, Yorke, 2004, Lauby, 2013, London School of Economics and Political Science, 2013) and growth of understanding during the Study, choice of terms to be used for group labels and types of elements were proposed.

A summary report was prepared and presented to a number of the stakeholder group in a round table discussion at Sutton Bonington campus for agreement. The name of the language tool was also agreed. The session supported completion of the final framework document and associated terminology to use. Further discussions were also held regarding the future use of the report and subsequent stages of the overall project.

4.4 RESULTS

4.4.1 Building the lexicon

Groups and terms were collected from a final selection of 13 literature sources listed in Table 4.1; examples of where items or terms were sourced are included.

Table 4.1 List of resources used to create the lexicon used for interviews

Resource and reference	Examples of terms or items identified
Ambition 2020: UK Commission for Employability and Skills (2009)	Planning and Organising; Problem Solving
Being the One with Their Foot in the Door: Price Waterhouse Cooper (2010)	Commercial/Financial; Adaptive
Biosciences Core Graduate Competencies: University of Nottingham (n.d.-a)	Digital Literacy; Social and Society
Brilliant Employability Skills. Trought (2012) (Figure 2.14)	Positive Attitude; Teamworking
Education and Skills Survey 2011. Confederation of British Industry (2011)	Oral Literacy; Improving Own Performance
The Dearing Report - Higher Education in the Learning Society. The National Committee of Inquiry into Higher Education (1997)	Application of Numeracy; Communication
The Employability Challenge. UK Commission for Employment and Skills (2009)	IT Skills; Punctuality
Employability Skills Explored. National Centre for Universities and Business (2015)	Self-Management; Entrepreneurism
Employers' Perception of Graduate Employability: Analytical report. Gallup Organisation (2010)	Sector Specific Skills; Clear Written Work
Graduate Employability: What do employers think and want? Archer and Davison (2008)	Decision Making; Confidence
How to Use Your Degree to Secure a Job: Kaplan's guide to core skills and employability. Sumner (2012)	Cultural Sensitivity, Innovation
Student Employability Profiles: A guide for employers. Kubler and Forbes (2006)	Emotional Intelligence; Work Experience
What Do Graduates Do? Higher Education Careers Services Unit (2014)	Leadership; Flexibility

Different sources employed a range of phrases to highlight similar 'skills', so these were grouped and a nominal term chosen for simplicity. Material was categorised into a nominal lexicon of 16 types of graduate attributes as guidance for conducting the interviews. This categorisation was based on typical sections in reference texts used for the literature review (Gallup

Organisation, 2010, Sumner, 2012, Trought, 2012, Higher Education Academy, 2015):

- self-management
- teamworking
- positive attitude
- business and commercial awareness
- problem solving
- communication and literacy
- communication skills
- application of numeracy
- application of IT - computer literacy
- entrepreneurialism
- global outlook
- social awareness
- academic skills
- subject/job specific skills
- past workplace experience
- personal development

This lexicon allowed the interviewer to prompt further discussions within each area, but was not explicitly shared with the participants or used in any particular order, as this may have influenced the data gathered. However it formed a useful tool for the researcher to check progress during an interview.

4.4.2 Interviews

Initial confidence was established by inspection of the raw data during the first few interviews for the quality and richness of material for each theme or area of the lexicon (Cohen *et al.*, 2011, Braun & Clarke, 2013). By commencing initial coding of the first five interviews, it allowed for any required refocus in subsequent interviews to be undertaken. A point of saturation with regard to quality of data against nodes of interest, was reached after six months and 12 interviews of approximately one hour in duration.

4.4.3 Thematic analysis

Following careful inspection of transcripts for clarity and quality, then collation of all additional items, data finally imported into NVivo™ comprised the following materials:

- 12 Transcripts of the interviews.
- 12 Sets of notes made by the interviewer supporting the transcription.
- Any miscellaneous material specifically shared or referred to by participants during interviews for instance, company frameworks.

Initial inspection of data revealed sections of confident articulation of terms and definitions whilst other material was more confused or vague. Later interviews were adjusted to address any particular aspects required. A list was also compiled from each of the transcripts taking the terms initially raised by participants themselves as important for an excellent graduate to possess. These were then used for cross-checking purposes to ensure these terms were captured within resulting coding where appropriate.

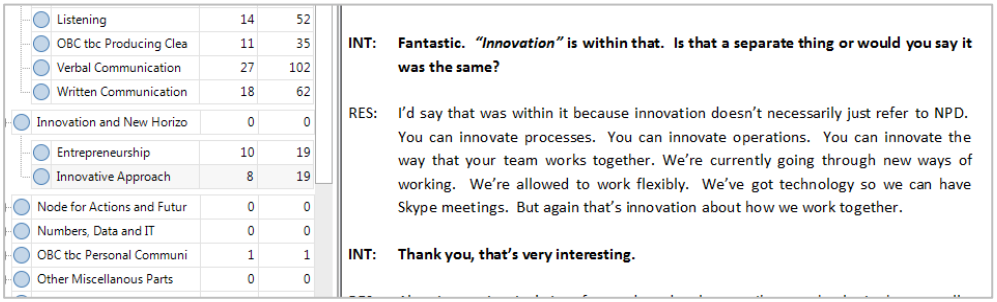


Figure 4.3 Screenshot of NVivo™ in later stages of the Study showing an example of material assigned to the node 'innovative approach'.

Coding for all interviews was fully completed, establishing:

- All gathered material pertaining to a particular term.
- Suggestions where agreement for terms or definitions were found.
- Disagreement or ambiguity in material for terms or definitions.
- Absence of material or no perceived relevance to a particular term.

At this stage data was coded into 64 individual elements (nodes) and 13 groups (Figure 4.3). The groups were drafted based on underlying intent and using interviewees own categorisation, or that developed during thematic analysis, for example 'working with others'. In addition any definitions provided for elements within transcripts, were analysed in detail and proposed phrases to characterise each element drafted.

An external auditor performed a cross-check by coding a single interview transcript 'LCO', Large Chilled Own-Label (Table 3.3). Results were compared and reviewed against the researcher's original coding; no concerns were identified.

The individual element*s* and groupings (and names of the groups) were further refined by the researcher, at which point some terms were merged and others highlighted as unclear. Rationale included:

- Merging of individual items with evident similarity in term or definition.
- Subsequent adjustment of groups of items until clarity was achieved.
- Provision of draft labels for groups.
- Identification where the definition of a particular skill remained inconclusive.

Material now comprised of 48 items assigned to one of 11 groups, and alongside any remaining points of query, were included in a preliminary report. The use of the word *element* to describe individual competencies had also commenced.

4.4.4 Consolidation

20 points were highlighted in the preliminary report issued to stakeholders that were considered to be in need of further review or development and are listed in Table 4.2.

Table 4.2 The 20 topics raised in online consolidation forum and associated outcomes.

Group	Items or *elements*	Focus raised in discussion	Outcome agreed in forum
Behaviours	*positive attitude*	Definition	Definition agreed
Behaviours	*open-minded*	Definition	Definition agreed
Behaviours	*confidence*	Definition	Definition agreed
Behaviours	*self-motivated* 'or' *energy*	Choice of name and definition	Removed energy. Definition agreed
Behaviours	*reliability* 'or' *commitment*	Choice of name	Removed commitment
Behaviours	*questioning approach* 'or' *enquiring mind*	Choice of name	Name agreed *questioning approach*
Behaviours	*adaptability*	Definition	Definition agreed
Problem solving	*decision making*	Definition	Definition agreed
Working effectively	*personal responsibility*	Which group to be in	Moved to *behaviours* group
Working effectively	*independence? patience?*	Should these be added to the list?	Removed patience from scope. Kept *independence*
Communication	*verbal communication*	Definition	Definition agreed
Communication	*written communication*	Definition	Definition agreed
Working with others	*leadership*	Definition	Definition agreed
Working with Others	*networking and relationship building*	Definition	Definition agreed
Numbers, data and IT	*digital literacy*	Definition	Definition agreed
Innovations and new horizons	*entrepreneurship*	Definition	Definition agreed
Worldwide perspective	*cultural sensitivity*	Required?	Definition agreed
Technical and workplace	*work experience*	Definition	Definition agreed
Social, political and environmental appreciation	*values and credibility* (and include company fit in scope?)	Definition and Scope	Removed company fit from scope. Definition agreed
The business world	*the commercial market and supply chain*	Choice of Name	Name agreed *commercial awareness*

Using the online forum, discussion topics were posted in batches of five, over 24 hour sessions to allow stakeholders to respond and discuss together with facilitation from the researcher. Of the total stakeholder group of twelve, nine were able to participate.

An example of a typical discussion thread recorded for refining the defining of *confidence* can be found in Appendix IV. If further work was needed or a new action generated, this was captured and the topic re-introduced on the final fifth day. A tracker managed the process during this stage.

Three of the 20 topics were re-posted with an additional question or point of clarification on the fifth day. The name for the framework was discussed as a separate topic. A final tracker of all comments and conclusions was completed at the end of the forum period for reference and the results of the session can be summarised as:

- Movement of one of the *elements* to another group.
- Agreement of final names of three *elements*.
- Completion of a number of definitions.

To initiate the process of choosing an appropriate name for the language tool, an additional topic was posted during the final day asking for suggestions which were then supplied to the next stage.

4.4.5 Finalisation

All outcomes of the language tool consolidation were approved in the round table discussion in September 2016. Consideration of the use of terms and title for the language tool comprised an open discussion, supported by material supplied to the session. It was considered important to establish a

suitable title which resonated effectively with target readers such as students and employers. In summary it was agreed:

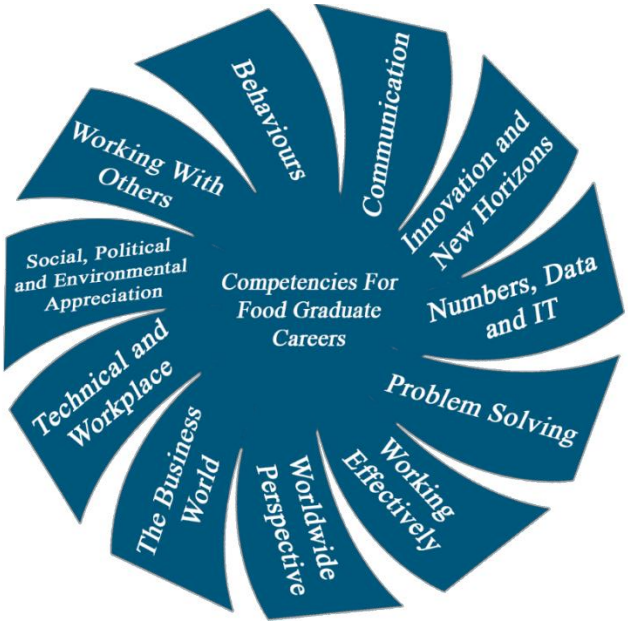
'Competencies for Food Graduate Careers' (CFGC) contains 11 *zones* with a total of 48 *elements* categorised as either behaviours, skills or knowledge. Terms used to support the framework have been clearly outlined in Table 4.3 and will be discussed later in the Chapter.

Table 4.3 Glossary of terms established for use in the competency framework developed during the Study.

Term	Study definition
Competencies	A set of knowledge, skills and behaviours that are required to successfully perform in a given role.
Behaviours	These are elements of how a person conducts themselves and operates in the workplace.
Skills	These tend to be learned proficiencies and indicate the capability to be able to carry out an operation or task. They can be innate but in general can be improved on with development opportunities (such as experience, teaching or training).
Knowledge	A theoretical or practical understanding of a subject. It does not means a person can actually perform a task but they should be able to describe it or write about it correctly.
Abilities	Inherent qualities that can influence the speed or effectiveness in developing or gaining skills, knowledge and behaviours.

A suitable 'pinwheel' diagram for the framework was created in advance of the session, and an example with the new title added is illustrated in Figure 4.4a. The names of each of the *elements* within a *zone* are displayed as a 'feather', shown by the example in Figure 4.4b.

(a)



(b)

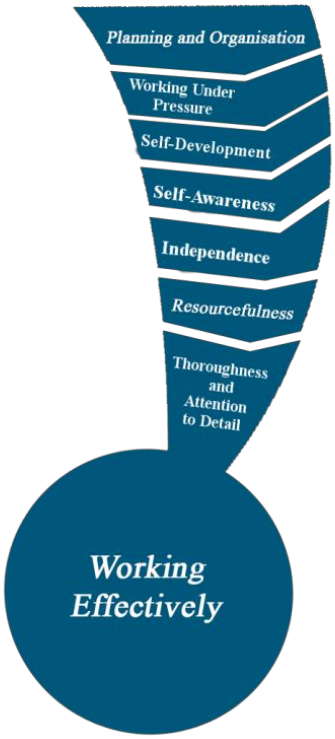


Figure 4.4 (a) Diagram of CFGC noting the title and the 11 zones, (b) Feather from a single Zone *working effectively* noting all the elements it contains.

To provide further detail within a *zone,* the definitions of each *element* were tabulated as illustrated in the example of Table 4.4**.**

Table 4.4 Definitions for elements in the *working effectively* zone.

Planning and Organising	
Definition	Remaining in control of activities under your responsibility and completing tasks to agreed deadlines.
Working Under Pressure	
Definition	Establishing your personal approach to balancing demands and challenges in working life.
Self-Development	
Definition	Owning your own future development in your current role and beyond.
Self-Awareness	
Definition	Understanding what you can do well and how you may be perceived by others and then developing your contributions and behaviours positively.
Independence	
Definition	Capacity for self-directed operation.
Resourcefulness	
Definition	Finding a way to achieve your goals and overcome problems.
Thoroughness and Attention To Detail	
Definition	Meticulous, careful and accurate.

A summary document was prepared (Appendix V) for use in Study B collating the elements and definitions for each zone. Finally for internal use, a more detailed CFGC Language Book was constructed containing a detailed matrix for each *element* (example in Figure 4.5), which includes relevant quotations from stakeholders and pertinent examples for students on how they may be able to develop or articulate the *element.*

Resourcefulness	
Definition	**Finding a way to achieve your goals and overcome problems**
Some examples of this element	• Forgetting your USB for a talk and having to deliver it without Powerpoint! • Finding out who can help you best when taking on a task in a new company you are working for. • Not going to your line manager or mentor with problems. Where possible go with ideas and possible solutions. • Not relying on having direct reports to get others to help you achieve a goal. • Thinking on your feet in a crisis; what do I do next and how do I do it? • Managing a reduced budget and still providing the core outputs for your department.
Relevant quotations	"...it is about thinking around a problem before just throwing it up in the air and just saying 'I've got a problem, come and help me?' " "It's the whole thing, yes. It's how you go about doing things." "No matter what circumstances, you'll find a way out of the problem." "In a particular situation you might have to try and fall back on something else that you might have in your armoury somewhere or, again, going and drawing on a person who might not be the obvious, not the line manager." "So, I guess, thinking laterally, thinking broadly." "Can you take a challenge, go away and come back with either a way you're going to approach solving it, or a solution?"

Figure 4.5 Example of a page in the detailed CFGC Language Book.

4.5 DISCUSSION

The aim of the Study was to provide a language tool to describe the types of competencies that may be desired in a food sciences graduate. The resulting output of CFGC is believed to have the correct level of context to be of value for educators, employers, students and graduates in understanding the type of competencies that may be desirable in food sciences graduate. This work

may help to embed a consistent language for student development and graduate recruitment, for all food industry stakeholders to embrace.

Over the course of the Study it was interesting to note that some *elements* captured were similarly defined by most stakeholders, for example *planning and organising*, whilst others required further examination and review in the online forum to agree the names for *elements* and their associated definitions, which included *leadership*.

4.5.1 Strengths and limitations of Study A

4.5.1.1 Sampling

As a sample of the target population was used for the Study, the subject of generalisability (Muijs, 2011, Mossop, 2012) requires careful consideration. With regard to the methodology selected, the researcher understands that using 12 stakeholders as participants is unlikely to represent all the views from the UK food industry with regard to food science graduate competencies. However the conscious choice of participants from different business types, sizes and roles within the supply chain aimed to provide the most sensible approach and thus a stratified sample. A wider sample size could be used in such a study, but consideration would be required for the value, versus the additional time and resource required to conduct the interviews and analyse the data.

4.5.1.2 Methodology, validity and reliability

Choice of a pre-piloted, semi-structured approach to interviewing was used in order to gather exploratory data accompanied by associated support of prompt material. The pre-designed lexicon to encourage a participant's ideas

and to ensure overall capture of commonly published terms in 'graduate skills' was considered beneficial. A number of the terms in CFGC were not in the original lexicon, as they were gathered from the interview material, so the concern of possibly leading the participant by suggesting terms appears to have been avoided. Audio recording and transcription was thought to contribute significantly to successful data collection and thus validity of results; manual recording of responses by the interviewer would, on reflection have delayed progression of the interview and inevitably causes loss of data quality (Cohen *et al.*, 2011).

Using proprietary software such as NVivo™ for the thematic analysis, supported thorough use of interview transcript material, was relatively easy to use. It also served as a flexible repository and location for inductive analysis of the data and supported Study reliability. The inclusion of two stages of quality control in the form of the triangulation or cross-check process (Bell & Opie, 2002) of the initial code book and then the independent coding of one of the transcripts by an external auditor (Creswell, 2014), increased confidence in the thematic analysis process. By the inclusion of a group consolidation process, respondent validation (Mays & Pope, 2000) of data generated by thematic analysis, was achieved. The facilitated online group forum, proved to be a simple yet effective method to discuss topics and the provision of a 24 hour window to engage in each topic, accommodated for a participant's other commitments and time pressures. Consensus was confidently gained as prescribed by a Delphi technique (Bok *et al.*, 2011, Sobaih *et al.*, 2012). Data were collected and stored automatically from the discussion threads providing accurate records.

4.5.1.3 Comparison to other studies and frameworks

Looking at similar previous approaches to compiling such a language tool, Enz *et al.* (1993) uses 'card-sort methodology' and a set of structured questions to capture types of competencies for career success from recruiters and employers of their hospitality-based postgraduates. With regard to the food industry, the ISEKI studies (Flynn *et al.*, 2013b) use a predefined list of 'skills' from Ho *et al.* (2011) to conduct 'brainstorming workshops' with employers to seek desirable staff skills (not graduate specific) across Europe in 2013. Study A is both graduate specific and has captured employers' perspectives of desirable competencies to tailor the list.

With respect to use of terminology, since completion of this Study, Joyner and Stevenson (2017) in the USA have outlined the development of a new food quality management module, utilising the views of industry experts. The methodology in part is similar to this Study, with use of a modified Delphi approach, however of interest is the consideration of literature to provide details of 'knowledge, skills and beliefs' of importance. It is encouraging that it is similar to the expressions agreed for CFGC.

Comparing the outcomes of Study A with the literature reviewed to develop the lexicon, there are similarities to be seen in a number of areas. Unsurprisingly the inclusion of some of the commonly used competencies (*elements*) in the workplace mirrors lists provided in a number of sources (Miller *et al.*, 2001, Sumner, 2012, Trought, 2012, Higher Education Careers Services Unit, 2014)

Comparison with the QAA subject benchmark statement (2016), can be conducted by reviewing supporting text and detailed matrices for 'generic

skills', the seven topics are listed in Table 2.2. Taking any additional points of note from the food science 'subject specific section' into account, and applying discernment to possibly associated terms, in total 27 of the 48 *elements* in the new CFGC language tool were found. *Elements* missing in the QAA statement include, *working under pressure, independence, resourcefulness, multicultural workplace, resilience, emotional intelligence* and *networking and relationship building.* It should also be noted that as it is primarily a reference document, the material is not presented in an accessible fashion for students.

Perhaps to be expected there is variability within all sources and no single tool or framework reviewed matches another identically, including CFGC. This may reflect the focus (such as a specific vocation), intended use of the material (such as a more generic guidance tool for all graduates) or the relative contemporary popularity of certain competencies. Looking at how some of the *elements* or terms are grouped, again there are similarities and variations between material (including CFGC) and this includes the names given to these groups such as 'communication' and 'working with others/teamworking' (Sumner, 2012, Higher Education Careers Services Unit, 2014, Higher Education Academy, 2015).

In summary, this Study was aimed to develop a language tool for use in the UK food industry, and CFGC is believed to be tailored for this. Firstly, the choice of *elements* that are included has been informed by the stakeholder interview process. In addition, the whole of the Study has allowed for definitions to be developed for each *element,* aimed to resonate effectively with all stakeholders of a graduate's early career in the food industry.

4.5.2 Development of framework terminology

On completion of Study A, the following terminology has been applied; Competencies for Food Graduate Careers (CFGC) is a language tool containing 48 *elements,* of which 15 were classified as *behaviours* and the remainder, either *knowledge* or *skills* (Table 4.3). The additional term, *abilities* was provisionally agreed as those qualities that influence development of the *elements* of the CFGC. It was also agreed at this stage for *elements* to be grouped into 11 *zones*. The diagram constructed to track project terminology development (Figure 3.6) has been further updated with these developments and can be found in Figure 4.6.

The original working definition of competency (section 2.6.1) as, 'a skill or attribute needed to do a job' has been extended to reflect CFGC's structure of a number of elements, so is now 'a set of knowledge, skills and behaviours that are required to successfully perform in a given role' (Table 4.3).

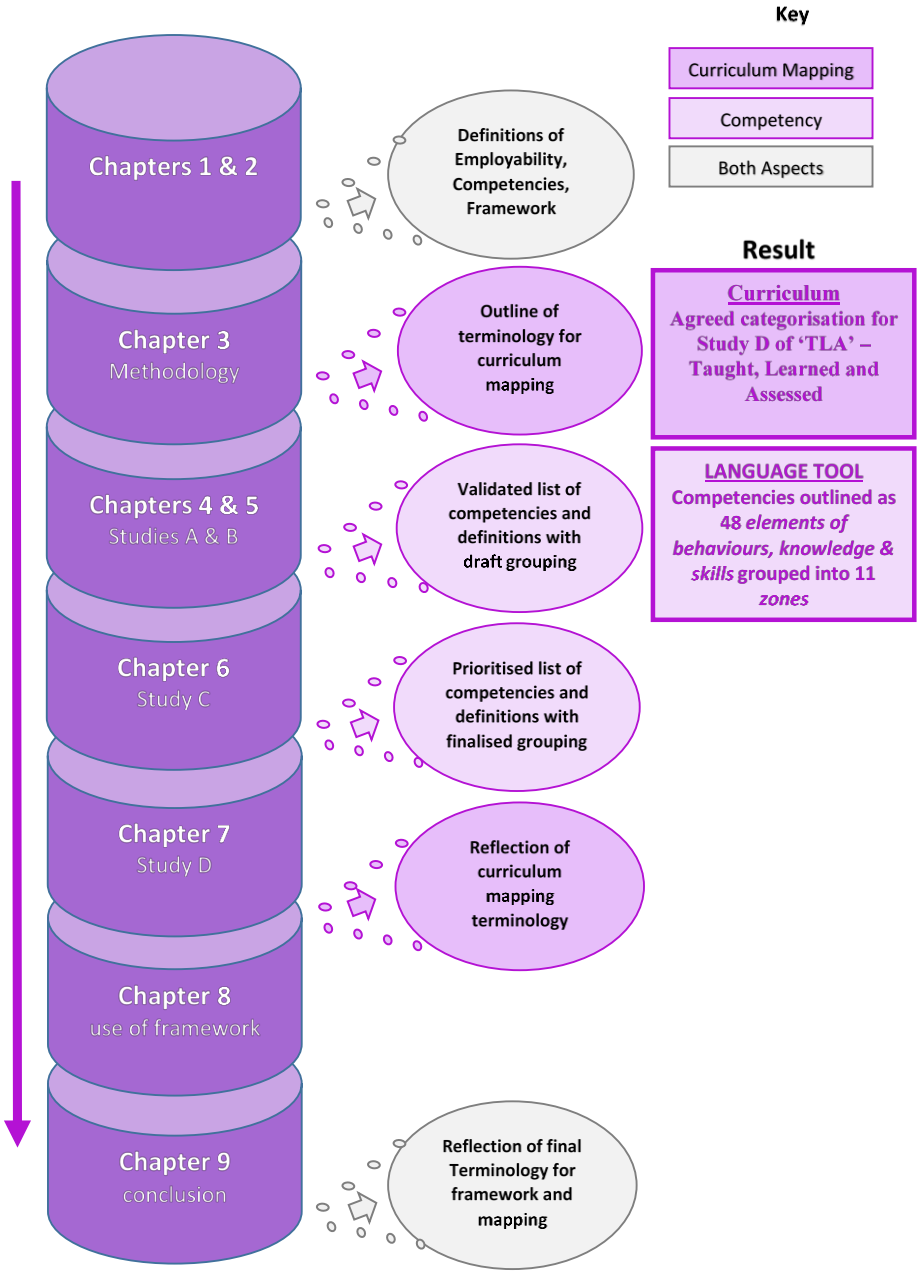


Figure 4.6 Diagram to illustrating progress of framework terminology at the end of Study A where Competencies for Food Graduate Careers is created.

4.6 OVERVIEW AND IMPLICATIONS OF STUDY A

The language tool comprises of a list of 48 competencies or *elements*, providing a tailored, consistent and relevant set of behaviours, knowledge and

skills that may be desirable in a food sciences graduate. In establishing a language used to define desirable food science graduates entering the food industry, CFGC provides an objective and useful reference for educators, students, graduates and employers. Involvement of stakeholders throughout the process has proven to be a prudent choice in gaining the breadth of sample material required. The selection of a range of stakeholders was also important to the credibility and validity of the Study.

Following the thematic analysis of interviews, the online forum for consolidation developed for use in the Study gave rise to a methodical and appropriate way for a group to evaluate refined data and ensure balanced results. In particular, shared, remote access and flexible timing of communication during the forum was valued, and the production of discussion threads for each topic provided effective data capture. It may be feasible for others to follow a similar process to develop language tools or frameworks pertinent to their graduates' typical career pathways.

This language tool informs all future stages of the project.

In the next Chapter the validity of CFGC is tested in more detail (Study B), introducing the material to a key stakeholder, the student. The next phase of the overall project is to determine what the most desirable *elements* may be for typical graduate entry roles, using an industry survey (Study C). Described in Chapter 6, integrating the language tool material into a wider industry survey, increases confidence in the relevance and quality of material gathered in the final framework.

From a HE perspective, using a case study at UoN, the CFGC framework is utilised to facilitate an informed reflection on food science degree course

curricula (Study D). Curriculum mapping results and future planned developments are outlined in Chapter 7. Degree providers can also use CFGC framework as a tool for undergraduates to recognise and develop key competencies desirable in a graduate entering the food industry. This was considered a valuable outcome of the project so introduction of CFGC to UoN students for careers support and personal development is presented in Chapter 8.

Finally CFGC is also hoped to be of some value for employers in the development of job specifications and role profiles with appropriate and consistent terms and definitions for attracting new graduates to their companies. Feedback from stakeholders suggests demand for such a competency framework, particularly in light of the skills shortage in the food industry as introduced at the start of Chapter 1. If consistent terminology is included in advertisements, students may target the right jobs to apply for and also may be able to articulate possession of desired competencies with more success. It is in the interest of all parties for the 'right candidates' to apply for the 'right job'. Initial work with employers is introduced in the final Chapter. The prospect of using consistent terminology for articulating desirable competencies tailored to food science graduate roles, and then developing curricula to support associated development of undergraduates in the UK could serve to increase the employability of graduates entering the food industry.

Chapter 5 Study B - Testing the Validity of the Language Tool

5.1 INTRODUCTION

In the previous Chapter Study A was presented, whereby a series of stakeholder interviews, thematic analysis and consolidation by a modified Delphi stakeholder group, produced a 'common language tool' named Competencies for Food Graduate Careers (CFGC) comprising 48 *elements* grouped into 11 *zones*. The tool sets out the competencies outlined by stakeholders as desirable in food sciences graduates. Chapter 5 completes work to address sub-question 1a, by testing the validity of the language tool and overall rigour, then discussing findings and implications.

> *Sub-question 1a. What is the universally understood language of the terms to define the key competencies?*

Measures taken to facilitate quality during the development of the tool are described, in addition to processes undertaken after completion of Study A. At this stage the language tool was created from the viewpoint of the employer or other industry stakeholders, including recent graduates and recruiters. The voice of the student was now necessitated; those who will be required to develop and articulate ability in the *elements* included in the final framework. A breadth of students were employed to test universal comprehension of the CFGC language tool, and thus validity. Additional consideration by selected employers was also undertaken.

5.2 APPROACH

The approach to evaluating quality in qualitative research is discussed in Chapter 3. The terms 'validity' and 'reliability' will be utilised (Creswell, 2014) alongside a collective term of 'rigour' as used by Davies and Dodd (2002) for reviewing the quality of the common language tool.

Study B describes how the validity of the CFGC language tool can be assessed in the planning and activity stages (Study A) and with additional post hoc testing (Study B). It was approached using a selection of validation strategies suggested by Creswell (2014) (Table 3.2), and within Study A comprised:

- Design of interview – pilot stage, recording and checking transcripts
- Thematic analysis – triangulation, external auditor
- Consolidation – respondent validation

Post hoc testing (Study B) included the following challenge processes:

- Student group interviews
- Dissemination and review by two recruiters or employers

5.3 PROCESSES UNDERTAKEN BEFORE AND DURING STUDY A

Care was taken to support validity of process during the development of the language tool using methodology as described in Chapter 3. A pilot stage was included in the design of the interviews, and sessions conducted were audio recorded and transcribed (section 3.2.2). As outlined in the previous two Chapters, additional processes were included in data analysis, mindful of validity and also 'reflexivity' or the influence of the researcher on outcomes

(Mays & Pope, 2000, Creswell, 2014), and these have been detailed previously.

5.4 TESTING WITH STUDENTS

It was of fundamental importance that undergraduates, in particular final year students understand and engage with any language tool or competency framework developed. Choice of methodology introduced in section 3.2.4, was a formal field group interview (Denzin & Lincoln, 2005).

5.4.1 Student field group interviews

In order to achieve a more robust challenge to transferability or generalizability (Braun & Clarke, 2013), Study B engaged with a wider pool of undergraduates, those at UoN and also two other HEIs in the UK. Selection of three institutes (for convenience) aimed to include courses with varied curricula, and admission pools with regard to geographical locations and tariff. Key features of each institute pertinent to this Study are outlined in Table 5.1.

Table 5.1 Degree courses for students participating in field group interviews.

Institute	BSc Degree Courses Offered	Placement Requirements and Options	Usual cohort size	Tariff
Cardiff Metropolitan University (CMU)	Food Science and Technology	Optional additional 'Year 3' (usually 40% take it). Also 12 week in summer option.	25	112 points (equivalent to BBC)
Queens University Belfast (QUB)	Food Quality, Safety and Nutrition	Additional 'Year 3' (usually 75% take it) or 16 week summer option required.	35	ABB/BBB
University of Nottingham (UoN)	Food Science	Optional additional 'Year 3' (usually 50-60% take it)	35~	ABB/BBB*
	Nutrition and Food Science			

~Cohort for the two degree courses combined

*Entry tariff applicable for final year group, spring 2017

Placement options were considered as they are likely to impact on a student's depth of experience of workplace requirements in the food industry. Formal field group interviews were performed each at the student cohort's institute of study, facilitated by the primary researcher. Details of the approach for conducting group interviews during the project included the 'pre-session strategy' (Krueger & Casey, 2009), summarised in Figure 5.1. Final year students were purposely targeted for all sessions. The session at UoN was populated by volunteers and entire cohorts attended for the other two universities.

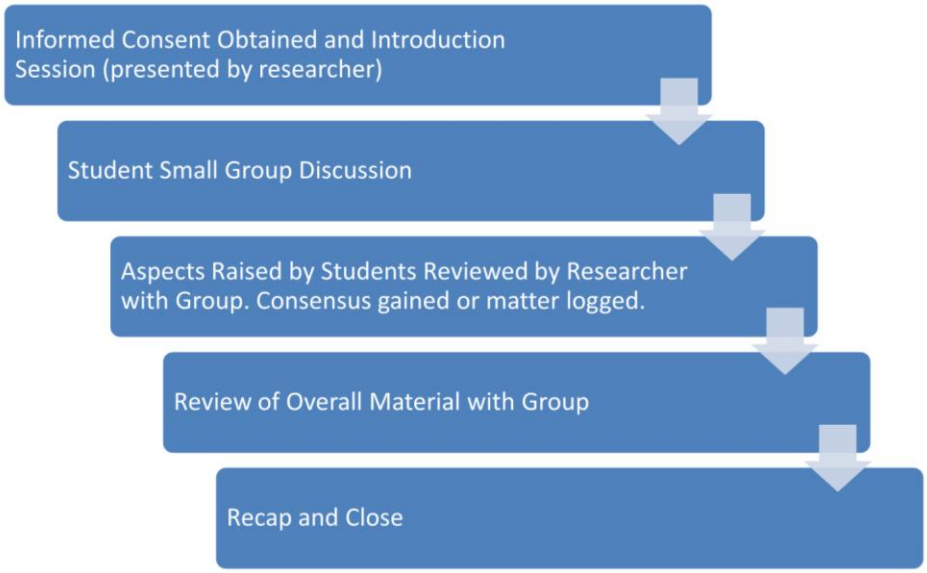


Figure 5.1 Pre-session strategy for student field group interview sessions during Study B.

5.4.2 Preparation and progression of sessions

5.4.2.1 Preparation

Following ethical approval (section 3.4), the following documents were provided electronically, two weeks in advance to participants via an academic at their institute of study, accompanied by an introduction communication, an example is provided in Appendix VI:

- Information sheet.
- Consent form (both audio/written and photography).
- Competencies for Food Graduate Careers - Summary for student groups (example in Appendix V).

Introductory material for sessions (Greenbaum, 2000) included the following: introduction, background of the project, aims of group session and a brief

overview of CFGC. In addition A3 printed versions of the 11 *zones* of CFGC (Appendix V, pages 3-14) were prepared for use during each session.

5.4.2.2 Room settings

Students were arranged in a flat lecture theatre or meeting room, with the ability to move into discussion groups of between four and seven students. A flip chart board with paper was also set up in a corner for displaying points made by students. Printed copies of CFGC were provided for reference to each group. The A3 size posters of 11 *zones* of CFGC were secured to the walls for reference and recording purposes during sessions.

5.4.2.3 Introduction and main activity

Using the pre-session strategy (Figure 5.1), introductions were shared between the researcher, students and other persons present at a session (observing home university academics) and informed consent obtained.

The initial presentation session was delivered in less than ten minutes. To avoid discussion of desirability of competencies in the workplace, emphasis was made that the session aimed to explore terms and definitions in the current model and that future work was planned to establish the importance of each *element* to specific roles.

The active part of the session commenced, ensuring use of key phrases appropriate for group facilitation (Appendix II). With a supposition that not all participants had pre-read the documentation, students in groups of four to seven were given up to ten minutes (as deemed required by the researcher) to review and discuss the CFGC document. Next they were asked to consider together, whether any of the *elements* or associated definitions listed in the

material were unclear in any way. After further group discussion, open comments received from students or groups were logged on the flipchart and tallies taken if similar items were raised (Figure 5.2).

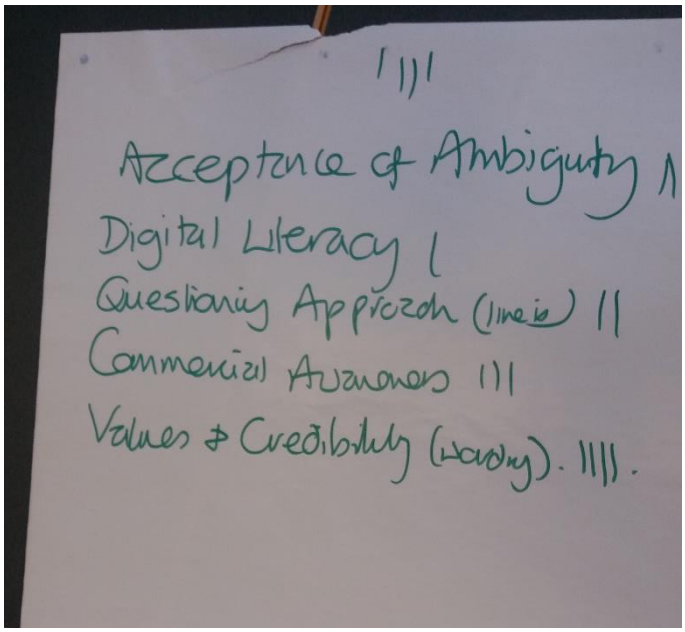


Figure 5.2 Illustration of the use of the flipchart to log initial student feedback during group interviews (session at UoN, Nov 2016).

Next, if an *element* had queries noted against it, the researcher explained the term and definition in more detail, encouraged debate or query within the student groups, offered relevant pre-prepared examples to keep 'ontological authenticity' (Guba & Lincoln, 1989), and checked understanding until clarity was achieved, the point addressed or the matter recorded as a concern. Using the A3 wall sheets for reference (Figure 5.3), all other *elements* were reviewed to ensure nothing had been missed. If additional suggested amendments or concerns were generated from these discussions they were logged directly on these A3 wall sheets.

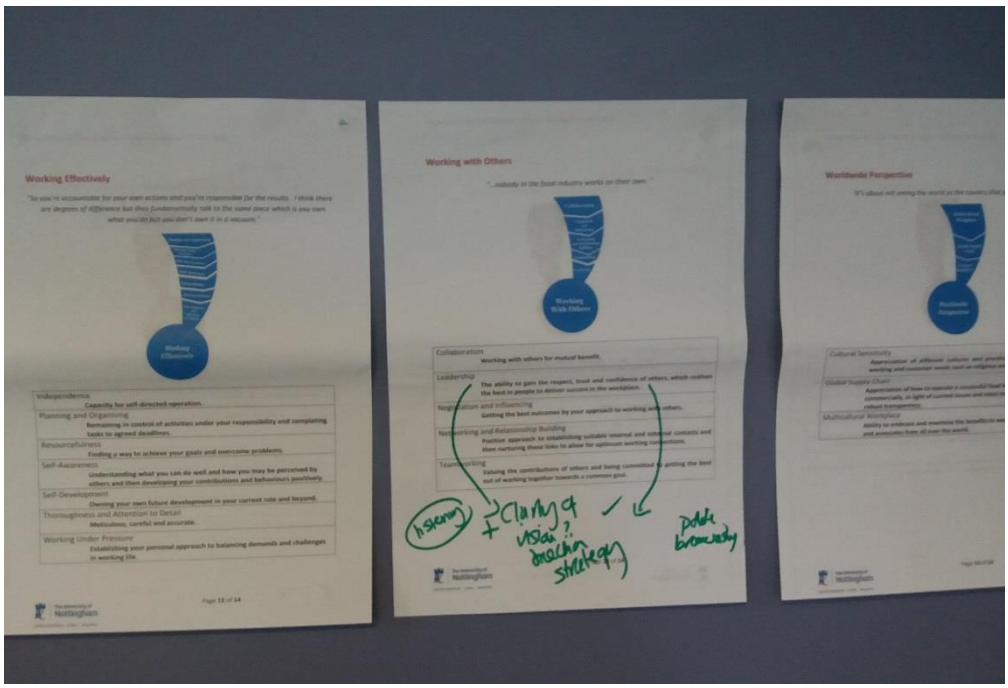


Figure 5.3 Illustration of the use of the A3 Posters to log student feedback and queries (session at University of Nottingham, Nov 2016).

5.4.2.4 Timing of the interviews

The first session at UoN was planned for one hour; however more time was required, so participants agreed to stay for additional time. Subsequent sessions were therefore organised for 1.5 hours. This provided ample time for introduction, group discussion and data collection.

Following the main activity, if time permitted, wrap up time allowed students to ask any questions they wished about the subject matter aside from the focus of the session.

5.4.3 Results - outline of sessions

Table 5.2 compares key features of the three field group interviews conducted between November 2016 and March 2017.

Table 5.2 Details of the field group interviews of final year undergraduate students (2016-7).

	University of Nottingham (UoN)	Cardiff Metropolitan University (CMU)	Queens University Belfast (QUB)
Date	Nov 2016	Jan 2017	March 2017
Number of students	11	13	31
Other persons present	Note taker	2 CMU academics	QUB Work Placement and Careers Adviser
Length of Session	1 hour 15 minutes	1 hour 30 minutes	1 hour 20 minutes
Method of supporting recording	Written notes	Audio	Audio

5.4.3.1 University of Nottingham (UoN)

Of the 11 students present, six had taken an additional year-long industrial placement. When asked to share any queries, a small number of students freely noted any aspects that they would like to review further and momentum was gained from this initial feedback. Material captured contained both queries on terms and definitions, as well as wider questions on the context of certain *elements*.

5.4.3.2 Cardiff Metropolitan University (CMU)

The majority of the students present had either been on a placement year or a 12 week summer internship. After initial review of CFGC by the students and a request to voice any points of query, no initial comments were raised and

the initial impression formed was genuine belief of understanding. On further probing, some queries were raised by a few students which are included in the section below.

5.4.3.3 Queens University Belfast (QUB)

All students present (Figure 5.4) had completed a one year placement or 16 week summer internship. The process was similar to the previous sessions, with time taken of one hour and 20 minutes. Following a request to provide feedback on any area of query, initial responses from some students (with nodding accession from the rest of the group) was that they understood all of them, however they wanted to 'discuss' some in more detail. A comment was also made by an individual in the group that this was a useful list. Overall the group appeared confident from their body language and responses they were clear that they understood what the terms and definitions meant.



Figure 5.4 Image of the initial group interview sessions of the CFGC language tool (session at Queen's University, Belfast, March 2017).

The specific *elements* that generated conversation are included in the detail below. Conversations were mainly focussed on the nature and requirements of individual graduate roles and in wrap up time this was expanded in more detail by the researcher.

5.4.4 Results - items for review following the group interviews

In general the terms and definition of *elements* in CFGC were understood by student cohorts. The following three *elements* were agreed of sufficient or consistent concern to warrant further review:

5.4.4.1 Digital literacy (zone: numbers, data and IT) "The ability to utilise today's digital society for your success."

At UoN and CMU over half of students had not heard of the term *digital literacy* before (Appendix V) or asked if it was just 'social media'. It was explained that although a relatively new term, it is increasingly relevant for employability. Some students suggested it involved use of social media and online communications and it was debated that some companies will require this type of activity in the workplace, others will not. It was proposed some workplace tasks would be unidirectional retrieval of information or research. The use of the word 'success' in the definition ("the ability to use today's society for your success") was stated as "wishy washy" by a UoN student and some of the group concurred. The group at CMU discussed social media image and all students were aware about 'cleaning up their presence' for application time.

A reflection on the *element* name and extension of the definition to embrace wider communications was proposed.

5.4.4.2 Handling data (zone: numbers, data and IT) "The ability to understand, treat and report data with confidence (this may include handling big data for some employers)."

At both UoN and CMU, initial queries were raised as to what extra level of expertise was required beyond that included in current degree study. Questions in both sessions centred on 'big data', which was not understood by most present. The relative newness of big data in vocabulary was explained and that some roles may require an ability to handle big data, but others may not. A possible review of the inclusion of 'big data' in the definition was proposed.

5.4.4.3 Negotiation and influencing (zone: working with others) "Getting the best outcomes by your approach to working with others."

A CMU student asked what the difference was between 'negotiating' and 'influencing' and how you can obtain evidence of these aspects. It was elucidated that negotiation is quite explicit, usually verbal, requiring two-way dialogue whereas influencing can be more subtle, indirect and suggestive. Examples of how to gather evidence of this competency were discussed and students' own ideas helped illustrate personal experiences as well as work and study-based evidence that can be exploited. A possible review of the definition was proposed to help differentiate the two words in the name.

5.4.5 Results - other items of note following the group interviews

The following *elements* were discussed but were not included in items for further review as either the matter was clarified to the students' satisfaction during the session, or the query was not specifically related to the term or definition.

5.4.5.1 Acceptance of ambiguity (zone: behaviours) "Appreciation that there may be different ways of achieving a result or more than one positive outcome."

The word 'ambiguity' appeared to be the main area of challenge at UoN and a suggestion was made to change it to 'uncertainty'. Students engaged with the example given, of making technical decisions (such as a product recall) where appropriate decisions may be altered by circumstances, in particular those students who had been on a placement. It was also discussed that there are sometimes a number of ways of achieving an end result. For the definition, 'desired outcome' rather than 'positive outcome' was suggested by the students. This maybe an example where introduction of terminology in teaching may be beneficial.

5.4.5.2 Questioning approach (zone: behaviours) "Taking genuine interest in finding out the answer or challenging the status quo."

Students were confident in their understanding, however a number of students at both UoN and QUB queried what is 'too much' questioning before becoming impolite; what is the 'appropriate' level of questioning as a new employee? In each instance, a few minutes conversation between students and the researcher was undertaken, to debate the balance expected between gaining understanding in a new role at work and avoiding bombardment of other staff. Discussion was included on requirements for tact, when questions possibly lead to a challenge on current workplace practice.

5.4.5.3 Other elements debated

Queries were raised on the following *elements* based on: geographical *scope, level of ability or extent of knowledge required, or which graduate roles require the element:*

- *Environment and sustainability (*zone*: social, political and environmental)* QUB students.
- *Values and credibility* (zone: *social, political and environmental appreciation*) UoN students.
- *Academic expertise* (zone: *technical and workplace*) QUB students.
- *Commercial awareness* (zone: *the business world*) UoN and QUB students.

It is worthwhile being mindful of possible requirements in future to 'quantify' these *elements*, as they are more akin to knowledge gathering, compared to other *elements* within the CFGC framework. A point where this matter is raised by students at a later stage, is explored in Chapter 8.

5.4.6 Strengths and limitations

5.4.6.1 Possible limitations

All students had the same level of prior knowledge of CFGC and the research/facilitator followed the pre-session strategy each time and made a concerted effort to neutralise or standardise any factors that may cause bias (Foddy, 1994). However circumstances remain that students at UoN had an established relationship with the researcher from past teaching activity during their degree studies. The relationship between an interviewer and participants can affect outcomes if not managed correctly (Vaughn *et al.*,

1996). Factors of possible influence to UoN students include bias or affinity for the source of the Study (Vinten *et al.*, 2016), and either confidence in airing views and queries, or conversely reticence to be honest in a less objective situation.

On reflection there appeared similar levels of confidence and interest in voicing opinions and asking questions at both UoN and QUB. The focal point of the questions and comments varied slightly, where the UoN students desired more discussion on the terms and definitions of CFGC than students at QUB. However both cohorts wished to spend time seeking advice and debating how to develop competencies and articulate them. At CMU the cohort initially confirmed they understood the terms and definitions, and after further probing, possibly more so than the other two groups (although some queries arose later). In general they took a little longer to raise questions and may have been less familiar with this type of session, although a few students were relatively more confident and asked a number of questions. Although nothing specific was found, overall it is fair to acknowledge a prior relationship with the facilitator may have generated differing viewpoints or influenced the quantity of information gathered.

Group size varied between sessions (11, 13 and 31) and although an upper size for formal focus groups can range up to 14 (Bloor, 2001, Franz, 2011), the use of a formal field interview as an organised group discussion (Vaughn *et al.*, 1996) permits a level of flexibility when the purpose is a 'validity check' on results from more detailed interviews (Frey & Fontana, 1991). Although equivalent size groups would have been ideal, reducing the amount of cohort attending at QUB would have been considered unfair, so all interested

students were invited to contribute and perhaps gain from the experience. To encourage consistency, the pre-session strategy required consensus to be gained, regardless of group size in any discussion where understanding was sought. Any items with no consensus were captured for further review. Finally as similarity or positive triangulation is evident across the three sessions, this provided reassurance in results.

The scope of this part of the Study was a sample of three from an approximation of 39 current 'food sciences' degree providers in the UK (The Complete University Guide, n.d.). As a challenge to possible transferability of the CFGC language tool, three was considered sufficient in light of careful choice of institutes to include a range of offerings.

5.4.6.2 Interesting aspects captured from sessions

The limited aspects of CFGC material that the students did not find initially clear centred around two topics. The first was directed to use of emerging terminology such as *digital literacy* and 'big data'. Initially this was surprising, especially in light of the majority of the students being classed as a generation of 'digital natives' (Dingli & Seychell, 2015). On reflection it is possible students may have required abilities, but not comprehend or engage with associated terminology.

The second topic centred on a desire from students in all sessions to understand the scope or level of competence required for any *element*. The survey to seek what *elements* are desirable for specific graduate jobs, covered in the next Chapter should contribute to providing this resource to students.

Aside from the aim of the sessions, rich data were gathered about potential use of CFGC in preparing for job selection processes and in QUB specifically, they were keen to use it for personal development work. CMU students showed interest in how to articulate or demonstrate their evidence of competency in selection processes.

5.4.7 Conclusion of student field group interviews

From the results gathered it can be concluded that all cohorts were in agreement that the majority of the 48 *element's* names and definitions were comprehensible. This provides confidence the 'language' obtained from the sequence of methods in Study A are fit for purpose. Figure 5.5 is an extract of the discussion points relating to possible challenges to terms and definitions used in the version of CFGC presented to the students.

	Discussion Points	Any points to carry forward/action?
Behaviours	UoN: Debate on how strong you need to be in each	Survey in Study C will cover level of importance
Acceptance of Ambiguity	UoN: Suggested 'Acceptance of Uncertainty'.	Discuss if amend the term and the definition?
'Appreciation that there may be different ways of achieving a result or more than one positive outcome.'	'Desired outcome' rather than 'positive outcome' suggested.	Suggest no change as only 1 of the 3 groups
Questioning Approach	UoN: Wanted to discuss how to balance the amount of questions you ask as a new graduate.	No change to CFGC suggested.
'Taking genuine interest in finding out the answer or challenging the status quo.'	QUB: How much do you need for a new graduate job?	Just more context perhaps for students in more detailed material. Or state balanced?
Numbers, Data and IT		
Digital Literacy	UoN: Most understood, some needed further explanation. Use of the word 'success'; commented that it was 'wishy washy' and some concurred.	Reflect on element name and definition
'the ability to use today's society for your success'	CMU: A student asked whether this is just social media. Outlined it is understanding and being comfortable with social media but also multimedia and other internet communications	Perhaps earlier introduction to the students to new terms and requirements (UoN) glossary?
Handling Data	UoN: The only query linked to what is 'big data'?	Perhaps amend definition or earlier introduction to the students to new terms such as 'big data' and requirements perhaps (UoN) Glossary?
'The ability to understand, treat and report data with confidence (this may include handling big data for some employers).'	CMU: Not quite sure of the definition. The only query linked to what is 'big data'?	
Working with Others		
Negotiation & Influencing	CMU: what the difference is between the 2 terms & how do you know you have evidence of them.	Should the definition be extended?
'Getting the best outcomes by your approach to working with others.'		

Figure 5.5 Extract of the key findings of Study B field group interviews.

From this, the following were suggested as requiring further review with the project stakeholders (Chapter 6):

- *Digital literacy* - reflect on *element* name and extend definition to define as multimedia communications.
- *Handling data* - reflect on inclusion of 'big data' in definition.
- *Negotiation and influencing* – reflect on definition.

- Consideration of desirability of each *element* for a specific graduate role established in Study C.
- Consider future education of students on terminology used for work base competences e.g. *acceptance of ambiguity*, where an explanation was required.

5.5 TESTING FACE VALIDITY AND INTEREST WITH SELECTED EMPLOYERS

Although the primary post-hoc assessment centred on undergraduate students, a section of 'face validity' assessment involved employers, to check if the language tool was understandable and suitable (Sapsford & Jupp, 2006). CFGC was presented to two employers during spring 2017 to gather further opinion. One was a validation exercise where the CFGC language tool was compared with an existing framework, whilst the other was an inspection of the tool by an employer without a current framework for comparison.

In addition to the formal work outlined below, contact commenced with the Campden BRI (n.d.) Teaching and Development group. Attendance and presentations to the bi-annual workshops since March 2017 have provided useful, informal validation of the value of CFGC to UK food industry employers. Further details of these sessions are included in Chapter 6.

5.5.1 Testing validity using a larger business with a formal competency framework

5.5.1.1 Detail of the review process

Purposive convenience sampling of a project stakeholder representing a large chilled food manufacturer 'LCO' (Table 3.3) was undertaken to benchmark

CFGC (Appendix V) against their internal company framework. There is a formal well developed competency framework in the business, utilised for recruitment and development purposes, including their two year technical graduate scheme; however it is not tailored for technical career pathways. Three roles that are typically undertaken by graduates progressing through the technical scheme pathway were considered, namely: Specification Technologist, Process Development Technologist, Quality Assurance Auditor. Comparisons were made by the LCO stakeholder, looking at each part of the company framework and sections relevant to the three roles concerned. Judgements were made where a match or similarities were found in terms and definitions. Results summarised by the stakeholder are reproduced in Figure 5.6.

Company Competency Category	Specification Technologist	Process Development Technologist	Quality Assurance Auditor	Link to Competencies for Food Graduate Careers; element (zone)	Used in Advertisement?	Included in Selection Processes?
Leadership				Leadership (working with others)		
Delivering sustainable results	Yes			Self-motivated (behaviours), adaptability (behaviours), questioning approach (behaviours)	Included in advert	Interview 1 & 2
Making robust decisions	Yes	Yes		Decision making (problem solving)		
Setting direction	Yes			Links but this is aligned to the company values statements and its specific associated language		
Working together	Yes	Yes		Teamworking (working with others), Listening (communications)	Included in advert	Group exercise
Other						
Analysis & problem solving		Yes		Critical thinking (problem solving)	Included in advert	Group exercise
Attention to detail		Yes	Yes	Thoroughness & attention to detail (working effectively)	Included in advert	Presentation
Maximising food safety	Yes	Yes		Specific technical aspects (technical and workplace)	Part of "passion for food science"	Interview 1&2
Organisation & planning	Yes	Yes	Yes	Planning & organising (working effectively)	Included in advert	Presentation & group exercise
Organisation & planning	Yes	Yes	Yes	Planning & organising (working effectively)	Include in advert	Presentation & group exercise

Figure 5.6 Extract of the review of CFGC against a company framework by a LCO stakeholder (large chilled own label manufacturer).

5.5.1.2 Interpretation

The stakeholder indicated that the language, definitions and scope of CFGC are appropriate for their technical graduate recruitment purposes. From the *elements* in CFGC, 11 are linked to material in the company graduate scheme framework, some in profiles for all three roles reviewed, others for one or two of them (Figure 5.3). It was also noted there was no cohesive link found between the *zones* in CFGC and the basic categories in the company's framework (Table 5.3). .

Table 5.3 Elements in CFGC identified as associated to the categories in the LCO stakeholder's company graduate scheme framework.

Zone	Elements	Alignment to Large Company Graduate Scheme Framework
Behaviours	Adaptability	Leadership: delivering results
Behaviours	Questioning approach	Leadership: delivering results
Behaviours	Self-motivated	Leadership: delivering results
Communications	Listening	Leadership: working together
Problem solving	Critical thinking	Leadership: making robust decisions
Problem solving	Decision making	Analysis and problem solving
Technical & workplace	Specific technical aspects	Maximising food safety
Working effectively	Planning and organising	Organisation and planning
Working effectively	Thoroughness and attention to detail	Attention to detail
Working with others	Teamworking	Working together
Working with others	Leadership	Overarching general category

The comparison of the categorisation of terms into groups is believed to be of a lesser consequence than the correctness of the terms and definitions, but can be part of future considerations for the final completion of CFGC during Study C.

A possible disparity noted by the LCO stakeholder during the comparison work was the absence in CFGC of reference to the person's fit to the company's own value statements or model. The inclusion of something such as 'company fit' was originally considered as a possible inclusion, but removed by group consensus within the prior consolidation forum process (section 4.4.4). The rationale taken was that 'company fit' for a competency

framework would be vague, and employers' perceptions of meaning would be variable. The LCO reviewer concluded by suggesting CFGC would be an excellent support tool to underpin the general company framework.

5.5.2 Testing validity using a smaller business with no formal competency framework

5.5.2.1 Detail of the review process

The next stage was to capture the perspective of a graduate employer without a current competency framework. The contact was purposively sourced by the project stakeholder representing recruitment consultants 'REC' (Table 3.3). The privately owned company, although with an embedded and successful graduate scheme in place (usually over two years), had no formal competency framework in the business for recruitment and development purposes. However the company was in the process of developing such a framework and associated tools for recruitment and selection activities. The reviewer plays a fundamental role in the recruitment and subsequent development of graduates within the company graduate scheme, and a number of these graduates are from a food science, agricultural or science background.

A prior meeting and telephone discussion was held at the company's head office with the reviewer and primary researcher, to outline project aims and objectives and progress to date. The appraisal of the CFGC language tool (Appendix V) was undertaken by the reviewer, reflecting on the limited material used for graduate recruitment and the reviewer's own judgment and experience. The reviewer was asked to consider two main questions for each *element* and its associated definition:

1. Is it clear and understandable?
2. Would this be a quality you would value in a graduate for your company scheme?

Feedback returned on a spreadsheet supported by open comments and follow up discussions on the telephone completed the activity.

5.5.2.2 Interpretation

The key finding was that all of the 48 *elements* and definitions were confirmed as comprehensible to the reviewer. This is a further indication of the transferability of CFGC. Open feedback from the reviewer included,

> *"I do agree with all of them and the definitions are good. It's useful to have these competencies written down and identified, I think employers have the ideas in mind of the type of person and skills they want – having these competencies can help develop the measures."*

With respect to question 1 relating to clarity and understanding, one *element* was highlighted; *acceptance of ambiguity* with the definition 'Appreciation that there may be different ways of achieving a result or more than one positive outcome'. It was confirmed as being understood but a comment was made,

> *"In our business it's about being able to accept that there's grey areas and people don't always know what change is coming up and when."*

With regard question 2 and to the value of the *elements*, the reviewer confirmed all were of value but as summarised in Table 5.4, some were

deemed less desirable than the rest. For one specific *element*, *leadership* it was suggested there was requirement for a candidate to have 'potential' rather than current possession of competence.

Table 5.4 Open comments from employer in smaller business relating to question 2, "Would this be a skill you would value in a graduate for your company scheme?"

Zone	Element	Additional comments
Behaviours	Emotional intelligence	We may start measuring this as part of the recruitment process using Thomas International GIA tool
Behaviours	Passion for subject	We want to see a passion for the business [*stated business type]*
Innovation & new horizons	Entrepreneurship	Is relevant but less so than the others- we want them to be innovative and business minded but very much a team player in the business
Technical & workplace	Specific technical aspects	Less so
Technical & workplace	Work experience	Less so
The business world	The mechanics of business	Less so
Working with others	Leadership	Potential for leadership - showing the right signs
Worldwide perspective	Global supply chain	In some roles

5.5.3 Outcomes of testing with a sample of employers

The outcome of the review against a large company graduate scheme framework by a project stakeholder and a more informal review by a recruiter from a smaller company with no structured model, has provided evidence on the comprehensibility of CFGC and transferability (Braun & Clarke, 2013) to a

wider context. The tool appears to align itself well with a current framework and have resonance with less structured graduate recruitment systems.

5.6 OVERVIEW AND IMPLICATIONS OF STUDY B

The majority of the *elements* constructed with involvement of project stakeholders to outline possible desirable graduate competencies, are understood by a key future target audience, the undergraduate student. The work has demonstrated transferability between a variety of UK student cohorts. Possible revisions outlined in Study B were reviewed at a later project stakeholder meeting in September 2017 and any minor amendments agreed will be outlined in the next Chapter. In addition the two businesses who undertook a short review of CGFC found it aligned well to their current model or graduate recruitment considerations. Both types of studies are encouraging and provide more confidence in the validity of the language tool, as no significant or structural revisions are required. Structural terminology of CFGC remains as proposed in Study A (Figure 4.6).

Successful completion of Study B allowed Study C to proceed, whereby a wider stakeholder view was collected, to capture the relative importance of each *element* in CFGC to the types of jobs food sciences students typically undertake after graduation. Study C completes the development of the CFGC framework and is presented in the next Chapter.

Chapter 6 Study C - Industry Survey

6.1 INTRODUCTION

Progressing from Studies A and B, Study C aims to conclude the process of addressing the first research question,

> *Question 1. What are the key competencies desirable and required for food science graduates to be successful in their career in the food industry?*

The following sub-questions are addressed in this Chapter,

> *Sub-question 1b. What are the typical roles food science students undertake after graduation?*
>
> *Sub-question 1c. What do employers believe are the key competencies for a food science graduate?*

Study C is where the quantitative constituent of the exploratory approach to mixed methods research commences (Table 3.1). To address these questions, a deeper understanding of typical graduate entry roles was required beyond personal viewpoint and hearsay, so project stakeholder influence remained a significant part of Study C. Using the CFGC language tool, a broader, larger industry voice was also required to legitimately define 'what makes a great food science graduate'. This legitimacy was considered vital to ensure credibility with the most important stakeholder, the student. In a study of food sciences curriculum development at their Universities in the USA, Hartel and Gardner (2003) agree that students, "find feedback from

working professionals useful in their development of important knowledge and abilities" (p.37). This project aimed to capture as many 'voices and views' from the food industry by survey participation, to create a relevant and useful framework. As industry were asked to rate desirable *elements* of graduate competencies rather than review current performance of graduates, this was a 'direct' investigation (Suleman, 2018). Immediate and future uses of the new CFGC framework are also presented and discussed in this Chapter.

6.2 METHODS

The survey was built and tested during 2016, launched in January 2017 and data analysis undertaken in subsequent months, culminating in a feedback meeting to the stakeholder group in September 2017.

The process outlined in Figure 6.1 was applied to undertake Study C. Rationale for choice of methodology for the survey and data analysis is located in Chapter 3.

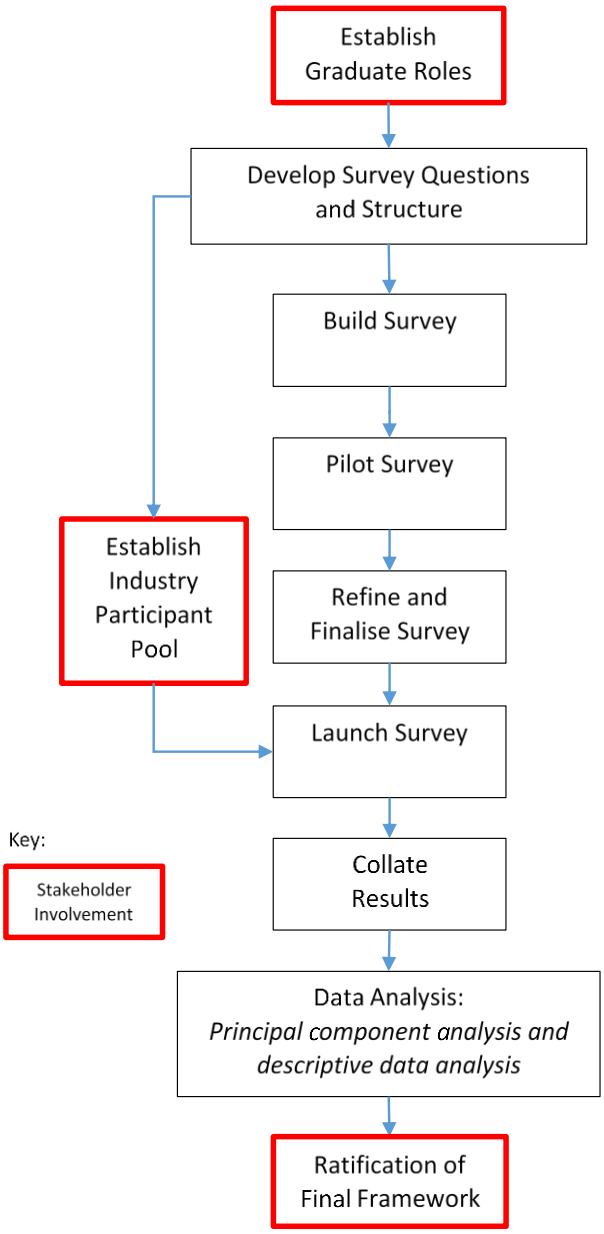


Figure 6.1 Process chosen for Study C.

6.2.1 Establishing graduate roles

During the stakeholder meeting in September 2016, a list was compiled of typical roles and associated titles that food science graduates may undertake as they enter the food industry using the 'starting point' (Figure 6.2), created

by the researcher, to instigate discussion. Outputs were presented, discussed and additional items captured for further analysis by the researcher. Stakeholders agreed that some roles logged were less frequently advertised or recruited to, but it was considered important that all career pathway options should be included in future work.

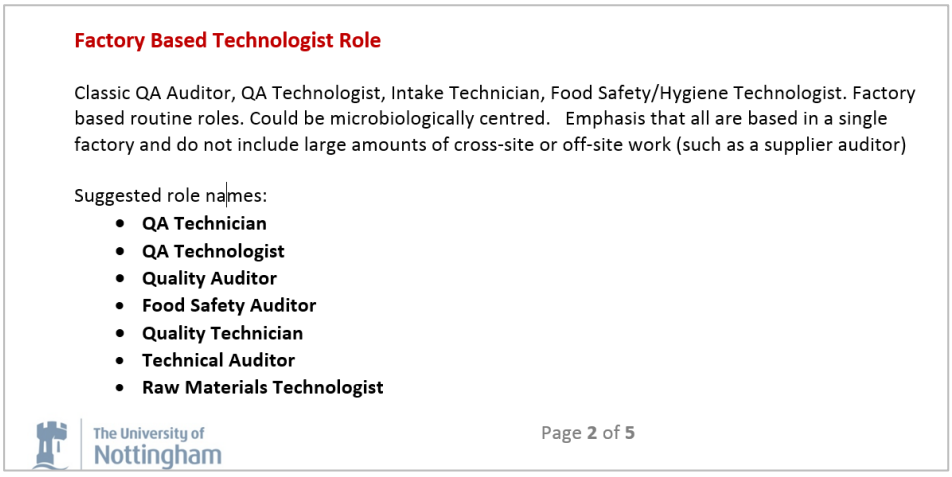


Figure 6.2 Initial information 'starting point' to initiate stakeholder suggestions of food science graduate destinations (September 2016).

Next, an in-depth review was undertaken to capture more information about UK food industry graduate roles, the range of titles used and descriptors. This included an analysis of:

- Current job market and advertisements from specific websites. 'Foodmanjobs' (Food Manufacture, n.d.) and recruitment agencies (Bennett, 2002).
- UK Food industry and graduate careers advice websites (Table 2.5).
- Employment destinations of recent UoN food sciences alumni.

A proposed list of 14 roles with associated titles and descriptors was compiled and issued to the stakeholder group for consideration (an example of material for a role is illustrated in Figure 6.3.


Factory Based Technologist Role

Classic QA Auditor, QA Technologist, Intake Technician, Food Safety/Hygiene Technologist. Factory based routine roles. Could be microbiologically centred. Emphasis that all are based in a single factory and do not include large amounts of cross-site or off-site work (such as a supplier auditor)

Suggested role names:

- **QA Technician**
- **QA Technologist**
- **Quality Auditor**
- **Food Safety Auditor**
- **Quality Technician**
- **Technical Auditor**
- **Raw Materials Technologist**

The University of Nottingham

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Figure 6.3 Example of one of 14 roles outlined to stakeholders.

After some final revisions the full document was finalised for use in the survey of Study C and a diagram created to support future communications.

6.2.2 Development of survey structure and questions

An online survey was constructed with Online Surveys™, using the approach detailed in section 3.2.5. Extracts of the full survey can be viewed in Appendix VII but an overview of the survey structure comprised:

- Introduction and aims.
- Survey information and ethical consent.
- Demographic questions.
- Choice of graduate role to review (typical roles).
- Main section centred on 48 elements of CFGC (Chapters 4 and 5).
- Option to review a further two roles.
- Final optional comment opportunity.
- Concluding page providing information on future work and contact details.

The survey focus was presented as 'What competencies are desirable in food sciences students for the initial roles they undertake after graduation?' A series of short anonymous demographic questions were included to identify and distinguish features of an industry participants' workplace, including the type of business sector they are employed e.g. chilled branded food manufacturer. A specific question to support data analysis was included to establish the participant's relationship to graduates, whether: a 'recruiter' (human resources, personnel or external recruitment consultant), a 'recent graduate', or an 'employer / line manager'. For this section the use of the survey routing feature prevented unnecessary additional questions being presented to a participant. A question to select which of the graduate roles

they wished to review was incorporated, supported by the role descriptors agreed with the project stakeholders, allowing participants to complete the survey based on the role they had knowledge of. At this stage participants were informed they could opt to review a further two roles later, if desired. To encourage participant engagement, material was personalised; the choice of role title was cascaded into subsequent text (Brace, 2013) using the piping feature of Online Surveys™ (n.d.) software (Figure 6.4).

For the review of each *element*, closed `forced choice' questions were utilised for this survey. A 'don't know' option was not included for this survey primarily as targeted participants had experience in subject matter and thus would be likely to answer with conviction and not need a neutral option (Foddy, 1994, Brace, 2013). Definitions were provided for each *element* within the question to support understanding and choice. *Zones* with a large number of *elements,* e.g. 15, were split into subpages to prevent presentation of unfavourably large pages but retaining a logical structure (Brace, 2013), therefore a total of 14 subpages were in the final survey.

As outlined in Chapter 3, core questions were structured in a five-point, unipolar Likert style with resultant useable scoring in the survey of '1 – not specifically desirable for the role' to '5 – essential for the role', as illustrated in Figure 6.4 (scoring numbers were not visible in the survey). A food science industry-based survey (Morgan *et al.*, 2006) with the similar number of *elements* to include (46) used a similar unipolar ascending Likert style scale.

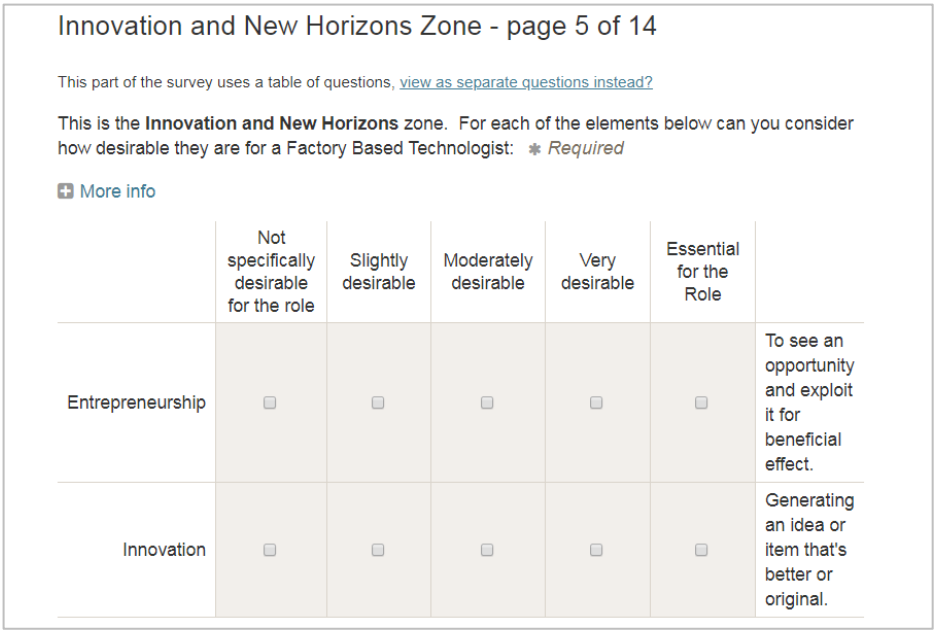


Figure 6.4 Example of the modified unipolar Likert style questions and the use of piping to provide context to text by adding role chosen by participant, e.g. 'Factory Based Technologist'.

6.2.3 Piloting and finalising survey

During December 2016, a pilot version of the survey was reviewed by eight volunteers, either colleagues or members of the project stakeholder group (section 3.2.1). After agreeing to participate, a URL for the pilot survey alongside an open response questionnaire (Appendix VIII) were sent electronically to participants. Responses were received within a two to three week period and data analysed to capture points of note and establish where changes and refinements were necessary. A total of 18 required alterations were identified, including correction of minor errors and simplifying introductory text. Clarification was also provided on typical length of time to complete the survey and assurance for removal of the progress bar (see section 3.2.5.2).

6.2.4 Establishing industry participant network

Bohlschield and Clark (2012) comment that the high response rate in their study, could be partially attributed to their prior interactions with the graduate and employer participants. This approach was harnessed in Study C, where the researcher established personal contact with as many new and existing industry representatives in the months before the survey was launched. This included alumni in contact with the researcher (Enz *et al.*, 1993), who were now employed in the food industry. Extensive efforts were made to capture employers of graduates in each of 14 roles, mindful that as some roles are less frequently recruited to, associated participants numbers may be limited. A preferred mode of contact of direct email or using 'LinkedIn' (https://www.linkedin.com) was established, and the data added to a tracking spreadsheet. Some contacts confirmed their ability to cascade the survey information to suitable work colleagues once received. As such a purposive sampling technique was employed (Creswell, 2014), followed by snowballing from the initial contacts (Sapsford & Jupp, 2006, Braun & Clarke, 2013).

6.2.5 Launch of survey

Mindful of Jackson's (2000) warning to avoid sending out surveys before holidays or in December, launch of the survey was delayed until mid-January 2017. The survey link was sent with messages designed to inform and encourage completion, adapted to the participant's prior knowledge of the project (Frankfort-Nachmias & Nachmias, 1996, Lawless & Heymann, 1999). The survey was sent to approximately 250 individuals directly. In addition to this, selected stakeholders were able to circulate the invitation to complete the survey by member's based social media groups, from organisations such as

the IFST (n.d.-c) and Campden BRI (n.d.). Any confirmed completion was logged to avoid needless further contact. Reminder emails were circulated after one to two weeks of launch and the survey finally closed in the first week of February 2017.

6.2.6 Data analysis

The main body of the survey comprised groups of forced choice questions with a unipolar rating scale (quantitative) supported by optional, open text opportunities (qualitative), for the participant to add context or comment to choices made in each group. As data was obtained from a sample of employers, inferential statistics were applied (Sapsford & Jupp, 2006).

6.2.6.1 Initial data inspection

Survey data was downloaded from survey software to a spreadsheet with numbers assigned to responses to the 48 core questions (*elements*). Initial sorting and data inspection allowed removal of samples with errors, or out of geographical scope.

The Chi-square test was applied to look for associations between variables (Sapsford & Jupp, 2006) which would encourage further investigation by methods such as multivariate analysis. This test checks for any statistical differences beyond that normally expected by chance in a population (Cohen *et al.*, 2011). If any correlations are found to be significantly different, the null hypothesis can be rejected and testing is worthwhile (Stevens, 2009). The Cronbach's alpha reliability test was also conducted, whereby 0.7 is the lower limit generally with 0.6 an acceptable limit for exploratory research (Hair, Black, Babin *et al.*, 2014).

Two approaches of data analysis were applied and combined to generate the final framework of CFGC, presented to and approved by the project stakeholders. Statistical methods comprised descriptive data analysis followed by principal component analysis (PCA).

6.2.6.2 Detailed descriptive analysis

Investigations by descriptive data analysis provided opportunity to visualise data and establish any relationships between variables. Desirability of the 48 specific *elements* of CFGC against the 14 typical graduate roles was explored using the following methods:

For each role:

- A stacked bar chart of responses against *elements,* presented in descending order.
- Frequency count of response '5' for an *element* by role type, presented in a list of descending order.
- Frequency count of a combination of responses '4' and '5' for an *element* by role type, presented in a list of descending order.

For each *element*:

- A stacked bar chart of responses against role, presented in descending order.
- The combined 'score' for each *element* by role type, converted and standardised to a common sample size for comparison purposes, presented graphically and compared with the 'score' for the total survey data set.

Roles identified at the top or left of each graph were captured and *elements* added to the results of analysis by role to allow a full comparison of data from both aspects. Care was taken in interpreting roles with lower sample sizes. After collating responses for each role and *element* a final list of desirable *elements* by role were compiled and a matrix generated. If an *element* was particularly strong in desirability for a role compared to others, it was highlighted with a possibility of use in future illustrations.

6.2.6.3 Principal component analysis (PCA) approach

Multivariate analysis looks for shared characteristics or correlations between multiple variables in a data set with a number of methods available dependent on application and data type. Principal component analysis (PCA) finds linear combinations of variables (factors) transforming original data into a new set of linearly independent 'principal components' (PC) (Lawless & Heymann, 1999). PCA is a form of 'factor analysis' (FA); 'common factor analysis' is used to look for any latent or underlying factors, whereas PCA looks for the fewest number of variables that explain the most variance in the data set (Stevens, 2009). After an initial quality check or pre-test of data, the type and number of rotations to perform are selected. With each rotation the data is explored from a new angle generating a PC, with the largest (usually first) accounting for the maximum amount of variance (or pattern) in the data set and subsequent rotations (total being equal to number of variables) producing successively smaller components (Lawless & Heymann, 1999, Jolliffe, 2002).

To suit the exploratory nature of the investigation, 'orthogonal' rotation (varimax)[21] was applied which generates uncorrelated components or factors[22] (Lawless & Heymann, 1999, Hair *et al.*, 2014). The components were then analysed to select how many to keep, which variables to retain within each one (loading cut-off) and assign some meaning or identity to the construct and each component (Stevens, 2009). Qualitative data obtained from open questions provided some support to the rationale of final outcomes. Su and Zhang (2015), and Velasco (2012) use PCA for analysis of similar types of surveys to Study C.

Aligned to pertinent literature and software, where some differentiate terms used before and after rotation and others use terms interchangeably, it was decided that the terms 'factors' and 'components' will be used interchangeably in this Chapter (Stevens, 2009, Hair *et al.*, 2014). With regard to the terminology used in software data extracts presented in the results section, 'F' refers to factors before rotation and 'D' factors after rotation. The terms 'variables' and *elements* are equivalent for this exercise.

PCA was performed using XLSTAT™ (https://www.xlstat.com)[23] with the chosen data set. Samples (participants) were entered in rows, and 'variables' in columns; the scores given for each of the questions posted on the 48 *elements*, plus 'supplementary variables' comprising a unique code for each

[21] The alternative rotation is oblique which allows correlation between factors or PCs, most suited to a confirmatory approach.

[22] Terminology in literature for results interpretation, employ the terms 'components' and 'factors' interchangeably.

[23] SPSS software is able to perform factor analysis only, not principal component analysis

participant (stating with ‘1’), the participant type (name and digit), typical graduate role chosen to review (name and digit).

A significant level of detail is included in this section regarding methodology, in contrast to many previous food science-based studies, justified by the exploratory nature of the Study (Lawless & Heymann, 1999).

6.2.6.3.1 Initial reliability

Initial reliability of data were explored by use of the tables presented in the XLSTAT™ report, namely Bartlett’s test of sphericity, aligned to the chi-square test already undertaken in initial data inspection (Field, 2013).

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Field, 2013) is an indication of how suited data is for factor analysis (scores are between 0 and 1). Kaiser states values between 0.8 and 1 indicate the sampling is adequate, and less than 0.6 (Tabachnick & Fidell, 2013) or 0.5 (Fleming, 2003) indicate the sampling is not adequate.

As a guide, Kaiser put the following values on the results (Stephanie, 2016):

- to 0.49 unacceptable
- 0.50 to 0.59 miserable
- 0.60 to 0.69 mediocre
- 0.70 to 0.79 middling
- 0.80 to 0.89 meritorious
- 0.90 to 1.00 marvellous

6.2.6.3.2 Eigenvalues

A review of factor eigenvalues aligned to Kaiser criterion was undertaken, whereby components are retained whose eigenvalues are greater than 1 (Stevens, 2009, Hair *et al.*, 2014). However to retain all factors without further investigation may preserve factors with no practical significance (Lawless & Heymann, 1999, Stevens, 2009). The contribution of the cumulative variance for the final choice of factors is suggested to be 60% or greater (Hair *et al.*, 2014) or 75% (Stevens, 2009). Inspecting the change of variability contribution for each successive factor before and after rotation can also support choices, especially in exploratory studies (Tabachnick & Fidell, 2013), where total variability may not reach 60%.

6.2.6.3.3 Rotations and biplots

PCA tests were run with a succession of orthogonal (varimax) rotations appropriate to the findings from the initial data and analysis of eigenvalues. Software used to run PCA, produces biplots or factor diagrams (Hair *et al.*, 2014) before and after any required rotation. Biplots visually illustrate affinity (loadings) of each variable against the first two components by their position within the plot. In some cases the clusters are easily seen for each component, in other cases, particularly with a spread of useable components beyond the first two, their use is limited.

6.2.6.3.4 Factor loadings

Key criteria for inspection include factor loadings which are the weighting of how a rotated factor or ‘component’ loads a ‘variable’. Factor loading is the correlation of a variable and a component. Analogous to Pearson's ‘r’, the

squared factor loading is the percentage of variance in that variable, explained by the factor e.g. if a loading result is 0.30 then squared, it is 0.09 or approximately 10% variance of that *element* (Hair *et al.*, 2014). Hair outlines for sample sizes of 200 and 250 to select loadings above 0.40 and 0.35, respectively, aligned to guidance that thresholds can reduce as sample sizes increase (Guadagnoli & Velicer, 1988, Hair *et al.*, 2014). However, Stevens (2009) initially suggests using 0.36 and 0.33 for the same sample sizes of 200 and 250 respectively, or just applying an overall cut off of 0.4. Others suggest general application of a threshold of 0.30 (Frankfort-Nachmias & Nachmias, 1996, Westad, Hersleth, Lea *et al.*, 2003) or 0.32 (Comrey, 1973, Tabachnick & Fidell, 2013), and for more predictable, structured or confirmatory data, cut-offs of 0.5 to 0.7 are suggested (Hair *et al.*, 2014).

6.2.6.3.5 Factor scores

Alternatively, factor scores are associated with the individual 'samples'. Factor scores provide the ability to explore which of the individual samples (rows) relates highly with a chosen variable or particular factor or component (Hair *et al.*, 2014). Scores are arbitrary for each test and range either side of zero, with positive scores indicating affiliation to a particular component. The average of factor scores for one sample (or group of samples assigned to a typical graduate role) across all the components in a test, should equal zero as should the average of all sample factor scores under one component. In the context of this Study, using selected supplementary variables in the data set, allowed grouping of samples into roles. Analysis of these groups by factor scores indicated level of affiliation of each role to each of the resultant components, or factors in the model.

6.2.6.3.6 Other considerations to inspect

Other considerations within this decision making process include communalities and cross-loadings. Communalities are the overall amount (%) a variable (*element*) is accounted for in a given model and how much it is associated with other variables (Field, 2013). It is the sum of the square of each factor loading. Hair (2014) suggests acceptable communality to be > 0.5 as a model, but Hogarty (2005) classes 0.4 or below as 'low'. Schoneman (1981) argues these thresholds may be a challenge in social sciences where communalities from some studies may average in the 30s or low 40s, so to choose a level to suit the exploratory nature of the study.

Cross-loading is where a variable (*element*) has more than one significant loading in a set of PCA results. Consideration should be made to understand a possible cause and whether the variable (*element*) has a reason to be in two factors. It may be a case of poor representation in any of the resulting components (Hair *et al.*, 2014), or there may be logic or meaning to the situation. There are suggested loading criteria that can be applied for choosing whether to keep a component (Guadagnoli & Velicer, 1988, Stevens, 2009), however as the survey is exploratory rather than confirmatory, the criteria do not fit these strict criteria.

6.2.6.4 Examining principal component analysis data

Using the information gathered, a summary of chosen criteria to support interpretation is summarised in Table 6.1. Interpretation of the factor matrix was approached in a manner drawn from the steps described by Hair *et al.* (2014) and is also described below. This process enabled the choice of a final rotational set and its most appropriate structure.

Table 6.1 Summary of the chosen criteria for PCA data interpretation for Study C.

Criteria	Thresholds or cut-off
Factor loading	0.32 and 0.35
Initial factor scores	≥ 0.40 or ≤ -0.40 (further refinements provided later)
Communality	0.4
Cross-loadings	minimise but keep all elements in the resulting model

6.2.6.4.1 Examining the factor pattern matrix of loading

Data for each component column was sorted into factor loadings for each variable (*element*) in descending order for each rotational set. Inspection of the high loadings in each component was undertaken for each rotational set to see if the pattern and model was sensible for the context of the Study.

6.2.6.4.2 Assess the communalities for each factor

Communalities were assessed for rotational sets. The number of *elements* outside of the threshold applied were analysed for each set, mindful all *elements* were to be retained in a final structure outcome.

6.2.6.4.3 Identify significant loading(s) for each factor

For each rotational set, using the cut-offs chosen, the *elements* included in each component could be observed. Cross-loadings identified would be reviewed at a later stage.

6.2.6.4.4 Reflect on models and provisionally label factors

Reflecting on the content (*elements*) of each component, provisional labels for factors were applied within rotational sets, as summarised, to allow for a practical reflection of structure in the context of CFGC and the overall project.

Choices were narrowed on the more appropriate rotational sets. As common practice in PCA, labels were applied to the proposed constructs on a conceptual rather than empirical basis, aiming to see if a meaningful structure was present in a model (Stevens, 2009, Hair *et al.*, 2014).

6.2.6.4.5 Factor scores analysis

Factor score data for different rotational sets provided in the PCA test reports were sorted by role type, and the mean scores by role type and each PC calculated. The appropriate initial thresholds were applied, to provide appropriate cut-off points, whereby factor scores of ≥ 0.40 or ≤ -0.40 were considered significantly positive or negative. Relationships of components to a role type could then be evaluated.

6.2.7 Finalisation

After results were finalised, the stakeholder group was engaged to refine and ratify the final construct and outputs (Perera *et al.*, 2016). Proposed visual representations of all aspects of the final framework were also agreed.

6.3 RESULTS AND DATA ANALYSIS

Figure 6.5 illustrates the 14 roles identified as typical for food sciences graduates to undertaken when entering the food industry.

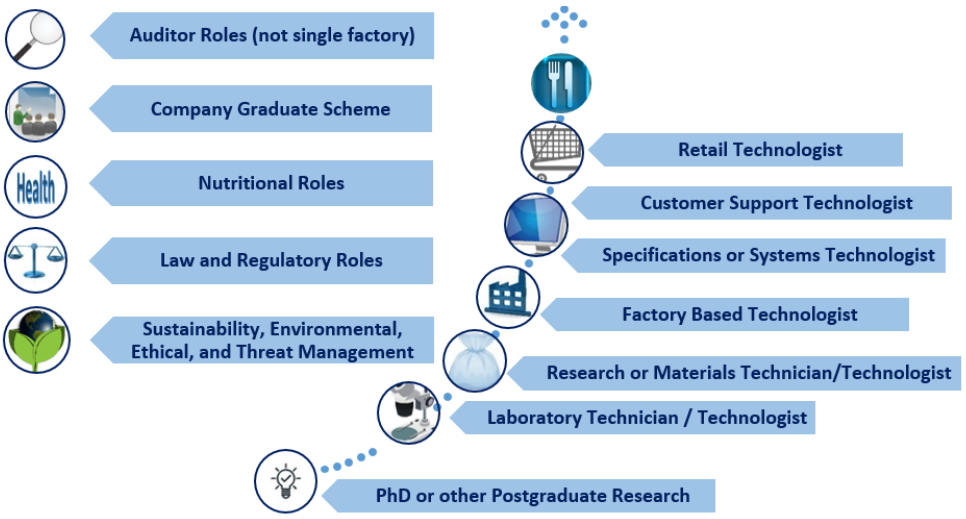


Figure 6.5 Illustration of final 14 typical graduate roles for food science graduates.

Data analysis progressed over the spring of 2017. The survey was opened 377 times, any part progression ending predominantly in the introductory stage. A total of 218 fully completed participant responses were collected, and where some participants completed the survey for two or three roles, this increased the initial data set. The scope of Study C was the food industry based in the UK and Republic of Ireland, so using demographic questions five inapplicable participants were removed from the data set at this stage. The final data set comprised 226 reviews of the selection of graduate roles, with the following numbers assigned to responses to the 48 core questions:

1 Not specifically desirable for the role.

2 Slightly desirable.

3 Moderately desirable.

4 Very desirable.

5 Essential for the role.

6.3.1 Initial analysis of data

Table 6.2 summarises basic descriptive statistics: 63% of the participants were employers (such as line managers), 23% recent graduates employed in the food industry, and 16% recruiters (where 4% are external recruitment consultants). Focussing on the 48 questions covering each of the *elements* of the CFGC individually, there appears general alignment between responses by types of participants. It was also observed only two of the participants did not score one of the questions, which should not have been possible with forced choice option (reported to Online Surveys as an error).

Table 6.2 Analysis of survey by participant type, focussing on the 48 rating questions, one for each element*. Responses to questions ranged from 1 = not specifically desirable for the role to 5 = essential for the role.

Respondent category	Total participants	Mean total scoring	Standard deviation	Mean lowest score used	Average of medians	Average range used	Interquartile range
Employers	138	183	17.50	1.71	3.95	3.28	1.00
Recent Graduates	51	183	21.80	1.69	4.00	3.27	1.00
Recruiters:	37	187	17.43	1.81	3.95	3.16	1.00
Human Resources	28	184	17.21	1.79	3.88	3.18	1.25
Recruitment consultant	9	196	20.94	1.89	4.17	3.11	1.00

*Data set is 226 and the mode for all categories were 4.

Data sorted by the 14 typical graduate roles (Table 6.3) produced data sets ranging from 3 to 55, and a summary of the raw data can be found in Appendix IX.

Table 6.3 Summary of survey responses by typical graduate role reviewed and participant type (grey shaded roles have sample sizes of <10).

	Employers	Recent graduates	Recruiters	Total
Auditor (not based in a single factory)	4	1	1	**6**
Company 'Graduate Scheme' Role	14	14	13	**41**
Customer Support Technologist	2	0	1	**3**
Factory Based Technologist	22	1	1	**24**
Laboratory Technician/Technologist	13	0	3	**16**
Law and Regulatory New Graduate Role	2	1	0	**3**
NPD, Development or Process Role	34	11	10	**55**
Nutritional Graduate Role	3	4	0	**7**
PhD or other Postgraduate Research Role	12	4	1	**17**
Research or Materials Technician/Technologist	7	1	0	**8**
Retail Technologist	6	3	2	**11**
Sensory Technologist Graduate Role	6	3	2	**11**
Specifications or Quality Systems Technologist	12	7	2	**21**
Sustainability, Environmental, Ethical and Threat Management Role	1	1	1	**3**
Total	**138**	**51**	**37**	**226**

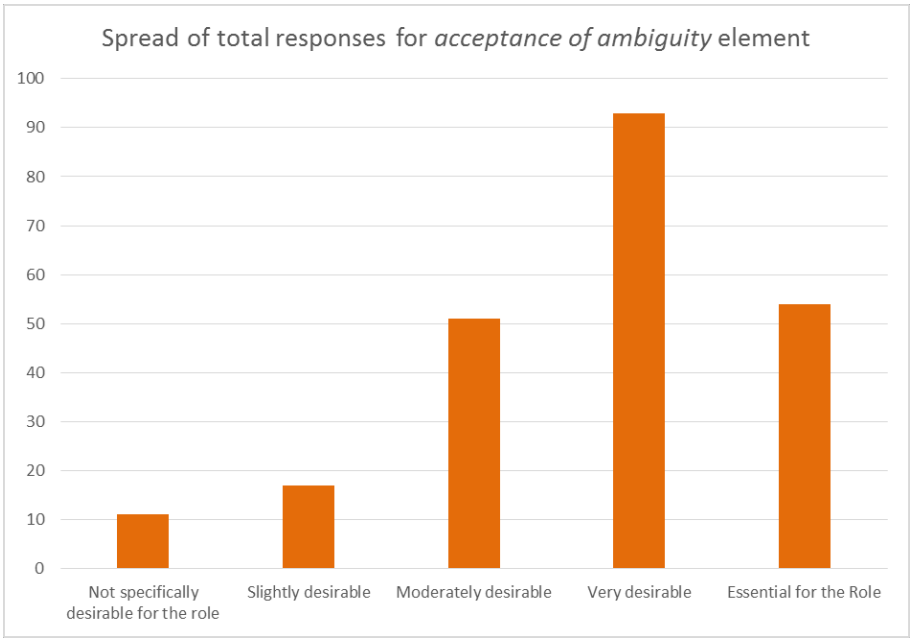
Looking at the lower data sets, knowledge of industry employment patterns provided some explanation. From personal judgment, results generally appear to mirror the prevalence of the number roles usually on offer in the

UK. The roles with lower sample sets (shaded in grey) have limitations for robust statistical analysis. Grouping smaller data sets would not be possible by any natural affiliation to provide meaningful outcomes. All data was retained reflecting stakeholder views that a full representation of the job market be included.

Aligned to the proportion of participant types, the majority of respondents for all roles was from employers (Table 6.3), and in 10 of the 14 roles representation made from both recent graduates and recruiters.

Non-parametric approaches were taken for analysis. Sorting data by roles and initially comparing the medians, there was little to differentiate between *elements* in the total data set. Data were also inspected visually in graphical format. Some initial observations were noted before detailed assessments commenced, for example the spread of results for the *element*, *acceptance of ambiguity* (Figure 6.6a) indicated relatively high desirability for the 'PhD or Other Postgraduate Research' role (Figure 6.6b).

(a)



(b)

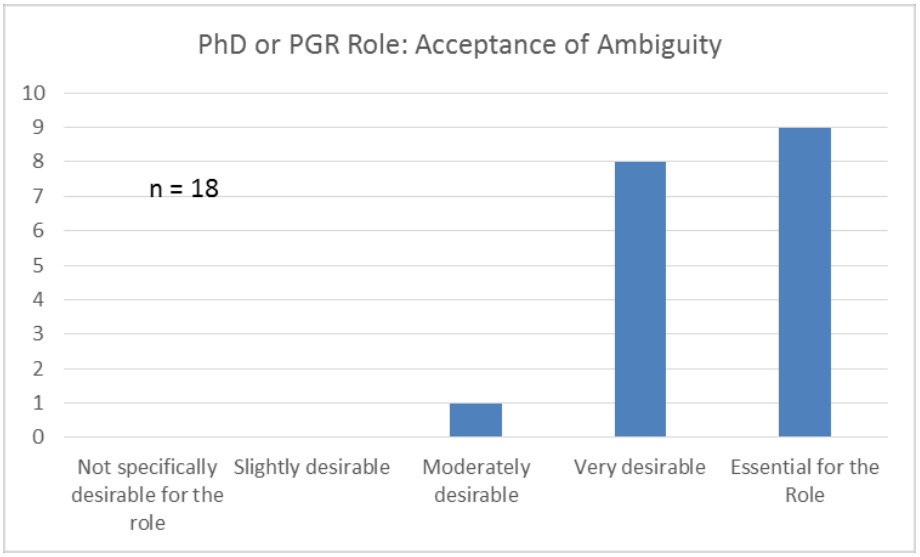


Figure 6.6 An example of initial data inspection from the industry survey for the element *acceptance of ambiguity*, where (a) displays full data (n=226) and (b) responses specific to the role 'PhD or Other Postgraduate Research'.

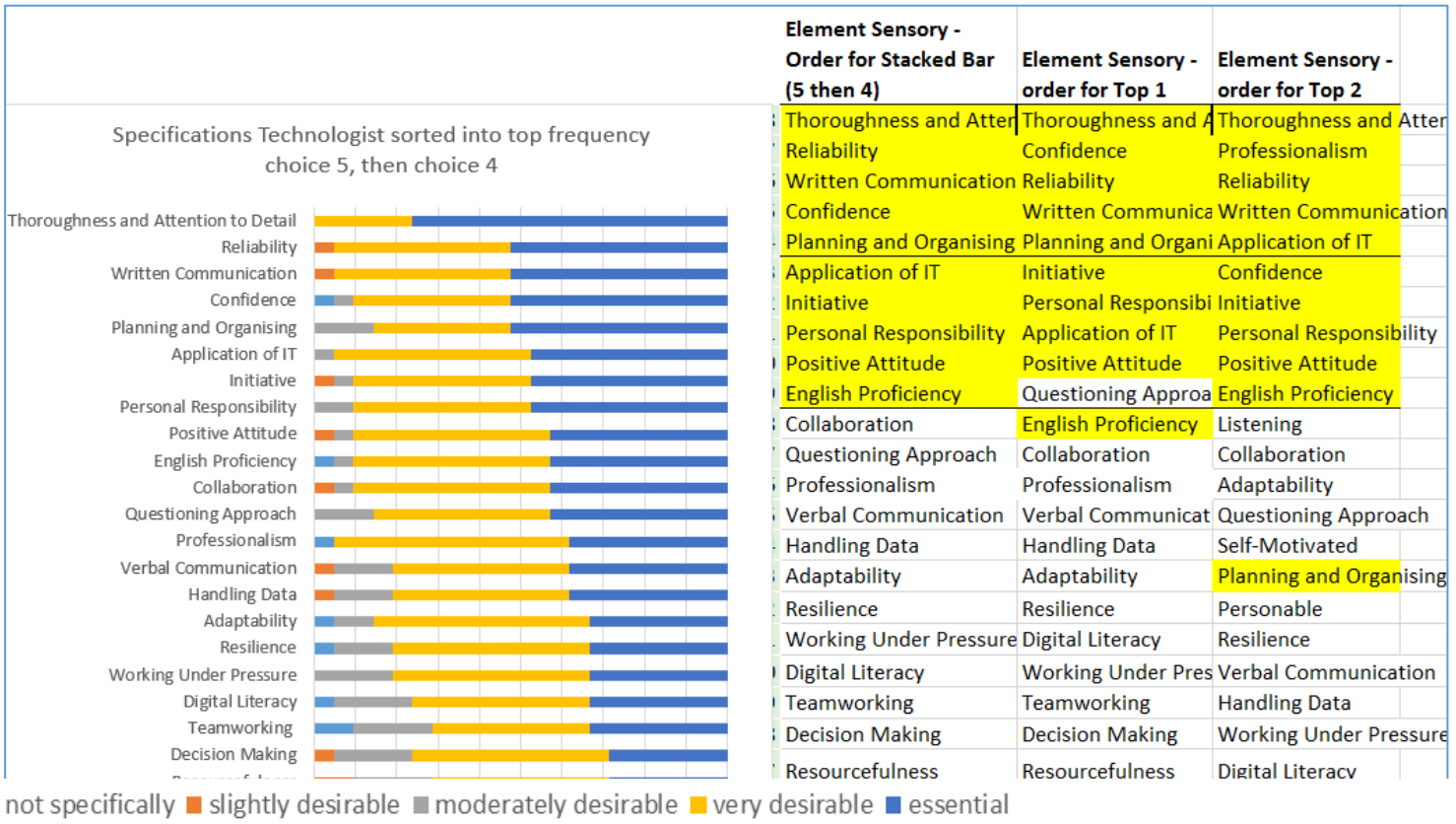
Cronbach's alpha reliability test results provide scores of >0.8 with the exception of the role, 'Research or Materials Technologist', at 0.59 (this is a role with sample size <10). However with the closeness of the recommended threshold of 0.6 for exploratory research (Hair *et al.*, 2014), all results were

accepted. Chi-square test results confirmed that some correlations are significantly different and thus the null hypothesis can be rejected and testing can progress.

6.3.2 Descriptive data analysis of individual elements

This part of the Study aimed to explore the desirability of the 48 specific *elements* of CFGC against the 14 typical graduate roles in survey data, using the forms of data presentation outlined in the method section. Of the 14 roles, six had sample sizes of <10, so care and sense were applied to judgements of their results and ranking with other roles to prevent creation of bias.

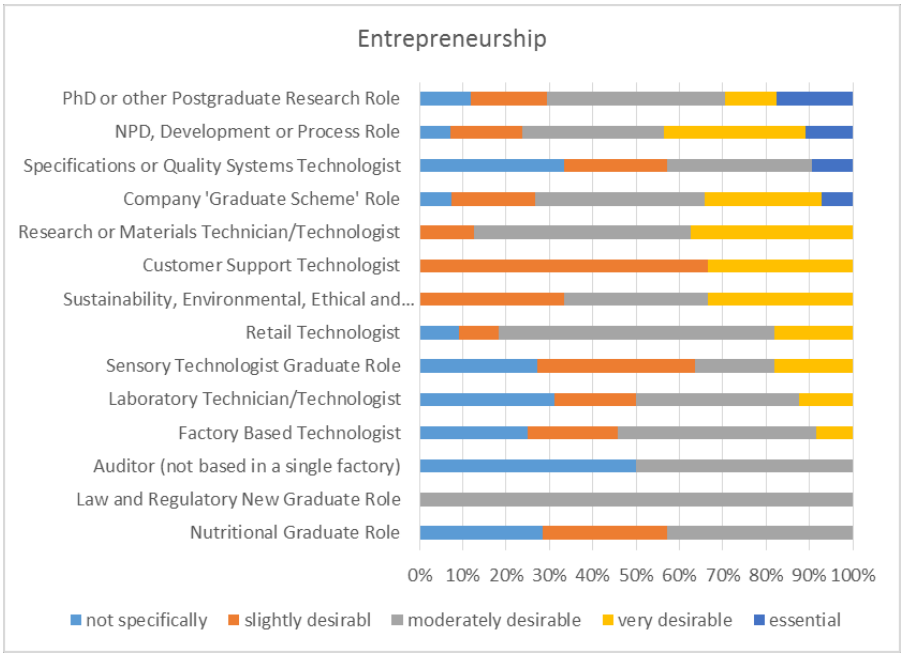
Figure 6.7 provides examples of data presentation by role type and Figure 6.8 illustrates presentation by *element*. *Elements* with the highest desirability to a role could then be identified by combining outcomes of each representation. In general *elements* selected were positioned at the top or left area of the 48 *elements* for each representation. Decisions were supported by use of printed copies of each illustration, to compare results effectively.



Element Sensory - Order for Stacked Bar (5 then 4)	Element Sensory - order for Top 1	Element Sensory - order for Top 2
Thoroughness and Atter	Thoroughness and A	Thoroughness and Atter
Reliability	Confidence	Professionalism
Written Communication	Reliability	Reliability
Confidence	Written Communica	Written Communication
Planning and Organising	Planning and Organi	Application of IT
Application of IT	Initiative	Confidence
Initiative	Personal Responsibi	Initiative
Personal Responsibility	Application of IT	Personal Responsibility
Positive Attitude	Positive Attitude	Positive Attitude
English Proficiency	Questioning Approa	English Proficiency
Collaboration	English Proficiency	Listening
Questioning Approach	Collaboration	Collaboration
Professionalism	Professionalism	Adaptability
Verbal Communication	Verbal Communicat	Questioning Approach
Handling Data	Handling Data	Self-Motivated
Adaptability	Adaptability	Planning and Organising
Resilience	Resilience	Personable
Working Under Pressure	Digital Literacy	Resilience
Digital Literacy	Working Under Pres	Verbal Communication
Teamworking	Teamworking	Handling Data
Decision Making	Decision Making	Working Under Pressure
Resourcefulness	Resourcefulness	Digital Literacy

Figure 6.7 Extract of process of inspection of data by role type with Specifications Technologist as an example, and elements of interest highlighted in yellow.

(a)



(b)

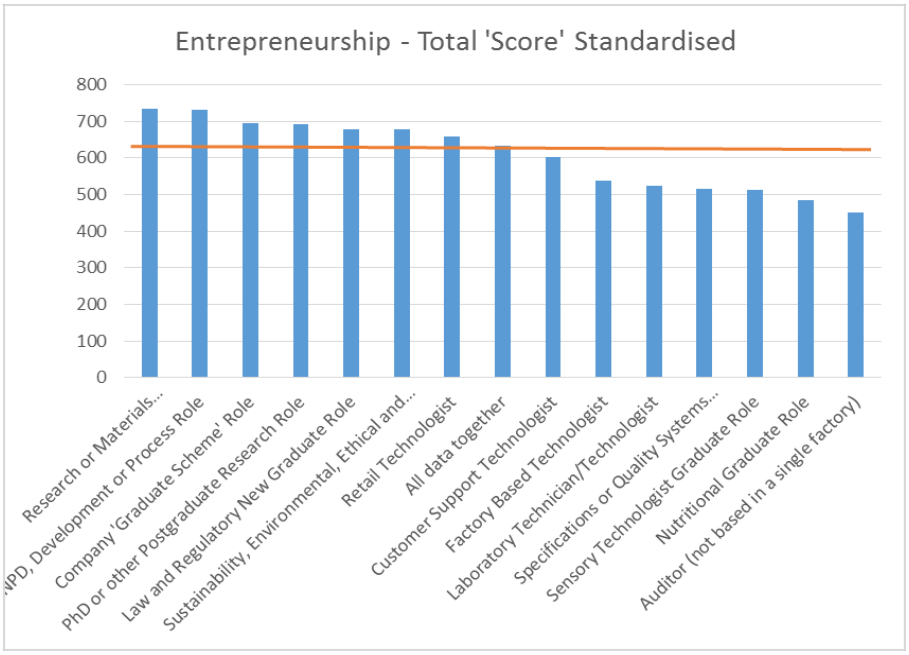


Figure 6.8 Inspection of data by element with *entrepreneurship* as an example where (a) presented a stacked bar chart of response data and (b) a standardised total scoring for comparison to a 'mean' standardised score (red line).

A summary of the collation of outcomes is illustrated in matrix form in Figure 6.9, whereby roles demonstrating higher desirability requirements compared to others are highlighted.

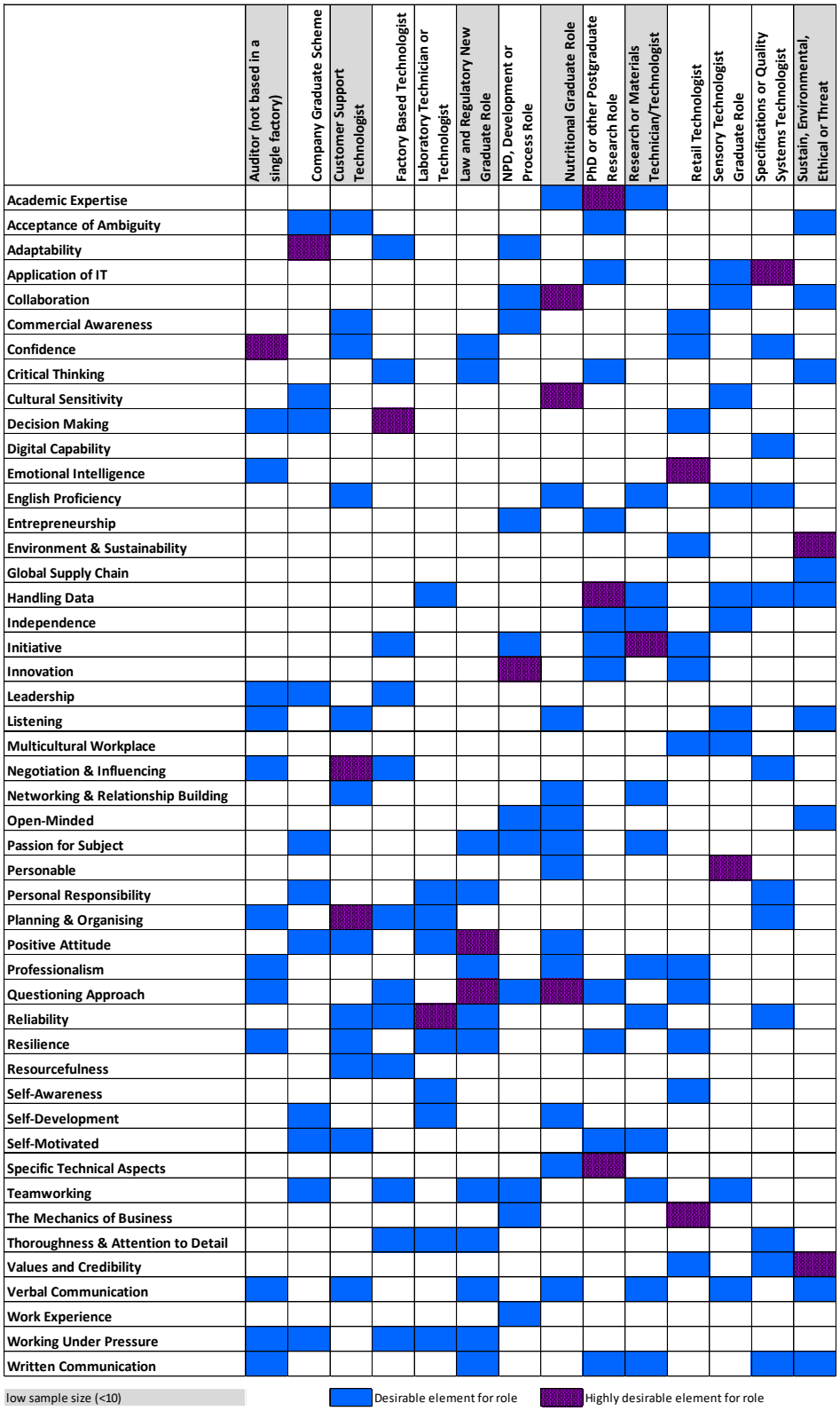


Figure 6.9 Matrix of desirable elements by typical graduate role.

Results varied between role types, however to ensure succinct information for students, the number of *elements* selected was no more than 14 and the final range presented 10-14 desirable *elements* for a role.

6.3.3 Principal component analysis

PCA was performed on the final data set using XLSTAT™. With respect to tests' initial reliability and usability of data, firstly Bartlett's test of sphericity results confirmed suitability for progression, but this test contributes limited value when applied to the large data set and number of variables present in this Study (Field, 2013, Tabachnick & Fidell, 2013).

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy results confirmed all values were >0.6 threshold (the range was 0.67 to 0.88), with only two measuring <0.7 and an overall scoring of 'meritorious' at 0.82.

A review of the factor Eigenvalues was undertaken where the number of values equals the number of variables (48). Using the rule of retaining those with a score of >1, (Stevens, 2009), up to 12 factors could be considered for future analysis (Figure 6.10).

	F1	F2	F3	F4	F5	F6	F7
Eigenvalue	9.859	3.341	2.633	2.123	1.930	1.737	1.577
Variability (%)	20.539	6.961	5.486	4.423	4.021	3.620	3.285
Cumulative %	20.539	27.500	32.986	37.409	41.430	45.050	48.335

	F8	F9	F10	F11	F12	F13
Eigenvalue	1.414	1.382	1.235	1.140	1.092	0.998
Variability (%)	2.947	2.880	2.573	2.375	2.275	2.080
Cumulative %	51.281	54.161	56.735	59.110	61.384	63.464

Figure 6.10 Extract of PCA report illustrating first 13 eigenvalues for the data set, where the number of values generated equals the number of variables.

Observing the contribution of variability of each eigenvalue, PCA tests were run with a succession of six, seven, eight and nine orthogonal (varimax) rotations. After full analysis of these dimensions, eight varimax rotations were determined to present the data most appropriately; the rationale is now detailed.

The variance data for the 8 rotations is summarised below in Figure 6.11, which describes the contribution of variance for each successive component. The four sets of rotations in ascending order produced cumulative variances of: 45%, 48%, 51% (below), and 54% respectively. Inclusion of as much of the variance was desired, if possible, however all are lower than those in commonly found in PCA factor sets. However given that this Study was taking an exploratory approach (Tabachnick & Fidell, 2013), the researcher elected to continue.

	D1	D2	D3	D4	D5	D6	D7	D8
Variability (%)	6.915	6.482	6.593	6.945	8.151	5.772	5.934	4.489
Cumulative %	6.915	13.397	19.990	26.935	35.086	40.858	46.792	51.281

Figure 6.11 Extract of PCA report with eight varimax rotations using XLSTAT™ outlining the contribution of variance of the eight components.

The biplot for the eight 'rotational sets' is shown in Figure 6.12. Although routinely used in PCA, it has limited use here, as it focusses only on the first two dimensions or components, D1 and D2, which as illustrated in Figure 6.11, contribute no more than 14% of the total variance. In addition there are 48 variables in the plot, which presents difficulty in visualisation. However, it is observed that a number of *elements* have affinity to a component, for example *environment and sustainability* to D2, which supports the choice of finalised model as detailed later.

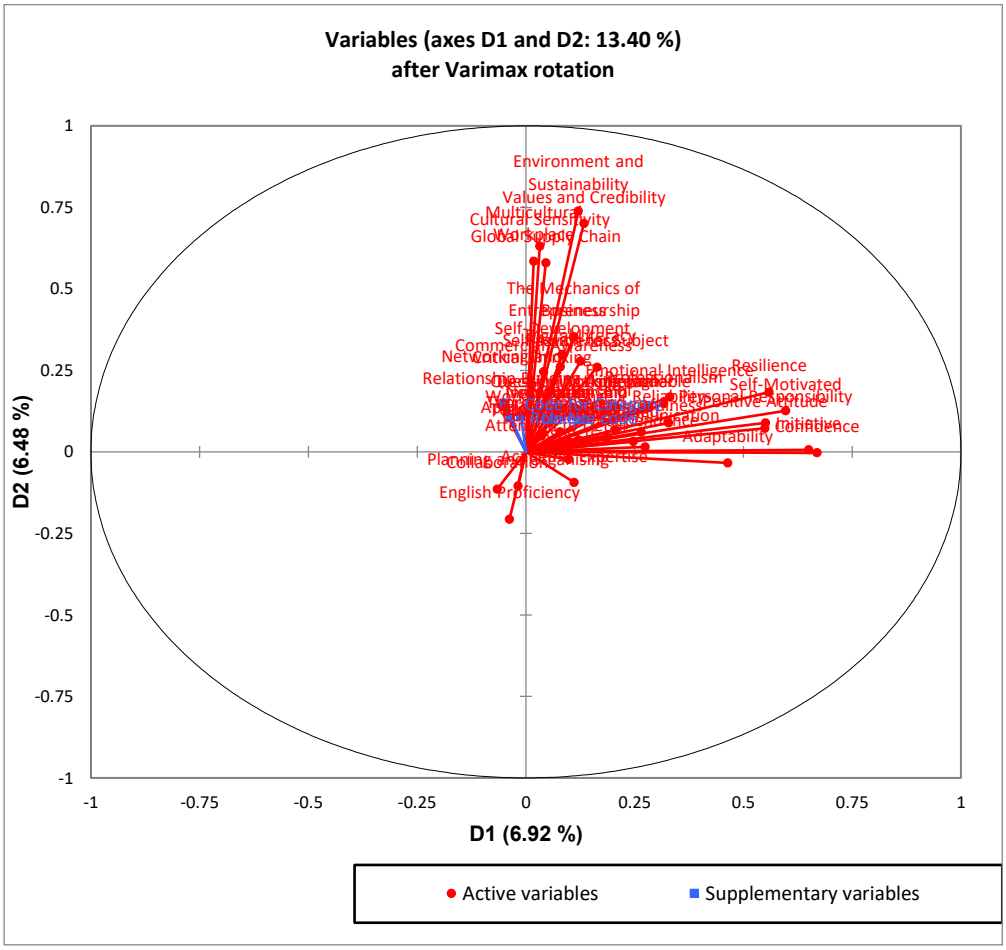


Figure 6.12 Biplot of PCA analysis with eight varimax rotations using XLSTAT™.

6.3.3.1 Examining the factor matrix

Analysis of the factor matrix for each rotational set commenced as described earlier with the associated threshold and cut-offs summarised in Table 6.1.

Initial inspection of the content (*elements*) of each component within each set were inspected to allow for practical reflection of each model with regard to CFGC and project context. For nine rotations, the groupings did not appear rational or simple in terms of what *elements* were found in each group, so progression of this option ceased from this point, leaving three sets to review.

6.3.3.2 Assessing the communalities

Communalities were assessed for the remaining three rotational sets with a nominal threshold of 0.4. For the eight rotational set average communality was 0.51 (Appendix X). Three variables (*elements*) had communalities of <0.4: *acceptance of ambiguity* (0.37), *personable* (0.36) and *self-development* (0.38). Reflecting on guidance from literature included earlier, a decision was made to include all variables. For sets with six and seven rotations, average communalities were lower at 0.45 and 0.48 respectively, with a greater number of individual communalities with <0.4, at 12 and 7, respectively.

6.3.3.3 Identifying significant loadings

With data sorted in each component by descending order of factor loadings for variables (*element*), rotational sets were compared using initial factor loading cut-offs of 0.32 and 0.35 to view which *elements* remained in each component. Any cross-loadings (an *element* in two components) were identified (example in Appendix X).

The test with six rotations resulted in *work experience* being excluded from all components, having a maximum loading of 0.207. After agreement that all 48 *elements* should remain, this set was rejected. With seven rotations, two variables were not included in any resulting factors when the factor loading cut-off was 0.35 (Figure 6.13); *self-development* (D6, 0.337) and *questioning approach* (D6, 0.328). However with eight rotations, all *elements* were included with a 0.35 cut-off. As all *elements* were included using a 0.32 cut-off for seven and eight rotations, both options remained.

	Factor loadings sorted by D5		Factor loadings sorted by D6		Factor loadings sorted by
3	% variability	8.063	% variability	5.429	% variability
	Working Well with Others	D5	Innovation and Creativity (and academia?)	D6	Dependability and Experi
3	**Teamworking**	**0.612**	**Innovation**	**0.722**	**Thoroughness and Attentio**
1	**Negotiation and Influencing**	**0.594**	**Entrepreneurship**	**0.610**	**Working Under Pressure**
6	**Listening**	**0.590**	**Open-Minded**	**0.520**	**Reliability**
2	**Verbal Communication**	**0.562**	**Passion for Subject**	**0.478**	**Professionalism**
8	**Emotional Intelligence**	**0.519**	**Academic Expertise**	**0.407**	**Work Experience**
1	**Collaboration**	**0.508**	**Collaboration**	**0.370**	**Planning and Organising**
8	**Personable**	**0.490**	**Self-Development**	**0.337**	**Personal Responsibility**
1	**Networking and Relationship Building**	**0.474**	**Questioning Approach**	**0.328**	Self-Development
6	**English Proficiency**	**0.448**	Networking and Relations	0.287	Specific Technical Aspects
4	**Self-Awareness**	**0.447**	Commercial Awareness	0.285	Collaboration
7	**Cultural Sensitivity**	**0.386**	Teamworking	0.256	Positive Attitude
0	**Leadership**	**0.375**	The Mechanics of Busines	0.251	Self-Awareness
2	Positive Attitude	0.301	Adaptability	0.238	Resourcefulness
0	Open-Minded	0.286	Initiative	0.226	Teamworking

Figure 6.13 Extract of PCA data from seven varimax rotations. The red box highlights two variables (*elements*) excluded from final outcome with a factor loading cut-off = 0.35: *self-development* (D6, 0.337) and *questioning approach* (D6, 0.328).

Reviewing cross-loadings, with a factor loading cut-off of 0.35 and seven rotations, 9 cross loadings were found, and correspondingly for eight rotations, there were 12 cross-loadings (Appendix X and Table 6.4). Using a 0.32 cut-off, the number of cross-loadings increased further (total of 17 for seven rotations, 15 for eight rotations). Factor loading cut-off was therefore finally set as 0.35.

Reviewing each cross-loaded *element* against the provisional component labels their inclusion appeared practical for each of the relevant components. As such each *element* remained cross-loaded with affiliation to two components. With varimax rotation, the components are independent, so any illustrations developed for CFGC will not specifically associate components or 'themes' where an *element* is cross-loaded.

Table 6.4 Examination of cross-loaded elements from PCA testing with eight varimax rotations.

Element	Cross loaded components		
personal responsibility	D1 D7	Positivity	Dependability and experience
English proficiency	D3 D5	Data, numbers and communications	Working well with others
verbal communication	D3 D5	Data, numbers and communications	Working well with others
entrepreneurship	D2 D6	Appreciation of the wider world	Innovation and creativity (and academia?)
academic expertise	D3 D6	Data, numbers and communications	Innovation and creativity (and academia?)
the mechanics of business	D2 D8	Appreciation of the wider world	The business world
planning and organising	D4 D7	Getting the job done and tackling problems	Dependability and experience
collaboration	D5 D6	Working well with others	Innovation and creativity (and academia?)
leadership	D4 D5	Getting the job done and tackling problems	Working well with others
negotiation and influencing	D4 D5	Getting the job done and tackling problems	Working well with others
cultural sensitivity	D2 D5	Appreciation of the wider world	Working well with others
global supply chain	D2 D8	Appreciation of the wider world	The business world

6.3.3.4 Reflecting on models and provisionally labelling factors

Draft names (Table 6.5) and definitions for each of the components in the two remaining rotational sets were assigned, pending stakeholder group agreement at the project roundtable meeting in summer 2017.

Table 6.5 Provisional labels for PCA components.

Component	Working title
D1	Positivity
D2	Appreciation of the wider world (includes business for six or seven rotations)
D3	Data, numbers & communications
D4	Getting the job done & tackling problems
D5	Working well with others
D6	Innovation & creativity (and academia?)
D7	Dependability & experience (not in six rotations)
D8	The business world

Following the project stakeholder meeting, components or 'groups' became known as *themes*, and the resulting model for eight rotations is illustrated in Figure 6.14.

% variability	6.915	% variability	6.482	% variability	6.593	% variability	6.945	% variability	8.151	% variability	5.772	% variability	5.934	% variability	4.489
Positivity	**D1**	*Appreciation of the wider world*	**D2**	*Data, numbers and communications*	**D3**	*Getting the job done and tackling problems*	**D4**	*Working well with others*	**D5**	*Innovation and creativity (and academia?)*	**D6**	*Dependability and experience*	**D7**	*The business world*	**D8**
Confidence	0.669	Environment & Sustainability	0.739	Application of IT	0.714	Decision Making	0.718	Teamworking	0.615	Innovation	0.726	Thoroughness & Attention to Detail	0.685	Commercial Awareness	0.711
Initiative	0.650	Values & Credibility	0.701	Handling Data	0.633	Critical Thinking	0.626	Listening	0.591	Entrepreneurship	0.641	Working Under Pressure	0.573	The Mechanics of Business	0.685
Self-Motivated	0.597	Cultural Sensitivity	0.631	Specific Technical Aspects	0.588	Independence	0.543	Negotiation & Influencing	0.577	Open-Minded	0.531	Reliability	0.524	Global Supply Chain	0.439
Resilience	0.559	Multicultural Workplace	0.585	Written Communication	0.579	Resourcefulness	0.512	Verbal Communication	0.559	Passion for Subject	0.508	Work Experience	0.499		
Personal Responsibility	0.551	Global Supply Chain	0.580	Academic Expertise	0.568	Planning & Organising	0.504	Emotional Intelligence	0.528	Academic Expertise	0.394	Professionalism	0.494		
Positive Attitude	0.549	Entrepreneurship	0.352	Digital Literacy	0.542	Leadership	0.451	Collaboration	0.523	Questioning Approach	0.373	Planning & Organising	0.435		
Adaptability	0.464	The Mechanics of Business	0.352	Verbal Communication	0.394	Acceptance of Ambiguity	0.446	Personable	0.491	Self-Development	0.372	Personal Responsibility	0.385		
				English Proficiency	0.357	Negotiation & Influencing	0.411	Networking & Relationship Building	0.477	Collaboration	0.360				
								Self-Awareness	0.463						
								English Proficiency	0.457						
								Cultural Sensitivity	0.402						
								Leadership	0.364						

(numeric values against elements are factor loadings)

Figure 6.14 Model with *themes* generated from eight varimax rotations illustrating associated elements under each *theme*.

6.3.3.5 Factor scores analysis

Factor score data for rotational sets provided in the PCA test reports were grouped by role type, and the mean scores calculated for each *theme,* to provide an initial understanding of the spread of weighting for each *theme* across roles. As explained earlier, initial cut-off points were applied, whereby factor scores of ≥ 0.40 or ≤ -0.40 were considered significantly positive or negative. Alternative shading was again applied to roles with sample sizes less than 10. An extract of data for eight rotations in Figure 6.15 illustrates how the results could then be evaluated. There was little to discriminate between both rotation sets left to consider. It is of interest that the 'PhD or Postgraduate Research' role has relatively strong association or dissociation with most *themes*, whilst 'Company Graduate Scheme' role appears to have no specific association to any of the *themes*.

	D1	D2	D3	D4	D5	D6	D7	D8
Auditor (not based in a single factory)								**6**
Mean	0.160	-0.480	-0.049	0.870	0.574	-1.058	0.047	-0.470
Customer Support Technologist								**3**
Mean	0.419	-0.187	0.606	0.394	0.611	-0.809	0.070	1.033
Factory Based Technologist								**24**
Mean	**-0.169**	**-0.255**	**-0.316**	**0.752**	**0.004**	**-0.322**	**0.373**	**-0.168**
Company 'Graduate Scheme' Role								**41**
Mean	**0.142**	**0.198**	**-0.369**	**-0.046**	**0.072**	**0.122**	**-0.363**	**0.061**
Laboratory Technician/Technologist								**16**
Mean	**0.067**	**-0.215**	**-0.375**	**-0.857**	**-0.292**	**-0.615**	**0.898**	**-0.293**
Law and Regulatory New Graduate Role								3
Mean	0.360	0.162	0.280	0.002	0.162	-0.333	0.771	-1.061
NPD, Development or Process Role								**55**
Mean	**-0.120**	**-0.101**	**-0.157**	**-0.176**	**0.021**	**0.646**	**-0.009**	**0.404**
Nutritional Graduate Role								7
Mean	-0.308	0.285	0.457	-0.734	0.701	-0.047	0.378	-0.082
PhD or other Postgraduate Research Role								**17**
Mean	**0.456**	**-0.091**	**0.857**	**0.462**	**-0.879**	**0.548**	**-0.604**	**-0.689**
Research or Materials Technician/Technologist								8
Mean	-0.081	-0.394	0.563	-0.020	0.126	0.395	0.000	0.035
Retail Technologist								**11**
Mean	**0.145**	**0.882**	**-0.290**	**0.340**	**-0.169**	**0.088**	**0.063**	**0.315**
Sensory Technologist Graduate Role								**11**
Mean	**-0.520**	**-0.260**	**0.095**	**-0.109**	**0.608**	**-0.796**	**-0.434**	**0.189**
Specifications or Quality Systems Technologist								**21**
Mean	**-0.082**	**0.044**	**0.601**	**-0.230**	**-0.137**	**-0.872**	**0.238**	**-0.215**
Sustainability, Environmental, Ethical and Threat Management Role								3
Mean	0.450	1.621	0.752	0.188	0.597	0.249	-1.341	-0.698

threshold applied +/- 0.40

All scores relative to other data across or down the matrix. No shading indicates close to zero

	Positive factor score		**Positive factor score (low sample size)**
	Negative factor score		**Negative factor score (low sample size)**

Figure 6.15 Extract of initial examination process of role factor scores from PCA testing with eight varimax rotations with columns D1-D8 displaying scores by component or *theme*.

There was little to discriminate between the two remaining options aside from *element* inclusion using 0.35 factor loading threshold. PCA reduces variables to provide meaningful groupings, so choice of components to retain should be made by balancing empirical criteria with theoretical basis (Hair *et al.*, 2014), so a judgement of the 'meaning' of each model was made. Preserving a

discrete component relating to business aspects was concluded as useful when characterising graduate roles, so the model of eight varimax rotations was chosen with an associated factor loading threshold of 0.35. Although a small proportion of cross-loading and lower communalities were detected, a use of contextual understanding of the subject under scrutiny can be included in exploratory research interpretation. With the logical fit of the final eight *themes*, the researcher understood the model to be meaningful for CFGC and the aims of Study C.

Concentrating on the eight *themes* model, data was transposed and split into the 14 role types and the factor score thresholds were further refined to provide better data differentiation between levels of affiliation to *themes*. This affiliation indicates relative desirability of a particular *theme* for a particular role. An example of the development of the information for one of the roles is illustrated in Figure 6.16 and illustration of all 14 roles can be found in Appendix XI. Visual identification of desirability by blue colour shading aimed to provide a simple, comprehensible method for the reader to interpret the final, collated results.

Specifications or Quality Systems Technologist

	Theme	Factor score
D1	positivity	-0.082
D2	appreciation of the wider world	**0.044**
D3	data, numbers and communications	**0.601**
D4	getting the job done and tackling problems	**-0.230**
D5	working well with others	**-0.137**
D6	innovation and creativity (and academia?)	**-0.872**
D7	dependability and experience	**0.238**
D8	The business world	**-0.215**

Key

original strong - grading	<-0.4
original strong + grading	>+0.4

Refined comparative desirability

against the 'theme' (using factor scores)

>0.5	Much more desirable than most other roles
+0.2 to +0.5	
-0.2 to +0.2	
<-0.2 to -0.5	
<-0.5	Less desirable than most other roles

Figure 6.16 Development of PCA factor scores (eight varimax rotation model) illustrating refined desirability of *themes* to the 'Specifications / Quality Systems Technologist' role. Draft labels for the *themes* are included.

6.3.4 Culmination of survey data analysis

After completion of descriptive data analysis and PCA, information was assembled for each of the 14 role types with regard to desirable *elements* and also relative affinity to the new eight *themes*. A report was developed in advance of the forthcoming stakeholders meeting, including outcomes and suggestions for exhibiting the results.

6.4 RATIFICATION BY STAKEHOLDERS

6.4.1 Aims of the session

The session aim was to update the stakeholder group (Chapter 3) about project progression over the preceding 12 months, in particular Study C.

Other matters reviewed and approved by the stakeholder group with a roundtable approach included:

- Consideration of minor amendments to names or definitions of three *elements* within CFGC from Study B.
- Provision of names and definitions for the eight new *themes*.
- Finalisation of the final CFGC model *themes* and structure.
- Agreement of future plans for dissemination and use.

Stakeholders received prior information and a proposed agenda in advance of the session held at Sutton Bonington campus in September 2017. The stakeholder group now included representation from IFST.

6.4.2 Outputs of the session

6.4.2.1 Amendments to CFGC core material

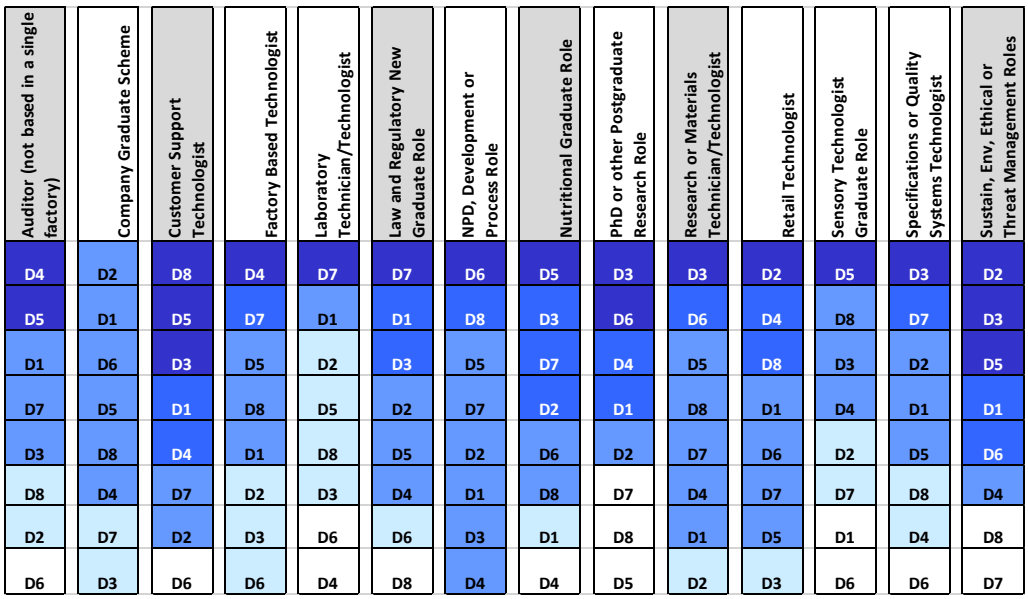
Study B (Chapter 5) endeavoured to test the reliability of the CFGC language tool with students and employers. The student field group interviews held at the three universities, confirmed sound understanding of CFGC except for a few specific areas. Table 6.6 summarises the three *elements* noted by more than one group as unclear in some form, and the amendments agreed with the stakeholders during the September meeting. In addition some minor requested revisions to the 'typical roles' document were agreed (e.g. inclusion of 'food service' sector into text).

Table 6.6 Amendments agreed to CFGC with stakeholder group.

Current element and definition	Revised version (September 2017)
digital literacy - the ability to use digital communications and technologies for your success.	*digital capabilities* - the ability to work effectively and communicate using all available technology for maximum impact.
handling data - the ability to understand, treat and report data with confidence (this may include handling large and complex data sets for some employers).	*handling data* - the ability to understand, manipulate and present data with confidence (this may include handling large and complex data sets).
negotiation & influencing - getting the best outcomes by your approach to working with others by direct or indirect methods/ways.	*negotiation & influencing* - getting the best outcomes for all parties by being persuasive in your approach when working towards an objective.

6.4.2.2 Themes, structure and presentation of CFGC

Presentation of survey outcomes, the eight new *themes* and their relative association to the 14 roles was undertaken. A new pictorial illustration (adapted from Appendix XI) was proposed and approved, indicating relative importance of a *theme* by the darkness of blue shading (Figure 6.17). From the stakeholders' experience, the resulting desirability of *themes* to each role appeared appropriate. For example, a 'PhD' pathway may require a particularly high level of some specific competencies, whereas for a 'Company Graduate Scheme', employers may require graduates to possess a more balanced set of competencies.



(grey shaded roles have sample sizes of <10)

Figure 6.17 Illustration of relative importance of each *theme* in CFGC against each typical graduate role.

The draft names and definitions for the eight *themes* derived from PCA were presented. Each *theme* was reviewed to ensure appropriate definitions were developed with the student as target audience. The final construct is presented in Table 6.7.

Table 6.7 Construct of eight *themes* of desirable competencies in CFGC.

Theme		'Explanation' of *theme*
D1	**Positivity**	Having the behaviours that drive success in the workplace
D2	**Appreciation of the wider world**	Engaging and embracing values, processes and ways of working in the industry with a diverse perspective.
D3	**Data, numbers and communications**	The ability to embrace information of all types, then use it and disseminate to best advantage.
D4	**Getting the job done & tackling problems**	Identifying and overcoming challenges to find solutions and reach your goals.
D5	**Working well with others**	Using a variety of styles for effectiveness and synergy in your relationships and activities with others.
D6	**Innovation and inquiry**	Creativity in mind, approach and method to find new opportunities and enable results.
D7	**Dependability**	Harnessing your experiences and skills to establish trust in your ability to deliver.
D8	**The business world**	Appreciation of systems and drivers that produce successful operational performance and profit.

Stakeholders debated transferring the grouping of CFGC from the original eleven *zones* to the eight new *themes*. Consideration was made to appropriate treatment and display of the 12 cross-loaded *elements* if there was a move to eight *themes* using the diagram provided (Figure 6.18). The prevailing view was to provide simplicity and ease of understanding of CFGC to priority audiences, namely undergraduate students and employers, so to use only one grouping in future.

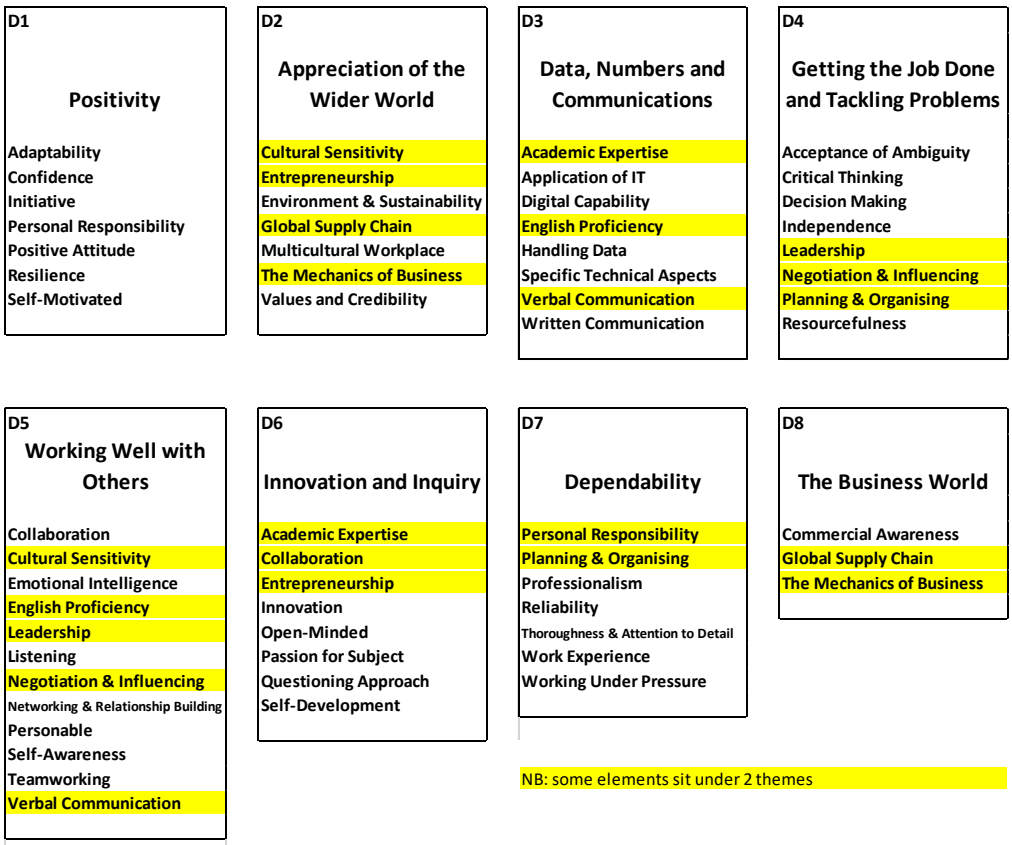


Figure 6.18 New structure of CFGC: suggested method to highlight content of cross-loading of elements (yellow shading).

Unanimous agreement was reached for a transition of the structure of CFGC from 11 *zones* (Figure 6.19a) to 8 *themes*. A new pinwheel design was constructed (Figure 6.19b), and at this stage the project had created,

- A language tool of 48 *elements* grouped into eight *themes*.
- 14 typical graduate roles for food scientists.
- An industry informed model of the desirable *elements* and *themes* for each of the 14 roles.

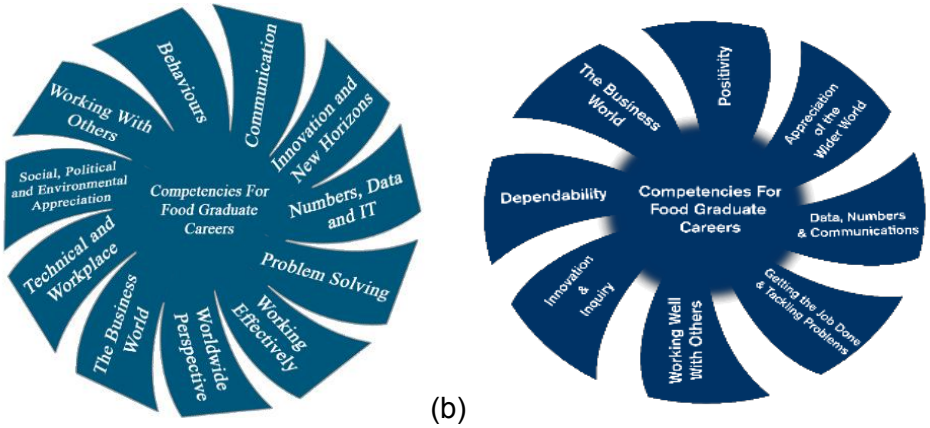


Figure 6.19 Comparison of original structure of CFGC of (a) 11 zones to the new format of (b) eight *themes*.

6.5 DISSEMINATION OF CFGC FRAMEWORK

The range of points of dissemination and use of CFGC was discussed with stakeholders and sessions with students and other industry parties.

6.5.1 Infographic for students

Material created from the project could now be compiled into profiles for each typical graduate entry role, highlighting the key *elements* and *themes* desirable by industry and employers. The profiles were introduced to undergraduate students both during teaching and in any wider communications. Emphasis was given to a simple 'infographic' poster design, and an example of such a profile, the widely recruited 'NPD, Development or Process' role is shown in Figure 6.20.

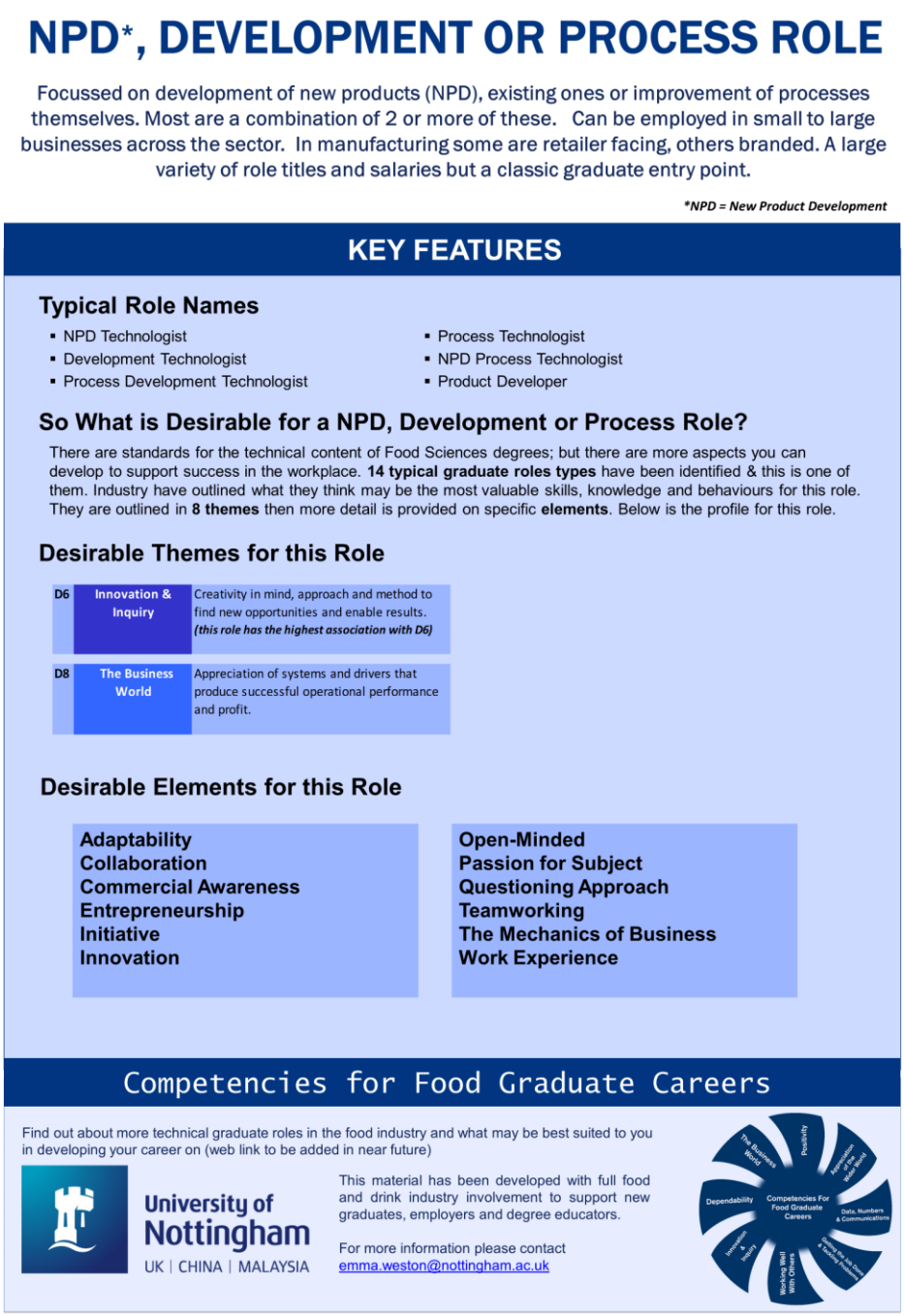
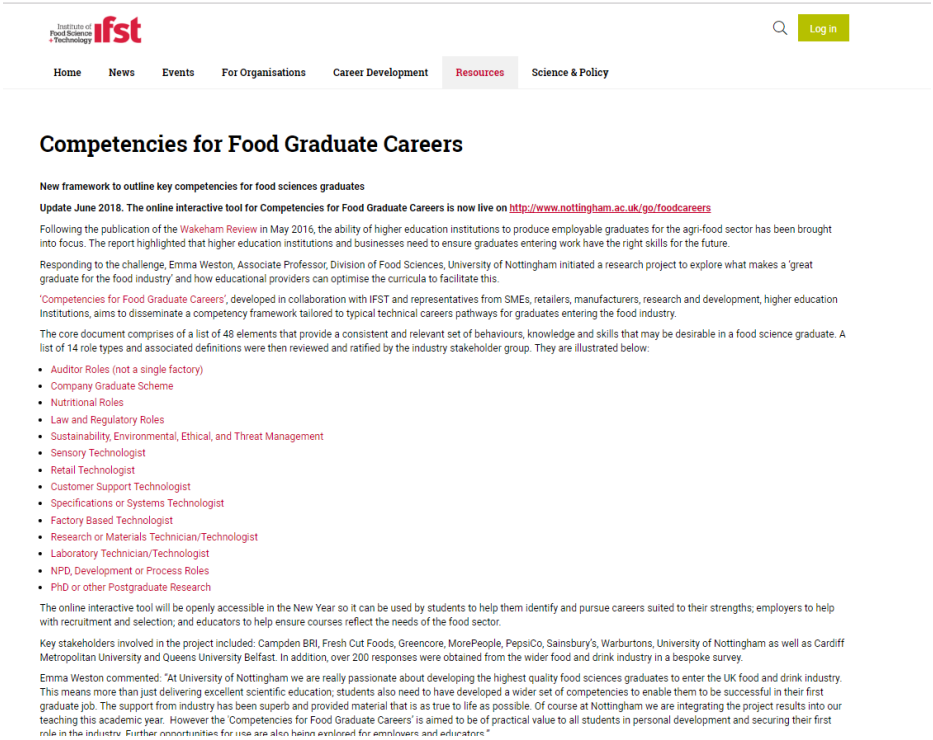


Figure 6.20 Proposed infographic for illustrating role profiles against CFGC, with 'NPD, Development or Process' role as an example.

Infographic posters and fuller details of CFGC were integrated into teaching in the next autumn semester for final year students to test and provide feedback (Chapter 8).

6.5.2 Publication of an industry targeted paper

In collaboration with the stakeholders, a paper was created and published in October 2017 on the IFST website, the leading UK professional body for food science (Weston, 2018a). Freely accessible to other degree educators, students and employers; a screen shot of the current main page is shown in Figure 6.21 and a copy of the original webpage material can be found in Appendix XII.



Log in

Home News Events For Organisations Career Development Resources Science & Policy

Competencies for Food Graduate Careers

New framework to outline key competencies for food sciences graduates

Update June 2018. The online interactive tool for Competencies for Food Graduate Careers is now live on http://www.nottingham.ac.uk/go/foodcareers

Following the publication of the Wakeham Review in May 2016, the ability of higher education institutions to produce employable graduates for the agri-food sector has been brought into focus. The report highlighted that higher education institutions and businesses need to ensure graduates entering work have the right skills for the future.

Responding to the challenge, Emma Weston, Associate Professor, Division of Food Sciences, University of Nottingham initiated a research project to explore what makes a 'great graduate for the food industry' and how educational providers can optimise the curricula to facilitate this.

'Competencies for Food Graduate Careers', developed in collaboration with IFST and representatives from SMEs, retailers, manufacturers, research and development, higher education Institutions, aims to disseminate a competency framework tailored to typical technical careers pathways for graduates entering the food industry.

The core document comprises of a list of 48 elements that provide a consistent and relevant set of behaviours, knowledge and skills that may be desirable in a food science graduate. A list of 14 role types and associated definitions were then reviewed and ratified by the industry stakeholder group. They are illustrated below:

- Auditor Roles (not a single factory)
- Company Graduate Scheme
- Nutritional Roles
- Law and Regulatory Roles
- Sustainability, Environmental, Ethical, and Threat Management
- Sensory Technologist
- Retail Technologist
- Customer Support Technologist
- Specifications or Systems Technologist
- Factory Based Technologist
- Research or Materials Technician/Technologist
- Laboratory Technician/Technologist
- NPD, Development or Process Roles
- PhD or other Postgraduate Research

The online interactive tool will be openly accessible in the New Year so it can be used by students to help them identify and pursue careers suited to their strengths; employers to help with recruitment and selection; and educators to help ensure courses reflect the needs of the food sector.

Key stakeholders involved in the project included: Campden BRI, Fresh Cut Foods, Greencore, MorePeople, PepsiCo, Sainsbury's, Warburtons, University of Nottingham as well as Cardiff Metropolitan University and Queens University Belfast. In addition, over 200 responses were obtained from the wider food and drink industry in a bespoke survey.

Emma Weston commented: "At University of Nottingham we are really passionate about developing the highest quality food sciences graduates to enter the UK food and drink industry. This means more than just delivering excellent scientific education; students also need to have developed a wider set of competencies to enable them to be successful in their first graduate job. The support from industry has been superb and provided material that is as true to life as possible. Of course at Nottingham we are integrating the project results into our teaching this academic year. However the 'Competencies for Food Graduate Careers' is aimed to be of practical value to all students in personal development and securing their first role in the industry. Further opportunities for use are also being explored for employers and educators."

Figure 6.21 Screenshot of the CFGC webpage on IFST website (Weston, 2018).

6.5.3 Further dissemination to industry

The researcher has been invited to attend the bi-annual members' meetings of the Training and Development group at Campden BRI (n.d.) since March 2017, to share CFGC with industry. Having presented three times at the time of writing, the sessions have introduced the framework and its intended use in

supporting the development of 'oven-ready' graduates. In the latest meeting (September 2018) a session was organised to explore the use of CFGC in recruitment by examining past advertisements against a suitable CFGC role profile (Figure 6.22) and developing more targeted content.

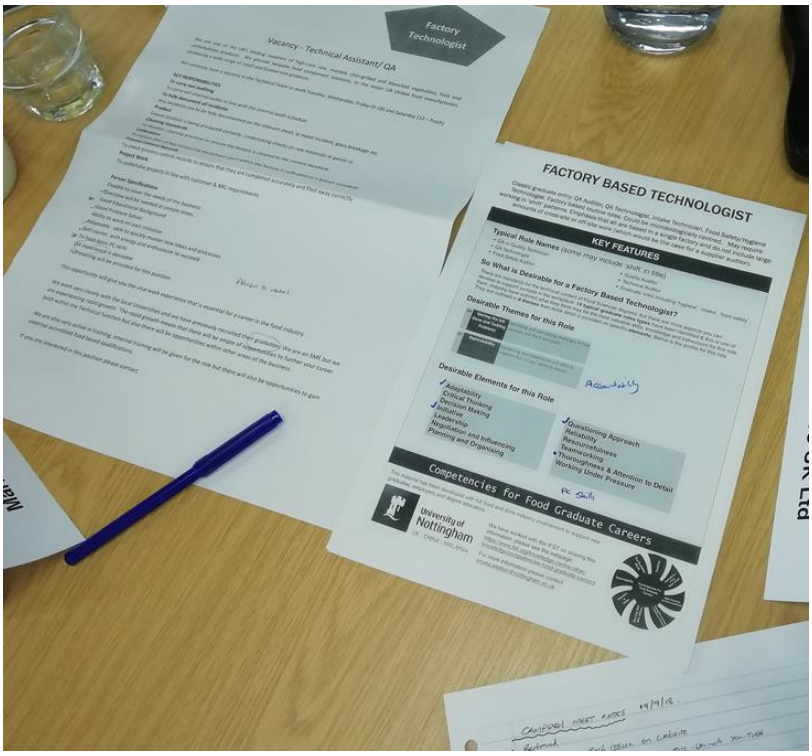


Figure 6.22 Review of CFGC against graduate role advertisements by attendees of Campden BRI Training and Development group meeting (September 2018).

Feedback from employers has been encouraging with regard to the use of CFGC in refining job specifications,

> *"I found your session yesterday very interesting and thought provoking. I am hoping to feedback to colleagues so we can take on board some of your suggestions!" (Delegate, Sept 2018)*

In the final Chapter, possibilities of using CFGC for recruitment and selection processes are suggested.

6.5.4 Extension of Study C within the scope of the project

The frequency of particular *elements'* appearance in the 14 role profiles (Figure 6.9) is of interest, and may provide some context to relative priority for development of *elements* in a student cohort. Possible comparisons to results of similar studies are discussed later in the Chapter, and included as an influence within curriculum mapping in Study D (Chapter 7).

Chapter 8 outlines initial integration of CFGC into undergraduate teaching at UoN for the purposes of career education and personal development. Inclusion was focussed on final year students (year 3 of core curriculum) in a specific module during autumn semester 2017. The suggestion of developing an interactive open access CFGC online tool, targeted at a wider field of students and new graduates was well received by the stakeholder group. The intention was to provide careers guidance for students, to support personal development and job application preparation. Options for developing the tool were reviewed and work commenced in October 2017, also outlined in Chapter 8.

6.6 OVERVIEW AND IMPLICATIONS OF STUDY C

6.6.1 Strengths and limitations of Study C

6.6.1.1 The industry survey

The use of the survey scale with undefined intervals between scale points or labels required the treatment of data as ordinal. Although others have treated similar scales as parametric data in the past (Waple, 2006, Hege *et al.*, 2010), the researcher chose to adhere to guidance and use non-parametric data analysis, which limits data handling options. The alternative was to try to

define scale points with trusted intervals and then instruct or train participants to use the scale effectively. As target survey participants were 'untrained participants' remotely spread across UK and the Republic of Ireland, this was not possible at the time, or likely to be in future. The inclusion of more points on the scale e.g. seven may have created more differentiation, but also may have provide clutter on a text labelled scale and five was a sensible approach for a unipolar scale. In addition, Dillman *et al.* (2014) state simpler scales reduce burden on respondents and suggest they may also avoid error from asking them to be, "more precise than they possibly can be" (p.151).

Assumptions have been made that all respondents completed information truthfully, however this cannot been fully verified. Exploration of responses during PCA has not indicated grouping of responses by subpage, and results produced meaningful *themes* which indicates confident consideration was made when making responses.

Limitations are also present in the relatively low sample size (<10) for six of the typical graduate roles (sizes ranging from three to eight). Removal of the data contravened agreement that all roles should be explored and presented to students, and it was expected some roles would not receive high levels of participants as few of those jobs are routinely recruited. Understanding robustness may be compromised, analysis and interpretation was undertaken with careful consideration throughout Study C. In addition, roles with low sample sizes are identified in all outputs and published material to highlight possible limitations.

Chapter 3 summarises past studies that shaped the choice of methodology in this project, including the prevalence of surveys in identifying types of

competencies desired in a future employee (González-Martínez *et al.*, 2015). Others collate data in a broader sense, then agree final outcomes in an expert forum (Perera *et al.*, 2016, Joyner, 2016). Mayor *et al.* (2015) in the ISEKI project uses a collation of surveys and workshops. Suleman's (2018) recent comparison of past approaches to building these frameworks suggests caution in providing a predefined list of skills to employers or graduates; however as this project utilised the viewpoints of employers themselves to build the lexicon and associated definitions (as suggested by Suleman), this is hoped to provide the required validity.

6.6.1.2 Generalizability, repeatability and influence of survey format

Generalizability assesses whether an approach or framework is applicable for use outside of the context or population of the experiment and whether it can be extended to the population at large (Field, 2013, Hair *et al.*, 2014). Initial confirmatory work by splitting the original data set, and retesting did not indicate the final model has significant generalizability. This suggests the Study and criteria applied be treated more as a discrete experiment, and studies with alternative context should be approached as new. However if the same survey was undertaken with the same population type of UK food industry employers, there is a likelihood it would have repeatability. It appears to be a sound indicator to students and HEIs of which desirable *themes* are aligned to different food science graduate roles.

Examination was undertaken to explore if there was any influence on responses, from splitting the 48 *element* questions into 14 subpages or *zones* (or part of *zones* for *behaviours* and *working effectively*). Some *zones* have similar grouping to the new *themes*, so for example the new *theme,*

D2 - *appreciation of the wider world* contains two original *zones, social, political and environmental appreciation* and *worldwide perspective*. Conversely *behaviours* has spread across a number of new *themes*. This suggests the participants have not simply grouped responses by page, otherwise all PCA *themes* would correspond directly to subpages. Further discussion on the new *themes* continues later in this Chapter.

As for all studies of this nature, CFGC captures a time framed view of UK and Republic of Ireland employers in 2017. The CIPD (n.d.) are clear supporters of competency frameworks but acknowledge criticism they can that they can focus on the past, and struggle to keep up to date in rapid change. However as there is currently no equivalent framework of any age in the UK it is reasoned that having a tailored framework in place for food sciences students to utilise is more beneficial than none. Some European-wide regional variations in desirable 'soft skills' for food science roles in industry were observed by Flynn *et al.* (2013b) so this is noteworthy for any future thoughts of transferability outside of the project scope.

6.6.2 Comparison of data to previous studies

Firstly, as introduced in section 2.7 there is limited cohesive previous work to define and describe typical roles for food sciences graduates as presented in this project (Figure 6.5). The UK-based careers information summarised in Table 2.5, for example 'Tasty Careers', is not graduate or technical specific and the derivation of any brief role descriptions is not made clear.

As previously appraised, the only book found dedicated to food science careers (Hartel & Klawitter, 2008) does provide variable levels of detail on competencies for some graduate roles in the USA. However the information

provided in each chapter is by a single specialist from the field (or in chapter 18, two specialists) rather than larger employer populations and the structure of the book does not allow for ease of comparison or provide a complete review of all roles. Direct comparison to the CFGC is not practicable. Hartel's 10 pathways (chapters) are largely similar to the 14 typical roles established in this project which is encouraging. However for example, the 'sensory technologist' is incorporated in chapter 22, entitled 'research and development', which is perhaps not completely correct as it can be a routine role and may require a different set of desirable competencies.

Using the frequency of inclusion of a CFGC *element* into one of the 14 typical graduate roles, those with a higher count are illustrated in Table 6.8. For general employability frameworks some 'skills' appear in most studies and include technical (IT), analytical, communication and teamworking as well as 'personal traits' (Suleman, 2018). These all (aside from the IT skills) appear to correlate well with Table 6.8.

Table 6.8 Frequency count of inclusion of desirability of an *element* into one of the 14 role profiles in CFGC. Those with a count of five or more are displayed.

element	frequency
Questioning Approach	7
Verbal Communication	7
Handling Data	6
Reliability	6
Resilience	6
Teamworking	6
Written Communication	6
Confidence	5
English Proficiency	5
Initiative	5
Listening	5
Passion for Subject	5
Planning and Organising	5
Positive Attitude	5
Professionalism	5
Working Under Pressure	5

From a food science perspective there is limited evidence of establishing employer's requirements for graduate competence. One institute (Morgan *et al.*, 2006) engage their Industry Advisory Board by use of a survey, to establish relative importance of constituents in the entire IFT standard (2016). Results for 'success skills' (Figure 2.16) are included in Appendix I, where 11 of the 13 'outcomes' of the 'success skills' group are rated relatively highly. However the authors' acknowledge the limitations of a restricted sample which is not representative of the food industry. There is also no consideration of changes in relative importance of competencies, dependant on graduate role undertaken. Another later study (Johnston *et al.*, 2014) engaging with USA employers, focusses on desirable competencies for food safety

curriculum specifically. Results from five 'core domains' of which one, less technical in focus, centres on 'communication and education' which appears to include the CFGC *elements* of *written, verbal communication, listening, academic expertise* and *digital capability*.

Only recently Joyner and Stevenson (2017), by use of a series of surveys with a small groups of experts and gaining consensus, ask employers what quality management skills may be desired, or are currently lacking in graduates. Their focus was primarily on technical skills with only a brief reference to a few 'soft skills' that are lacking.

Extensive Europe-wide work undertaken by ISEKI has generated skills lists including 'soft skills' for food scientists and technologists (FST) but not specifically for graduates (Flynn *et al.*, 2013b, Mayor *et al.*, 2015) by utilising previously developed lists and then working with employers on prioritisation. The outcomes of Flynn's study (Table 2.3) establish 'communicating' as the number one sector or non-sector skill (a soft skill) which aligns well to high counts of *verbal* and *written communication* in the CFGC in Table 6.8. With the 'regional variation' observed, only in the south does 'working with others' reach the top three (aligned to CFGC), where in the northern region, a technical skill, 'product development' is rated highly (Flynn *et al.*, 2013b).

The titles of the seven sections of 'generic skills' in the UK's QAA benchmark standard (2016) for Agriculture, Horticulture, Forestry, Food, Nutrition and Consumer Sciences (Table 2.2) are not opposed to the *elements* in CFGC. However they cannot be compared, as no weighting is provided for material in the fuller table, generally or by degree course, much less specific career pathways on graduation. As noted above, the USA does have the IFT

Undergraduate Education Standard (2016) for food sciences courses with seven ‘success skills’ (Figure 2.16) broadly outlining requirements that are included in the 48 *elements* of CFGC. For both contexts it is unlikely anyone would question the advantage of possession of the ‘skills’ listed in both documents, including ‘communication’ and ‘interpersonal’ skills, but no detail has been given on weighting of these specific competencies required for different food science graduate roles.

Other studies in the field have focussed on seeking to understand what competencies may be lacking in current graduates (Bohlscheid & Clark, 2012, Flynn *et al.*, 2013a, Flynn *et al.*, 2017), as opposed to capturing desirable profiles, so are discussed in the next Chapter.

In summary in the UK, CFGC fills a novel gap in knowledge, superseding only general profiles, with no indication of competency desirability within lists provided. Previous resources are suggested to have limited use for food sciences graduates, based on the variety of role profiles identified in CFGC, with diverse pathways and associated criteria for selection. Although studies have been undertaken to investigate into specific pathways in other European studies and in the USA, there appears no other framework published, encompassing desirable competencies for typical food science graduate roles.

6.6.3 Development of framework terminology

Progressing from Figure 4.6, the diagram tracking the process of project terminology development can be further updated as seen in Figure 6.23.

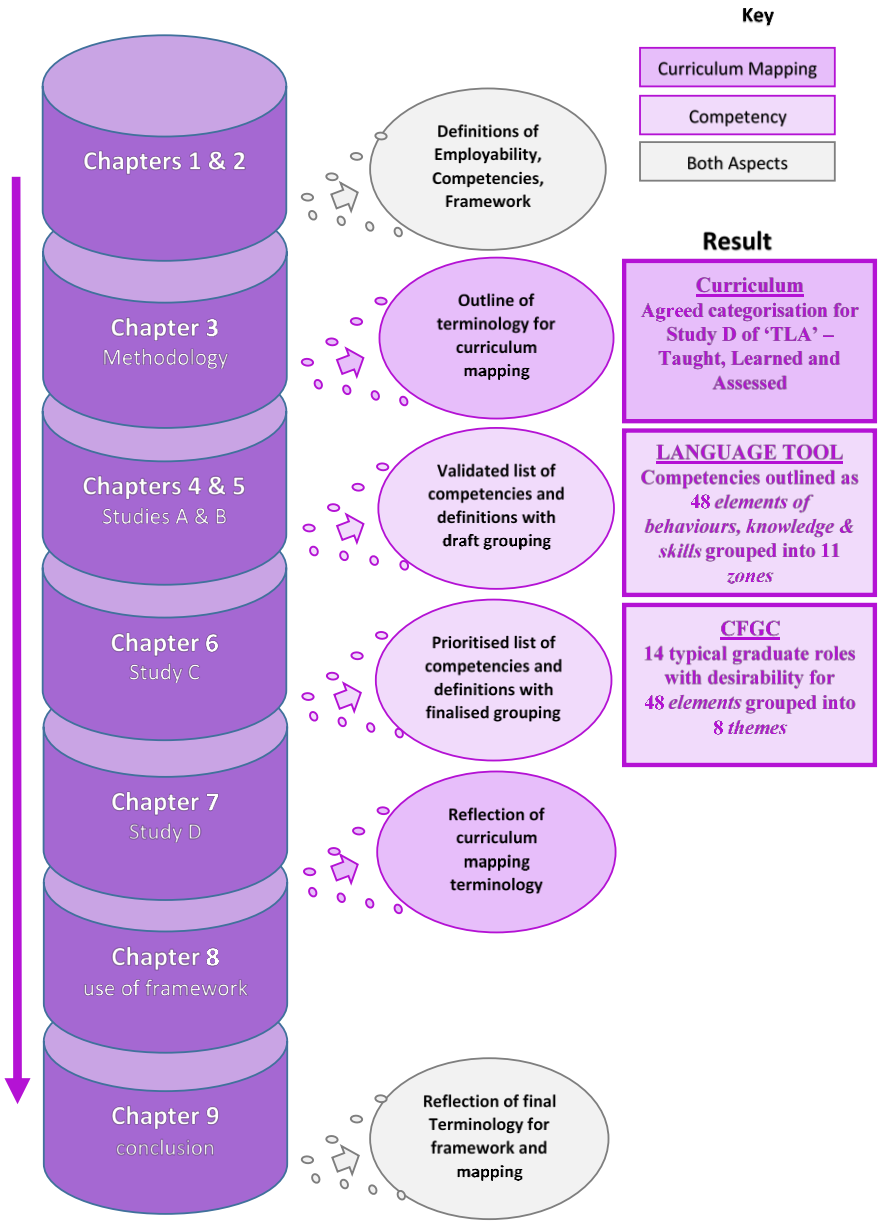


Figure 6.23 Updated diagram to illustrate the progress in terminology development and classification during the project after Study C.

As summarised by the diagram, a composition of the 48 *elements* to comprise CFGC remains as before. However results from performing PCA on the industry survey data, ratified by the project stakeholder group, provided a new grouping, of eight *themes* to replace the original 11 *zones*. This has resulted

in the spread of the 15 *elements* in the *behaviours zone* into five of the new *themes* (D1, D4, D5, D6, D7, see Figure 6.18), however it is worth noting seven have specifically grouped to form *theme,* D1 – *positivity*. Differentiating groups into types of *elements (*behaviours, knowledge and skills) has thus ceased. Reflecting on consideration of elements that are more knowledge-based, for example *commercial awareness* (section 5.4.5), it is worth noting there is no clear assignment of such elements into a particular *theme*.

In addition, 14 typical graduate roles have been outlined, approved by the stakeholder group and utilised in the industry survey to create tailored profiles outlining desirable *elements* and *themes* to each role (Figures 6.17 and 6.20).

6.7 CONCLUSION

A Likert style, UK, industry-wide survey was completed involving 218 participants from a broad range of food sciences employment areas, evaluated by a combination of multivariate and descriptive data analysis. Results are subject to accuracy of the survey sample, but indicate that in the UK food industry, types of desirable qualities in a food science graduate can be divided into a framework of eight *themes* comprising 48 *elements*. 14 typical roles to enter the industry as a food science graduate were identified and relative affinity or 'desirability' of *themes* and *elements* to each role established. A format for the use and presentation have been presented.

Study C aimed to capture the views of employers and develop a framework to illustrate what they desire in a food sciences graduate. By clearly engaging with industry stakeholders in defining the terms and language to use (Studies A and B) and providing a distinct list of graduate roles, a bespoke baseline

was provided with a high level of 'face validity' (Sapsford & Jupp, 2006). In shaping a suitable survey and ensuring wide industry participation, a unique data set was acquired and subsequent to suitable data analysis, a framework of desirable competencies for 14 typical roles has been produced highlighting there is no general blueprint for an ideal food science graduate.

The encouraging level of industry engagement in the process reflects employers' interest in ensuring degree providers develop 'oven-ready' graduates. Beyond the scope of the project, it is suggested that the industry survey be repeated a few years hence, using the same approach as Study C. The aim would be to test repeatability, but also to gauge if employers have altered opinions of the desirable competencies for food science graduates. With respect to possible direct benefits to employers, the interest in selecting and recruiting the right person for a job is significant. The CIPD (n.d.) assert effective recruitment should find for a given role, the right people, at the right time, and in doing so saves money, resource and time. There could be significant value in employers using CFGC to improve the accuracy of their recruitment and selection processes and this will be discussed in Chapter 9.

Chapter 7 Study D - Curriculum Mapping

7.1 INTRODUCTION

The creation of the CFGC framework has now been presented, from inception in Chapter 4 (Study A), testing in Chapter 5 (Study B) and establishing employer desirability in Chapter 6 (Study C). The application of CFGC for undergraduate careers education and exploration of wider uses will be explored in Chapter 8. Firstly, Chapter 7 aims to address research question 2 completely,

> *Question 2. Using a case study at University of Nottingham do current vocational degree courses provide these competencies?*
>
> *Sub-question 2a. How are the key competencies included in course teaching at University of Nottingham?*
>
> *Sub-question 2b. What recommendations to curricula design may be made for the future?*

Study D aims to establish where opportunity for development of each of the 48 *element*s of CFGC exists within current curricula at UoN. Study C has provided evidence of employers' desirability of CFGC in graduates. This aligns to research with food science employers in the USA (Morgan *et al.*, 2006), identifying a high desirability for IFT 'success skills', concluding that these skills should be embedded throughout the curriculum. Beyond the direct mapping of course content, two indirect factors were added to Study D. Perceptions of recent graduates were sought, aiming to provide some measure of effectiveness of delivery. In addition, drawing from Study C data,

employers' desirability for each *element* can provide a 'level of importance' to contextualise content evaluation. These indirect measures aimed to support a more comprehensive investigation of programme effectiveness (Hartel & Gardner, 2003). Following description of data interpretation, extracts of the report prepared for the Division of Food Sciences is then presented, outlining any recommendations made to address key gaps by enhancement of: content, delivery, communication or assessment.

In summary, the aim of curriculum mapping in Study D was to ascertain if desirability of an *element* or competency as indicated by employers, was reflected in an equivalent level of course content, appropriately perceived by the student. The ideal would be to achieve 'congruence' (Waple, 2006) where for example, if the desirability is 'high', then the course content and student perception of inclusion should also be 'high'.

With an understanding that no past single approach met the requirements of Study D, an initial protocol was developed, supported by an iterative approach for the main investigation.

7.2 APPROACH

An introduction on the choice of approach undertaken for curriculum mapping can be found in section 3.2.7. Initial requirements to frame Study D centred on mapping only core modules studied and the ability for each module convenor (teaching lead) to engage with the mapping process. In determining inclusion of an *element* in a module, quantification was sought, as well as consideration of both formal and informal inclusions. To provide context to the data for each *element*, it was aimed to establish some perception of both

effectiveness of inclusion and also understanding of how important each *element* was to work readiness. Finally if possible, consideration of any common broader development opportunities within course study was sought. These requirements shaped the design of Study D, illustrated in Figure 7.1.

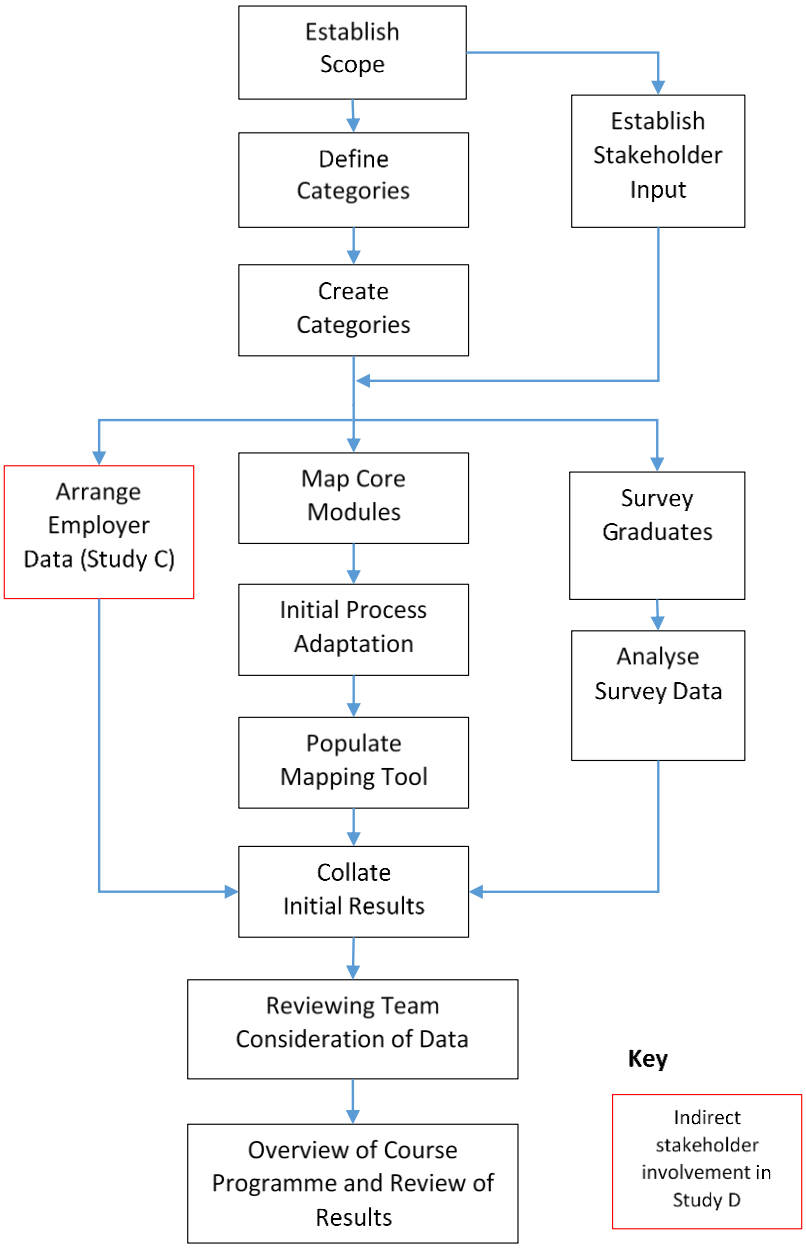


Figure 7.1 Approach taken for curriculum mapping in Study D.

An initial ‘mapping team’ and subsequent ‘reviewing team’ were created with staff from the Division of Food Sciences. The mapping team comprised the researcher in partnership with a fellow academic colleague, to encourage reliability. Initial protocol and plans were agreed and piloted on three modules. After this pilot, the process was refined for use in all future activities and any amendments or reflections shared and actions taken progressively. The larger ‘reviewing team’ included towards the end of Figure 7.1, included those responsible for overall degree programmes, namely the two course directors and the Head of the Division of Food Sciences, and were engaged in the later stages of the study for inspection and interpretation of data across programmes.

Module convenors were engaged in their own module mapping processes to ensure accurate data was obtained. As suggested by Jacobs (2004), the process of planting seeds in advance was employed, aiming to engage with module convenors on the possible benefits of the exercise in advance of working sessions (Barrie, 2007). Sessions with module convenors to review evidence and reach consensus of inclusions, were followed with further appraisals if required, to support reliability of mapping activities. Regular checks were employed initially by the mapping team (Sumsion & Goodfellow, 2004, Hale, 2008, Spencer *et al.*, 2012) and following final data collation, by the reviewing team.

Bloom’s (1976) original description of the ‘latent curriculum’ shaping individual learning as embraced by Bath *et al.* (2004), Hege *et al.* (2007) and recommended in hindsight by Spencer *et al.* (2012) was appreciated, so by involving graduates, understanding student perception of the content of

course programmes would support the success of Study D. The voice of the employer (Morgan *et al.*, 2006, Perera *et al.*, 2016) was a significant consideration to be incorporated. Study C created a unique employers' viewpoint of desirability for each of the 48 *element*s in CFGC with respect to graduate jobs and could be harnessed for use in the mapping process.

7.3 METHODS

7.3.1 Scope

As introduced in section 1.4, the core programmes of BSc (Hons) Food Sciences and BSc (Hons) Nutrition and Food Sciences (University of Nottingham, n.d.-b), were the focus of Study D, and work progressed from the summer 2017 for 10 months. A flexible approach was undertaken to facilitate the two degree pathways (Joyner, 2016), where each core module was mapped discretely. Pertinent course details are summarised in Table 7.1.

Table 7.1 Course programme key features (status at summer 2017).

BSc Course Programme	Total core modules (10, 20, 40 credits)	Modules not shared with the other programme	Additional optional module spaces
Food Science	21	2	2 / 3
Nutrition and Food Science	22	3	1

Courses undergo routine development, based on student, staff and employer feedback so no cohort will have an identical experience, however programme level learning outcomes have remained the same over recent years. In the first year, content is common to both programmes (however prior to 2017, the 10 credit physiology modules were different). In years two and three, the

programmes partly diverge with food science students taking microbiology modules, whereas the nutrition and food science cohort take nutritionally focussed alternatives. They have comparatively limited optional module credits which can be chosen from related biosciences topics, or broader subjects including business skills or languages. Some optional modules were included in the mapping activities to generate a wider view of opportunities for students, but were not included the main data analysis or this project scope.

7.3.2 Stakeholder engagement

The following stakeholders were identified as necessary to enhance the validity of Study D:

7.3.2.1 Working teams

The mapping team developed protocol, conducted all module mapping and regularly reviewed progression and data collected together to ensure processes applied were correct and consistent. The reviewing team provided a broader assessment of resulting data, ratified outcomes of Study D and agreed future opportunities and areas for development.

7.3.2.2 Module convenors

Direct involvement of module convenors was considered worthwhile to obtain accurate data. Staff were briefed on the potential benefits of the study, in advance of one-to-one sessions with a member of the mapping team. Any subsequent revisions were made as required until mutual agreements was obtained.

7.3.2.3 Students

Confirming whether students have detected the opportunity to develop each *element* during their education reinforces the effectiveness of the inclusion (or the converse). Online surveys to recent graduates (this having student perspective) provided this data for Study D.

7.3.2.4 Employers

The project stakeholder group (section 3.2.1) participating in Studies A and C remained informed of the mapping activity but were not directly involved in Study D. However Study C generated a unique employers' viewpoint of desirability for each of the 48 *element*s in CFGC with respect to graduate jobs. From this, a desirability factor or 'level of importance' for each *element* was created.

7.3.3 Curriculum categories

As detailed in Chapter 3 (section 3.3), an adaptation of the School of Biosciences (n.d.) 'TLA' system was undertaken by the researcher and the School Director of Teaching and Learning in the spring of 2017. Definitions were revised and the ability to differentiate between formal and informal inclusions added. The process applied was not aligned directly to any one literature source, but took references from past research as illustrated in Table 7.2.

Table 7.2 Categories used for mapping elements for Study D and reflection on associations to past literature.

Category	Definition used in Study D	Alignment to previous studies
Formal	Explicitly contained in modular specification, documentation, assessment criteria or timetabled activities	
Informal	Agreed development opportunities for an *element* present in the module. However not explicit in learning outcomes (LOs), formal documentation or assessment paperwork. E.g. *negotiating and influencing* may be practised/developed in group project work but not explicitly described in LOs or assessment criteria. Also includes where the opportunity for a student to develop is **variable** or where there is only opportunity for a **certain proportion** of the cohort to e.g. lead a team.	Alignment to informal curriculum (and perhaps some of the hidden curriculum) (Hafferty, 1998). Also aligns to consideration by Spencer *et al.* (2012) of confidence of inclusion where by informal denotes limited confidence.
Taught (T)	Anything given to the students, a lecture, document, video, discussion, tutorial, facilitation, coaching, practical session, instruction, training, procedures etc.	Includes declared or intended curriculum (English, 1978, Kelley *et al.*, 2008, Harden, 2001a, Vinten *et al.*, 2016) Also includes most of the taught categories, i.e. that which is presented.
Learned (L)	Anything self-directed, such as study or investigations (note if group or individual). Also include if they practice something e.g. *English proficiency* is developed by the group work, listening developed in a viva voce.	Learned as outlined in study D is included in studies from Kelley *et al*. (2008) or Ramia *et al.* (2016) as learned or experienced or the other part of operational (as above).
Assessed (A)	Some type of assessment included in module teaching whether formative or summative.	Assessed links directly to categories used by authors above termed either assessed or tested.

7.3.4 Mapping code

Table 7.3 illustrates the scoring system applied in Study D for mapping each core module. The maximum scoring of an individual *element* in a module totals 3.7, where formal and informal inclusions in teaching and learning are in place, as well as formative and summative assessments.

Table 7.3 Scoring applied when inclusion of an element is confirmed in a module.

Item	**Scoring given**
Formally Taught	1.0
Formally Learned	1.0
Formally Formatively Assessed	0.5
Formally Summatively Assessed	1.0
Informally included in module (any combination of taught, learned, assessed or a *variable* inclusion)	0.2 (maximum per module for all informal factors is 0.2)
Ideal or benchmark score for a module stating inclusion of an *element* in a module is proposed as 3.0	

This maximum score is unlikely to be achieved in reality. For the purposes of comparing inclusion levels in later stages an 'ideal' inclusion of 3.0 was considered appropriate by the mapping team, where a convenor believed an *element* was explicitly included in a module.

7.3.5 Module mapping exercise

Convenors were initially contacted to outline the project aims and identify a suitable time for initial assessment with one hour as the suggested time for this session. In advance, a process outline (Figure 7.2) was developed by the mapping team.

Curriculum Mapping Work 2017

Process

Send CFGC to the MC or ask for the info below in advance to do a prior review before the meeting (more depth and prep for core modules needed, optional less so)

Review the module documentation, programme details, learning outcomes, timetable and assessment material/criteria

Use the definition of each element of CFGC to help understand each element with the MC

Be clear in type up if a '**Formal** inclusion' - the element is explicitly contained in modular specification, documentation, assessment criteria or timetabled activities, *e.g.* aims to develop presentation skills *(oral communication).*

Or is it an '**Informal** /implicit Inclusion' - the element is developed as part of material or activities in the module but not in LO's or assessment paperwork. *e.g. negotiating and influencing may be practised/increased in group project work but not in LO's or assessment criteria.*
Also includes where the opportunity for a student to develop is **variable** or where there is only opportunity for a **certain proportion** of the cohort to e.g. *lead a team.*

If queries need some more debate after meeting then note down and shade in blue

Definitions of TLA for this review

- Taught – Anything given to the students, a lecture, document, video, discussion, tutorial, facilitation, coaching, practical session, instruction, training, procedures etc..
- Learned – Anything self-directed, such as study or investigations (note if group or individual). Also include if they practice something e.g. English proficiency is developed by the group work, listening developed in a viva voce.
- Assessed – Some type of assessment included in module teaching whether formative or summative. Also note if the term e.g. commercial awareness is in the marking sheet / criteria for the assessment, or if more informal not stated. State the detail as required e.g. written comms is included in coursework lab report.

Keep notes of all material logged and we can reduce/split and refine later

Keep copies of the module information used for the review, paper is fine

Shading on Master Sheet

Purple shading if the element is not guaranteed to be included each year (variable) or not all students get the opportunity to develop it e.g. leadership if one 1 per 5 do this.

needs some further confirmation with MBT/EW or MC

Believed to be a significant or strong inclusion of the element

Finalising/Completion

Once typed up the review then send to the MC (just their column) for sign off or to answer further Qs

Then complete and date

Figure 7.2 Process outline utilised by the mapping team for assessment of each core module with convenors (final version).

A copy of the process outline, plus a detailed CFGC language book (example in Figure 4.5) with full details for each *element*, was provided to the convenor in advance of the mapping session, with a suggestion to undertake some independent, initial review, if the convenor was confident in doing so.

During the session, module material was reviewed against each *element* of CFGC and manual notes were taken using a blank matrix. The scope of material under consideration included formally issued items including: the module specification with LOs, formal student documentation on the UoN internal e-learning platform (n.d.-d), assessment criteria and other formally issued items deemed suitable by the module convenor. Any recent or forthcoming changes to the module content significant to the study were noted.

As module convenors outside the School of Biosciences (n.d.) were unfamiliar the TLA system, a pre-mapping assessment was undertaken by a member of the mapping team. This was relayed to the module convenor prior to the meeting and employed as a basis for the review session.

7.3.6 Initial process review

At regular intervals, progress and data from each module examination were appraised by the mapping team. After mapping three modules, some refining of the process (Figure 7.2) was agreed, notably including the additional step of returning a draft report with any outstanding queries highlighted in blue, before seeking final module convenor approval. Points of query pertaining to specific modules were discussed together before work progressed. Reviews also served to capture any broader details of interest.

7.3.7 Data population

The notes taken from module mapping exercises were initially compiled on Excel as a repository for raw data (Figure 7.3). Quantification of the data were undertaken utilising the scoring system illustrated later in Table 7.4.

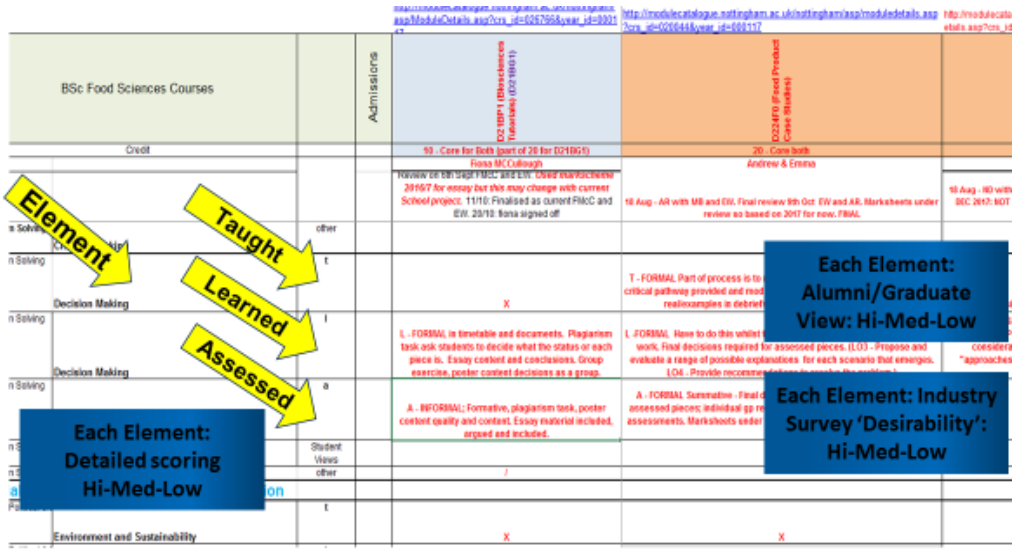


Figure 7.3 Population of module mapping results on a spreadsheet.

In addition, data were entered into UoN curriculum mapping system, a screenshot is provided in Figure 7.4.

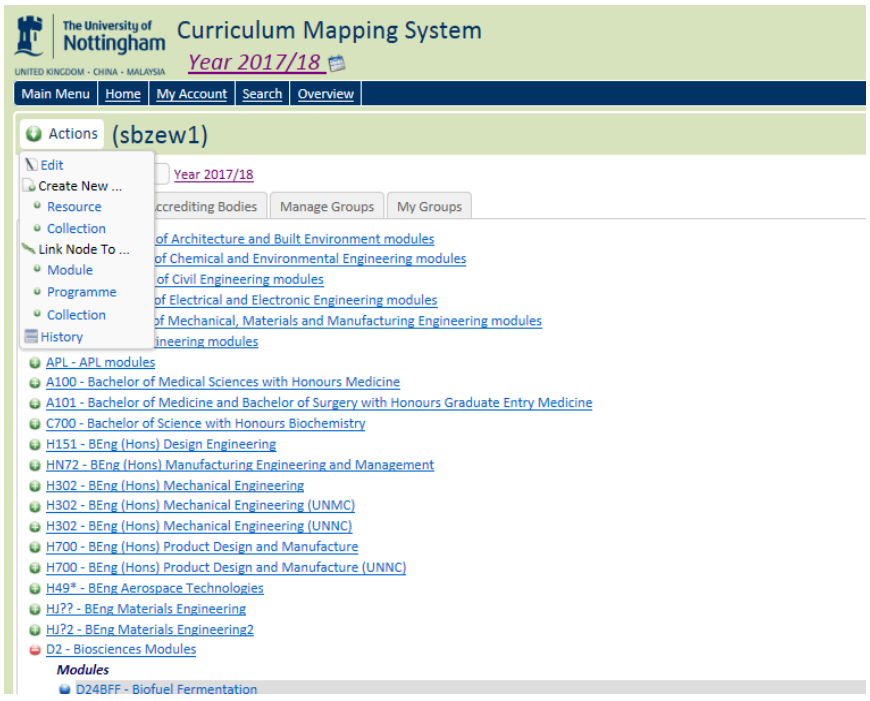


Figure 7.4 Screenshot of UoN curriculum mapping system.

Data from module mapping were input into this system as 'accrediting body outcomes' against each mapped module. Two core BSc course programme reports were constructed, plus another separate repository for optional modules. Data was handled on both systems for the initial stages.

Once populated, data were reviewed by the mapping team and the 'course score' for each of the 48 *element*s was inspected. A simple mechanism to categorise the level of course score was devised as illustrated in Table 7.4. As explained earlier, the 'ideal' nominal inclusion level per module was set at 3.0 and the total course 'ideal' calculated by multiplying by the number of core modules in each course. As the two courses have a different number of core modules, 'totals' reflect this, so for Food Sciences, 3.0 x 21 = 63 and for Nutrition and Food Sciences, 3.0 x 22 = 66. Justification for applying the difference in 'total' was to have representation of the amount core modules (and thus opportunity for development) contributing to a programme. The course score for each element was compared as a proportion of the relevant 'total'. For example, a course score of 6.3 is equivalent to 10% of the total score for a food science course and so would be categorised as 'medium'.

Table 7.4 Method of categorisation of course content.

Category	Criteria	Food Science with 21 core modules	Nutrition and Food Science with 22 core modules
Low	<10% inclusion	<6.3	<6.6
Medium	10-29.9% inclusion	6.3 – 18.8	6.6 – 19.7
High	30% inclusion or greater	18.9 or greater	19.8 or greater

*Based on an ideal score of 3.0 per module to provide '100%'

Colour coding or heat mapping was applied to the results to illustrate levels of inclusion more clearly on the spreadsheet, however the internal curriculum mapping tool was initially utilised to produce this.

7.3.8 Graduate survey to gather student perception

Gathering information from graduates having completed full degree study was considered a useful mechanism to source student perception of CFGC within courses. An 'indirect' approach (Suleman, 2018) in the form of an online survey, gathered student perception of 'inclusion levels' of CFGC *element*s in their studies.

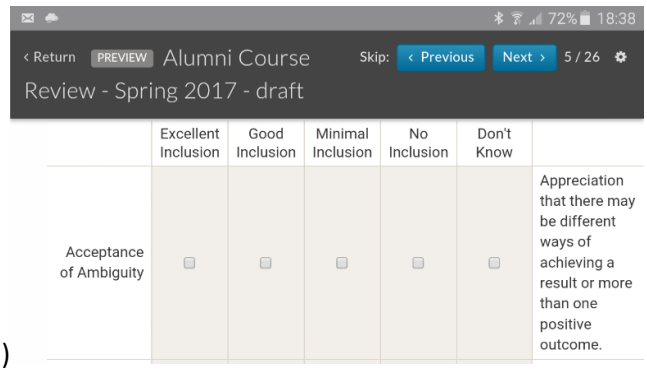
7.3.8.1 Development and launch of survey

An adaptation of the industry survey from Study C (section 3.2.5) was issued to graduates from 2015, 2016 and 2017, an extract can be found in Appendix XIII. Reflecting cohort numbers, target sample sizes were lower for this activity.

Study D asked graduates to recall perceptions from the past, rather than take a view for future requirements (as the 'desirability' context for the industry survey). Introductory text included, 'We will ask you to review a list of competencies and confirm their level of inclusion in your degree studies', and questions were designed to ask graduates to what level each *element* was included in their course (example can be found later in Figure 7.6). Optional open text questions with less structured prompts (Bohlscheid & Clark, 2012) were included on each page, for participants to provide any detail they may recall where an *element* was included in specific modules.

Similar to other student or graduate surveys, questions were structured in a five-point unipolar 'Likert style' (Hege *et al.*, 2007, Cobb, 2015, Maloshonok & Terentev, 2016), however unlike the industry survey for Study C, the inclusion of a 'don't know' option was added to support any recall issues, and the responses were presented vertically. With regard to including 'don't know', the risk of 'satisficing' where the participant takes the 'easy option' (Krosnick, 1999, Dillman *et al.*, 2014) was appreciated, however Malonoshonok and Terentev in 2016, suggest the likelihood of choosing 'don't know' is reduced when using radio buttons to select responses. With the researcher's experience of student survey completion, it was anticipated participants were likely to complete surveys on hand held devices (Brace, 2013), so vertical scales with radio buttons (Figure 7.5b) were selected as the more appropriate question format.

(a)



(b)

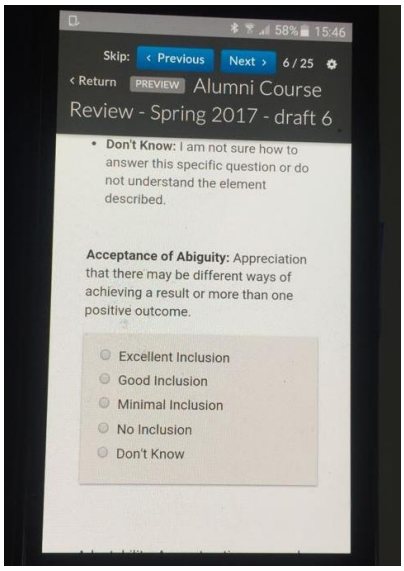


Figure 7.5 Examples of question readability on handheld devices with (a) horizontally presented scales and (b) vertically presented scales.

Resultant useable scoring in the graduate survey (Figures 7.5 and 7.6) was, '1 - excellent inclusion' to '4 - no inclusion'. However, a review of 'don't know' inclusions was conducted to ensure all data were evaluated (Manisera & Zuccolotto, 2014). Data generated would be treated as non-parametric. Despite adapting the survey from a previously launched version during Study C, an informal pilot was conducted and as a result, refinements were made to the introductory text page before launch. Figure 7.6 illustrates an example of

a question with the expandable ‘more info’ feature (Online Surveys (formerly BOS), n.d.) opened to display response definitions.

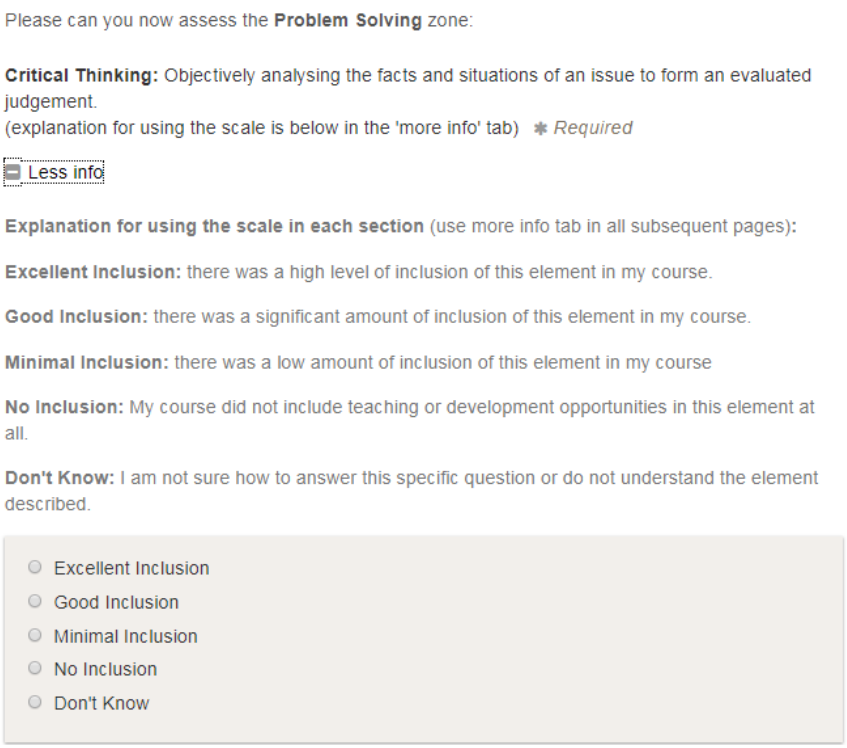


Figure 7.6 Further example of question type utilised in survey issued to students graduating in spring 2017. The ‘more info’ icon is expanded in this screenshot to display scale label definitions.

Surveys were communicated to graduates of 2015 and 2016 by an explanatory message containing the survey URL link, via social media connections (https://www.linkedin.com) or by existing email contact, similar to alumni studies by Bohlschied and Clark (2012), and Weller *et al.* (2015). To take advantage of project timings, graduates of 2017 were approached personally on completion of their course and introduced to the project and survey aims, before receiving the survey link electronically by email.

7.3.8.2 Data analysis

Ordinal data obtained from the graduates from both programmes across the three years were collated due to the limited sample size. If a response for any *element* was recorded as '5 - Don't Know' the item was removed from the data set (for separate inspection) and total responses for that *element* reduced accordingly (Manisera & Zuccolotto, 2014). Data analysis were conducted using frequency distribution (Lawless & Heymann, 1999, Jackson & Furnham, 2000). Frequency of selection of the two most positive responses formed the basis of categorisation as summarised in Table 7.5.

Table 7.5 Categorisation of graduate survey responses; (a) survey coding, (b) subsequent method of categorisation of responses.

(a)

	Response	Frequency count
1	Excellent Inclusion	No.1
2	Good Inclusion	No.2
3	Minimal Inclusion	
4	No Inclusion	
5	Don't Know	

(b)

Graduate survey inclusion code		
LOW	Any excluded from below	
MED	>70% are No. 1 + No.2	
HIGH	> 50% are No.1	

Comments collected from open text to support quantitative data were also analysed by simple thematic evaluation.

7.3.9 Adaptation of employers' data

Consideration of 'relative importance' of each of the *element*s of CFGC in the workplace would provide context for the results of the curriculum mapping. Results of Study C (Chapter 6) provided the number of times an *element* from CFGC was deemed desirable for one of the 14 typical graduate roles as summarised in Figure 7.7.

	Auditor (not based in a single factory)	Company Graduate Scheme	Customer Support Technologist	Factory Based Technologist	Laboratory Technician or Technologist	Law and Regulatory New Graduate Role	NPD, Development or Process Role	Nutritional Graduate Role	PhD or other Postgraduate Research Role	Research or Materials Technician/Technologist	Retail Technologist	Sensory Technologist Graduate Role	Specifications or Quality Systems Technologist	Sustain, Environmental, Ethical or Threat Management Roles	Frequency count
Academic Expertise								■	■	■					3
Acceptance of Ambiguity		■	■						■					■	4
Adaptability		■		■			■								3
Application of IT									■			■	■		3
Collaboration							■	■				■		■	4
Commercial Awareness			■				■				■				3
Confidence	■		■			■					■		■		5
Critical Thinking				■		■			■					■	4
Cultural Sensitivity		■						■				■			3
Decision Making	■	■		■							■				4
Digital Capability													■		1
Emotional Intelligence	■										■				2
English Proficiency			■					■		■		■	■		5
Entrepreneurship							■		■						2
Environment & Sustainability											■			■	2
Global Supply Chain														■	1
Handling Data					■				■	■		■	■	■	6
Independence									■	■		■			3
Initiative				■			■		■	■	■				5
Innovation							■		■		■				3
Leadership	■	■		■											3
Listening	■		■					■				■		■	5
Multicultural Workplace											■	■			2
Negotiation & Influencing	■		■	■									■		4
Networking & Relationship Building			■					■		■					3
Open-Minded							■	■						■	3
Passion for Subject		■				■	■	■		■					5
Personable								■				■			2
Personal Responsibility		■			■	■							■		4
Planning and Organising	■		■	■	■								■		5
Positive Attitude		■	■		■	■		■							5
Professionalism	■					■		■		■	■				5
Questioning Approach	■			■		■	■	■	■		■				7
Reliability			■	■	■	■				■			■		6
Resilience	■		■		■	■			■		■				6
Resourcefulness			■	■											2
Self-Awareness					■						■				2
Self-Development		■			■			■							3
Self-Motivated		■	■						■	■					4
Specific Technical Aspects								■	■						2
Teamworking		■		■		■	■			■		■			6
The Mechanics of Business							■				■				2
Thoroughness & Attention to Detail				■	■	■							■		4
Values & Credibility											■		■	■	3
Verbal Communication	■		■			■		■		■		■		■	7
Work Experience							■								1
Working Under Pressure	■	■		■	■	■									5
Written Communication	■					■			■	■			■	■	6

low sample size <10

Figure 7.7 Illustration of frequency count of *elements* desirable for the typical graduate roles (adaptation of Figure 6.9).

The more frequently an *element* was included in the matrix, the increased relative 'importance' it may have in the graduate workplace, e.g. *academic expertise* has a 'count' of '3'. As six of the 14 roles had low response rates and resultant sample sets (<10), specific treatment was made by halving the count and thus impact on final scores. In consultation with the project stakeholder group it was agreed that as these roles are less frequently recruited, they have arguably less weighting on competency requirements for a graduate pool. Returning to the example of *academic expertise* with a 'count' of '3', two of the roles have low sample sizes and thus halved, so the total results (Table 7.6) becomes '2'. The process of converting data to 'High', 'Medium' and 'Low' was conducted by applying the following factors:

- Counting the inclusion of each *element* across the 14 roles.
- Halving counts from roles with low sample sizes.
- Categorisation as summarised in Table 7.6.

Table 7.6 Matrix to categorise employers' desirability of *elements*.

Weighted result	Scoring
0 - 1.5	Low
2.0 - 3.5	Medium
4.0 or greater (up to 5.5 in reality)	High

7.3.10 Process of results collation and analysis.

Data from the three collection streams: employer desirability, course content and graduate perception were compiled on a spreadsheet with a row for each of the 48 *element*s. Data associated with each *element* were placed in

columns and colour coding applied to associated ‘low’, ‘medium’ and ‘high’ categories. *Element*s with congruence between employer desirability, content and student perception were deemed ‘balanced’ and no further action taken during this study. *Element*s were highlighted as ‘imbalanced’ if employer’s desirability score was ‘high’ or ‘medium’ but course content or graduate scoring was below this. To support further investigations, rows were re-ordered so that ‘imbalanced’ *element*s were at the top of the spreadsheet. Available material for each imbalanced *element* was compiled into a set of notes including module inclusions, open comments from the graduate surveys and quotations from employer stakeholder interviews in Study A (as collated in the Language Book, example in Figure 4.5).

From this stage, results were of an appropriate level of order to involve the reviewing team. A series of meetings were conducted from February to April 2018, with notes recorded on discussions, findings and decisions agreed. It was appreciated the mapping process captured a moment in time (Harden, 2001a, Bath *et al.*, 2004), and reflections on current status, past experience and future strategy were included if possible, in debates and plans.

However, two specific considerations were undertaken before final consolidation and review of future development opportunities.

7.3.10.1 D23PRO - Final year research project module

During the module mapping stages it was noted the comparative scale (40 credits) and nature of the final year research project commanded an unusual opportunity for a student to significantly develop many *element*s of CFGC. The duration of focus over the final semester (effectively 3 days per week of

independent endeavour) was appreciated, so consideration of how this could be captured in the mapping results was agreed worthwhile.

7.3.10.2 Wider development opportunities outside of a single module

Suggestions were collated where it was thought a particular *element* could be developed in activities outside of specific modules. Examination was undertaken to establish if it would be valid, for certain *element*s in CFGC to be understood as being developed by the wider journey of studying a degree course (Barrie, 2007), and if so how this could be included into mapping results.

7.3.11 Review and consolidation

Following a detailed review of initial results, exploration of additional considerations just outlined, and any subsequent amendments, a final report was created, aiming to highlight areas of imbalance using the criteria below:

- All *element*s where the employers' desirability were scored 'low' were placed at the bottom of the list (no action required).
- All *element*s where the employers' desirability were scored 'medium' or 'high' and the content score and student perception were equally scored were placed at the bottom of the list (no action required).
- *Element*s with 'imbalance', where the employers' desirability was not matched by course content and/or student perception were placed towards the top of the list (review required).

Of the ‘imbalanced’ *element*s:

- If the employers’ desirability was ‘high’ or ‘medium’ and course content was scored ‘low’ then they were taken to the top of the list ahead of others and marked with a red box (priority).
- If the employers’ desirability was ‘high’ or ‘medium’ and there was any other ‘imbalance’ of course content OR student perception against desirability, then they were placed below the red items and marked with an amber box (investigate)

Following examination of the final report by the reviewing team, suitably prioritised proposals for development of teaching content, approach and communications were made. Ideas including workshops and guided activity sessions were considered (Anthoney, Stead & Turney, 2017), in addition to conventional approaches.

7.4 RESULTS

7.4.1 Collation of results and initial analysis

7.4.1.1 Results from graduate survey

A total of 37 participants completed the survey, 15 from those graduating in 2015 or 2016 and the remaining 22 from the 2017 cohort. Not all graduates could be contacted or responded to the contact made, but this represents approximately 35% of the three cohorts. After initial inspection all data were retained apart from any responses of ‘don’t know’. There were 24 instances of this response, predominantly from the 2017 graduates, representing 1.3% of the total data set. Sixteen of the responses were derived from six

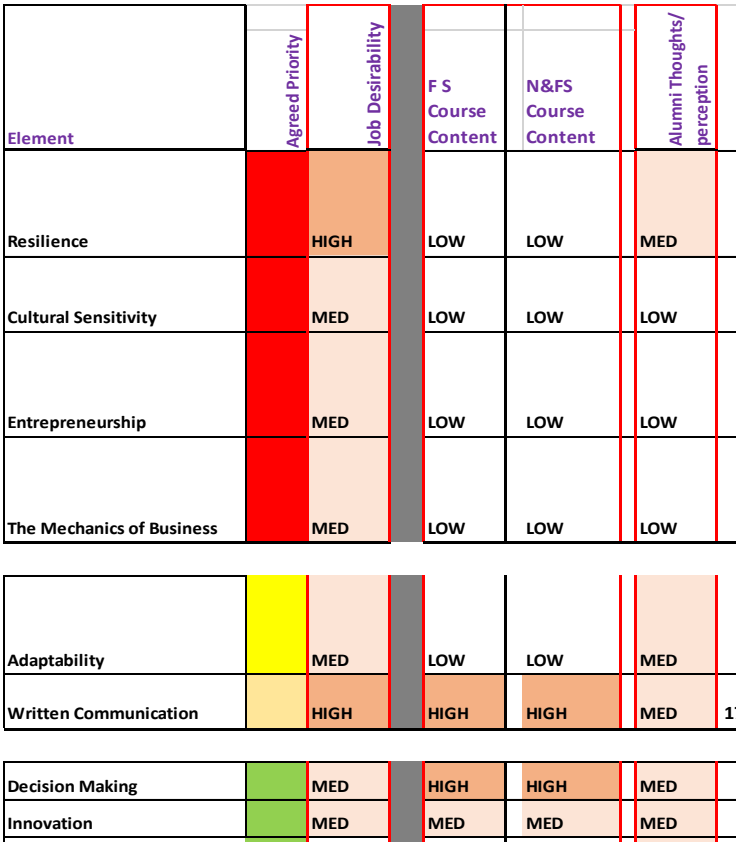
participants (five from the 2017 cohort) and the rest were singular instances. Two *elements* appearing to generate uncertainty of response were, *work experience* and *English proficiency,* which can be explained perhaps as not all students engage with the former, and most of the cohort do not need to consider the latter during their degree study. Prevalence of 'don't know' responses from recent (2017) graduates (especially the five participants above) could be that students do not always notice their personal development in real time and have yet to practice their competency in the world of work (Trought, 2012).

7.4.1.2 Initial collation and analysis

To summarise, Study D was designed to generate and categorise the following data with regard to each *element* of CFGC:

- Employers' desirability for each *element* in a graduate adapted from results of Study C.
- Contents of core modules within two food science degree courses captured by mapping against each *element*.
- Graduate perception of inclusion of *element*s in teaching, captured from survey responses.

An extract of initial results from the mapping team can be seen in Figure 7.8 where visual comparisons could start to be made for each *element* between employer desirability, levels of curricular content and graduate perception of inclusion (student view). Areas of incongruence and proposed 'imbalanced' were situated at the top of the sheet and detailed notes compiled.



Element	Agreed Priority	Job Desirability	F S Course Content	N&FS Course Content	Alumni Thoughts/ perception
Resilience		HIGH	LOW	LOW	MED
Cultural Sensitivity		MED	LOW	LOW	LOW
Entrepreneurship		MED	LOW	LOW	LOW
The Mechanics of Business		MED	LOW	LOW	LOW
Adaptability		MED	LOW	LOW	MED
Written Communication		HIGH	HIGH	HIGH	MED
Decision Making		MED	HIGH	HIGH	MED
Innovation		MED	MED	MED	MED

Figure 7.8 Extract of initial result spreadsheets from Study D.

7.4.2 Building the final report

7.4.2.1 The reviewing team

Initial results and aspects highlighted for consideration were discussed. Due to the nature and level of independent work undertaken by the student, it was agreed to double the scoring of any formal inclusion of an *element* the final year module, D23PRO - Research Project. Next, the possibility of wider competency development opportunities outside modules was considered. An example was *planning and organising,* where it was suggested by a number of staff members, students will develop this *element* by handling their timetabled activities, assessment deadlines and wider living commitments

whilst studying for a degree. Conversely, it could be argued there would not be an expectation for *global supply chain* to be developed outside of specific modular teaching.

The reviewing team established that wider development opportunities would be valid where an *element* could be justifiably developed in activities outside of individual modular teaching. This could include working on a combination of modules at any point of study or generally agreed situations an undergraduate student would experience during their three years of study as a young adult. Scope included typical challenges encountered by a person leaving the family home for the first time to start degree study. It is appreciated some individuals, for example mature students would be less likely to develop some of these *elements* as significantly. However it is currently the norm for food science undergraduates to arrive for qualifying year (one) at 18 or 19 years of age.

The process of confirming which *element* would be justifiably developed during wider degree study was conducted by prior independent assessment, followed by a collective review. Once agreement was reached, the results alongside the justifications were recorded. A total of 22 *elements* of the 48 were considered developed during wider study (Table 7.7).

Table 7.7 The 22 *elements* considered developed by wider food science course study by reviewing team.

adaptability	confidence
cultural sensitivity	decision making
emotional intelligence	English proficiency
Independence	listening
multicultural workplace	negotiation and influencing
open-minded	passion for subject
personal responsibility	planning and organising
resilience	resourcefulness
self-awareness	self-development
self-motivated	values and credibility
verbal communication	working under pressure

The coding applied for these 22 *elements* was set at 1.0 (Table 7.3), with a view that it recognised inclusion at a level of a single formal learning opportunity in a single module.

7.4.2.2 Format of final report

Following application of the amendments agreed above, a final report was produced and an extract is included over the next two pages (Figure 7.9).

Element	Employer's job desirability	Food Science		Nutrition & Food Science		Student perception, graduate survey	Agreed priority focus
		Total course content score & categorisation		Total course content score & categorisation			
Working Under Pressure	HIGH	6.4	MED	6.2	LOW	MED	
Cultural Sensitivity	MED	4.2	LOW	4.6	LOW	LOW	
Entrepreneurship	MED	6.2	LOW	5.2	LOW	LOW	
The Mechanics of Business	MED	4.4	LOW	4.4	LOW	LOW	
Leadership	MED	3.9	LOW	3.7	LOW	MED	
Negotiation & Influencing	MED	2.0	LOW	1.8	LOW	MED	
Open-Minded	MED	4.2	LOW	6.4	LOW	MED	
Positive Attitude	MED	4.7	LOW	4.5	LOW	MED	
Self-Motivated	MED	6.5	MED	5.5	LOW	MED	
Resilience	HIGH	7.6	MED	7.4	MED	MED	
Initiative	HIGH	10.2	MED	10.0	MED	MED	
Questioning Approach	HIGH	15.9	MED	12.3	MED	MED	
Reliability	HIGH	10.8	MED	9.4	MED	MED	
Teamworking	HIGH	18.4	MED	18.6	MED	HIGH	
Planning & Organising	HIGH	21.7	HIGH	18.7	MED	HIGH	
Verbal Communication	HIGH	21.4	HIGH	24.2	HIGH	MED	
Handling Data	HIGH	35.7	HIGH	33.7	HIGH	MED	
Written Communication	HIGH	46.0	HIGH	45.2	HIGH	MED	
Commercial Awareness	MED	13.2	MED	12.2	MED	LOW	
Academic Expertise	MED	37.4	HIGH	40.4	HIGH	HIGH	
Acceptance of Ambiguity	MED	9.8	MED	8.6	MED	MED	
Adaptability	MED	8.6	MED	7.6	MED	MED	
Application of IT	MED	14.2	MED	15.0	MED	MED	
Confidence	MED	8.6	MED	8.6	MED	MED	

Figure 7.9 Extract of curriculum mapping outcome report. Details of categorisation used can be found in Figures 7.4, 7.5 and 7.7 (page 1 of 2).

Element	Employer's job desirability	Food Science		Nutrition & Food Science		Student perception, graduate survey	Agreed priority focus
		Total course content score & categorisation		Total course content score & categorisation			
Critical Thinking	MED	30.7	HIGH	33.5	HIGH	MED	
Collaboration	MED	6.6	MED	6.8	MED	HIGH	
Decision Making	MED	31.9	HIGH	26.9	HIGH	MED	
English Proficiency	MED	23.4	HIGH	25.2	HIGH	MED	
Independence	MED	6.6	MED	6.8	MED	HIGH	
Innovation	MED	12.0	MED	9.8	MED	MED	
Listening	MED	9.7	MED	11.3	MED	MED	
Multicultural Workplace	MED	10.9	MED	11.9	MED	MED	
Passion for Subject	MED	20.0	HIGH	19.0	MED	HIGH	
Personal Responsibility	MED	14.6	MED	13.8	MED	MED	
Professionalism	MED	11.0	MED	11.0	MED	HIGH	
Self-Awareness	MED	11.7	MED	11.7	MED	MED	
Self-Development	MED	11.5	MED	11.5	MED	MED	
Thoroughness & Attention to Detail	MED	25.0	HIGH	19.7	MED	MED	
Values and Credibility	MED	16.6	MED	16.8	MED	MED	
Digital Capability	LOW	4.3	LOW	4.3	LOW	MED	
Emotional Intelligence	LOW	6.2	LOW	5.8	LOW	MED	
Environment & Sustainability	LOW	7.6	MED	7.6	MED	LOW	
Global Supply Chain	LOW	5.4	LOW	5.4	LOW	LOW	
Networking & Relationship Building	LOW	4.0	LOW	3.6	LOW	MED	
Personable	LOW	4.8	LOW	4.6	LOW	MED	
Resourcefulness	LOW	6.6	MED	5.8	LOW	MED	
Specific Technical Aspects	LOW	47.9	HIGH	42.4	HIGH	MED	
Work Experience	LOW	1.8	LOW	1.8	LOW	LOW	

Figure 7.9 Extract of curriculum mapping outcome report. Details of categorisation used can be found in Figures 7.4, 7.5 and 7.7 (page 2 of 2).

The outcomes are presented in ‘priority order’ denoted by the right hand column with red, amber and green shading described as:

- Red – ‘imbalanced’ with relatively high job desirability but low course content AND student perception of content.
- Amber – ‘imbalanced’ where course content OR student perception are not equivalent to relative job desirability.
- Green – no issues or relatively low job desirability.

From mapping, the course content of 13 and 16 elements were calculated as ‘low’, in the BSc Food Science and Nutrition and Food Science courses respectively. A total of seven elements were considered by graduates to be ‘low’ in inclusion. A summary of the imbalanced elements from in Figure 7.9, is presented in Table 7.8.

Table 7.8 Overview of imbalanced *elements* from the curriculum mapping exercise.

Scored 'red'	
Working under pressure	cultural sensitivity
entrepreneurship	the mechanics of business
Scored 'amber' for course content	
leadership	negotiation and influencing
open-minded	positive attitude
self-motivated	resilience
initiative	questioning approach
reliability	teamworking
planning and organising	
Scored 'amber' for student perception	
verbal communication	handling data
written Communication	commercial Awareness

7.5 DISCUSSION

7.5.1 Review of imbalance of individual elements

Outcomes of the reviewing team's consideration of five of the *element*s requiring priority consideration are explained below.

7.5.1.1 Working under pressure

Theme	D7 - Dependability
Definition	Establishing your personal approach to balancing demands and challenges in working life.

The full details for the review is included as an example in Appendix XIV. *Working under pressure* has a 'high' desirability for employers (Table 7.9). However for content the food sciences course is categorised as 'medium',

and for the nutrition and food sciences course, 'low' (although only 0.4 from achieving medium score). Student perception is 'medium'.

Table 7.9 Outcomes of working under pressure *element.*

Element		Job desirability	Course content (score and categorisation)*				Graduate survey / student perception
			Food Science		Nutrition and Food Science		
Working Under Pressure		HIGH	6.4	MED	6.2	LOW	MED

* Scoring has a wider development factor of 1.0 added

With this particular *element* the reviewing team believed there was appreciable opportunity to practise *working under pressure* during broader degree study and this is supported by comments in the graduate survey,

> *"Again working under pressure with many deadlines/exams at once [at] university is, by nature, a stressful environment and encourages you to thrive under pressure."*

> *"Having short deadlines (restricted in the time you can spend on something) was uncomfortable and therefore helped develop this a lot."*

Comments about inclusion in specific modules by graduates and convenors noted development of *working under pressure,* was present but it was not formally stated in the module information (so implicit) for example, D23PRO - Research Project. Efforts are required to improve explicit notification of inclusion into modules and increase student awareness of when this *element* is being cultivated during teaching.

7.5.1.2 Cultural sensitivity

Theme	D2 - Appreciation of the Wider World D5 - Working Well With Others
Definition	Appreciation of different cultures and practices that impact on ways of working and customer needs such as religious and dietary requirements

This *element* has a 'medium' desirability for employers (Table 7.10**)**. However content in both courses and student perception is categorised as 'low'.

Table 7.10 Outcomes of cultural sensitivity *element.*

Element		Job desirability	Course content (score and categorisation)*				Graduate survey / student perception
			Food Science		Nutrition and Food Science		
Cultural Sensitivity		**MED**	4.2	**LOW**	4.6	**LOW**	**LOW**

Some open comments from student feedback suggest there was insufficient inclusion in the course including,

> *"…don't feel like this is really looked at in enough detail through our modules. Although it has been touched upon, it was never the focus."*

The reviewing team agreed that there needs to be increased opportunity for *cultural sensitivity* development in both courses, either by specific material inclusions in modules or generally in the course.

7.5.1.3 Entrepreneurship

Theme	D2 - Appreciation of the Wider World D6 - Innovation and Inquiry
Definition	To see an opportunity and exploit it for beneficial effect.

Similar to *cultural sensitivity,* this *element* has a 'medium' desirability for employers, whilst content for both courses and also student perception is categorised as 'low' (Table 7.11). However with an additional component in a microbiology module, the food science course requires only 0.1 more to be categorised as 'medium'.

Table 7.11 Outcomes of entrepreneurship *element.*

Element		Job desirability	Course content (score and categorisation)*				Graduate survey / student perception
			Food Science		Nutrition and Food Science		
Entrepreneurship		MED	6.2	LOW	5.2	LOW	LOW

* Scoring does not have a wider development factor of 1.0 added

This *element* is not considered a core part of food sciences undergraduate curricula so the low content categorisation was expected. Comments from students include,

> *"Only ~~left~~ [felt?] like this was included in the last year with the npd project."*

This refers to the 'New Product Development' project in the final semester (part of D23BF2 - Food Factory Operations) which is the only sizeable inclusion of the *entrepreneurship* in core modules. Two comments were also recorded by graduates about the inclusion of this *element* in the optional

module N13214 - Exploring Perspectives in Entrepreneurship, which would be understandable. Recent inclusions of a session with a visiting retailer in a first year module D212A2 - Contemporary Agricultural Systems, may improve student perception in future.

7.5.1.4 The mechanics of business

Theme	D2 – Appreciation of the Wider World D8 - The Business World
Definition	ppreciation of generic commercial aspects of handling money such as types of costs, profits, reports and risk.

The *element* has medium employer desirability but 'low' inclusion in both course content and student perception (Table 7.12). This *element* would not be considered a core inclusion for food science courses, discussed later in the Chapter.

Table 7.12 Outcomes of the mechanics of business *element.*

Element		Job desirability	Course content (score and categorisation)*				Graduate survey / student perception
			Food Science		Nutrition and Food Science		
The Mechanics of Business		**MED**	4.4	**LOW**	4.4	**LOW**	**LOW**

* Scoring does not have a wider development factor of 1.0 added

Student comments again reflect the limited nature of core module inclusion,

> *"Costing was not really emphasized during the NPD module. This is the only place I could see any inclusion relating to it."*

However optional modules were noted to provide greater opportunities for developing the *mechanics of business*,

"I have experienced through participation in Ecotrophelia[24]."

"I took the Introduction to Marketing module at the business school but basic business mechanics could have been included earlier on, particularly for those who wanted to enter the industry at a business-level."

7.5.1.5 Resilience

Theme	D1 – Positivity
Definition	Responding positively to adverse situations and persevering.

Resilience was considered highly desirable by employers (Table 7.13), however the course inclusion and student's perception were categorised as 'medium'.

Table 7.13 Outcomes of resilience *element.*

Element		Job desirability	Course content (score and categorisation)*				Graduate survey / student perception
			Food Science		Nutrition and Food Science		
Resilience		**HIGH**	7.6	**MED**	7.4	**MED**	**MED**

* Scoring has a wider development factor of 1.0 added

Students made only few open comments, but they included,

"… required to complete the degree, having deadlines close together and hard projects really helped to build these skills."

[24] Ecotrophelia is an external, optional student innovation project

"I felt my resilience was only challenged during my final semester of my degree, spring semester."

There is limited initial opportunity for increasing inclusion in courses and it will be unlikely to result in re-categorisation to 'high'. The reviewing team understood development of *resilience* was beneficial for graduate employment, however it was agreed possessing *resilience* is also of value during undergraduate study itself so further discussion was necessary.

7.5.2 Consideration of student perception and areas of imbalance

A number of *element*s had low student perception of inclusion of an *element* compared to course content including: *verbal communication, handling data, written communication* and *commercial awareness*. Possible factors were considered. Firstly the course has been refined in a number of areas in recent years, especially during the first year, which caused variation in the student experience for each cohort (survey undertaken with graduates of 2015, 2016 and 2017). It is also appreciated those who graduated a number of years ago (2015) may have recall bias (Ramia *et al.*, 2016), and conversely as noted earlier, fresh graduates (2017) may not yet be able to reflect on what they have learned or developed. The process of explicitly highlighting to students exactly where they are developing employability competencies within study is at an early stage at UoN; the results of Study D are to be a foundation for improved signposting. Finally it is worthwhile considering whether the stated 'inclusion' of an *element* in a module is effective in creating a useful and recognisable development opportunity for the student.

7.5.3 Suggestions for development of content

Throughout the module mapping exercise there were inclusions of 'informal' items debated in the one-to-one sessions (see Table 7.2). These included activities or sessions that were routinely incorporated into a module, but not made explicit to the student in documentation or timetables provided. An example would be *working under pressure* (Appendix XIV), which is commonly experienced and thus challenged during the final year Research Project module (D23PRO). It would therefore be expected that this development opportunity is explicit. However, currently it is not included in a LO (a possible suggestion could be, 'you will be more confident in handling work pressure') or included in the more expansive supporting module information given to students. It was suggested in some circumstances, the module convenor should modify module documentation to 'formalise' the inclusion of an *element*. This was agreed as a reasonable adjustment to be effected in the coming academic year. However the modifications are not reflected in the final report for Study D.

Alternatively, in some cases it was thought more appropriate to increase course content of a particular *element* to match employer's desirability; the most appropriate modules or year of study were selected for attention. This could be achieved by inclusion of taught, learned or assessed components. As a result of the outcomes of Study D, consideration has been made whether it was possible to traditionally 'teach' (Vinten *et al.*, 2016) certain *element*s either generally or in the context of food science degree study. It is suggested there may be difficulty in adding formal development inclusions of *element*s such as *personable*, preventing improvements in mapping scores.

However some, including *resilience,* may be formally included by alternative or active forms of teaching inclusions (Bhattachaya, 2013). This aspect of competency development could be explored further in future.

Some *elements* such as *entrepreneurship* are not currently considered core to food science education (University of Nottingham, n.d.-b, The Quality Assurance Agency for Higher Education, 2016), however some students may be desirous of greater development opportunities. They could be clearly directed to: select certain optional modules, study available self-directed learning material, take an industry placement year, or undertake wider experiences to assist their focussed personal development. There are also University-wide initiatives (n.d.-c) for example, Ingenuity19 or the Nottingham Advantage Award (Careers and Employability Service, n.d.), that offer competency development and experiences beyond course study.

7.5.4 Future plans

The action plan to utilise the learnings from Study D comprises the following features:

- Minor amendments to modules.
- Communication to students where specific *element*s are not intrinsic to a food science course.
- Development of new course content.
- Opportunities to make existing competency development more explicit.
- Broader or longer term activities.

7.5.4.1 Minor amendments to modules

Some of the minor amendments or adjustments to modules are summarised in Table 7.14, however fuller details of suggested amendments and developments are included in Appendix XV.

Table 7.14 Examples of the core modules planned for minor amendments.

Module details	**Examples of *elements* for adjustment**
D211F4 - Food Commodities and Primary Processing	*positive attitude, verbal communication*
D21BF1 - Food Materials and Ingredients	*teamworking, planning and organising*
D223NA - Nutrition, Regulation and Endocrinology	*questioning approach*
D224F0 - Food Products Case Studies	*negotiation and influencing, open-minded*
D224FA - Microbial Mechanisms of Foodbourne Disease	*reliability, teamworking*
D224FB - Food Safety and Legislation	*working under pressure, cultural sensitivity*
D235F8 - Personal and Professional Development for Food Scientists	*self-motivation, resilience*
D235F1 - Microbial Methods and Isolation	*reliability, teamworking*
D235F9 - Food Flavour and Physiology of Perception	*teamworking*
D23BF2 - Food Factory Operations	*negotiation and influencing, resilience*
D23PRO - Research Project	*working under pressure, open-minded*

An adjustment could be: formalising learning opportunities by explicit reference in module documentation, teaching materials or assessment criteria documentation. Increasing emphasis to students regarding the inclusion of a particular *element* in a module could be undertaken. Alternatively, it may have been agreed with a module convenor to add new material or content.

Additionally there is a requirement to communicate to students where specific *elements* are not intrinsic to a food science course. There are five *element*s with 'medium' desirability by employers and 'low' inclusion in courses, but agreed by the reviewing team as only limited features of food science degree curricula (University of Nottingham, n.d.-b, The Quality Assurance Agency for Higher Education, 2016), and thus do not warrant significantly increased inclusion in the short term:

- *entrepreneurship*
- *leadership*
- *negotiation and influencing*
- *the mechanics of business*
- *commercial awareness* (note: has 'medium' in course content)

If possible, appropriate inclusion opportunities will be considered in future, to reflect future employer needs. In the meantime, for students wishing to improve competency in these *elements,* clear signposting will be provided to where optional modules may develop these *element*s, or opportunities outside of study should be considered (suggestions listed earlier).

7.5.4.2 Example of development of new course content

Any *element*s with 'imbalanced' course content in the final report were examined in some detail by the reviewing team. Earlier examples of *working under pressure* and *resilience* are *elements* associated with abilities to recognise high workload, difficulties or stress, and ability to take the appropriate actions or access support as required (Bhattachaya, 2013). It was agreed there could be a relationship between the two *element*s when

considering development strategies. Whilst *working under pressure* and *resilience* have been confirmed desirable for a graduate to possess, the reviewing team suggested they would be equally as desirable during undergraduate study. Occasions for development may be most useful in the early part of the course. Anthoney *et al.* (2017) have recently highlighted that universities,

> *"have a vital role to play in fostering positive mind-sets amongst students and developing strong and resilient independent learners."* *(p.404)*

The plan was to create a short workshop for newly arrived undergraduate 'Freshers' to discuss and foster personal resilience and an ability to handle pressure. To support a more open and relevant environment it was planned for the session to be led by current final year students given prior training. A nursing educator at the University of Dundee advocates the value of interaction between students to share experiences on handling pressure (Gallie *et al.*, 2017). Similar student-led sessions have recently been trialled at UoN by the School of Veterinary Medicine and Science (Abas, 2018), where fourth year students facilitated a teaching session for a selected group of first year vet students on mental wellbeing and resilience awareness, using contextual case scenarios. Abas (2018) comments the session was believed a valuable inclusion, concluding, "peer facilitation was overwhelmingly preferred to facilitation by staff in this context" (p.1).

The planned workshop revolved around 'concept mapping'. Based on the theory by Ausubel, Novak and Hanesian (1978) of making a distinction between rote learning and meaningful study, the concept map was developed

by Novak (2010). The premise is that learning can be enhanced where a task can be associated in some way to what the learner already knows. Concept mapping put simply, is a diagram of ideas or concepts with linked interrelations. It usually has a central idea or concept and then related items or nodes are added to the map, linked to this central point. Links can also be added as appropriate across other items, aiming to mimic the way knowledge is organised in the human memory. The connections or lines between items are given direction using uni- or bi- directional arrows, then articulated with prepositions or phrases such as: 'causes', 'leads to', or 'supports'. In its purest form, the map forms a hierarchical structure and Novak (2002) emphasises the prepositions given to connections are pivotal to create meaning in the map.

Concept mapping has been widely employed as a graphical tool in number of professions since the end of the 20th century, many using software designed to build such maps (Novak, 2010). For HE it has been particularly embraced by healthcare professions (Harpaz, Balik & Ehrenfeld, 2004, Schmehl, 2014).

A recent study outlines the inclusion of concept mapping in a resilience building workshop with a sample of the undergraduates at University of Surrey (Anthoney *et al.*, 2017). Using central concepts including 'mental and emotional health' and 'success', the paper-based concept mapping activities in Surrey's workshop appear to enhance students awareness of internal and external factors that can influence them. Associated discussions during the mapping activity are suggested useful for students to externalise ideas and beliefs. They conclude concept mapping appears to help the students identify

what they have used in the past to maintain personal resilience and appreciate they could harness the same approaches at University.

Professional support was sought internally from a University Health Promotion Adviser and externally from the 'Let's Live Well in Rushcliffe' team (Nottinghamshire County Council, 2018). It was agreed the choice of content and language should be centred on a positive learning experience. The peer-led workshop was delivered to the September 2018 intake and outcomes are discussed in the next Chapter.

7.5.4.3 Ensuring development opportunities are explicit

As outlined in Table 7.8, four *element*s had a level of content to match desirability, however student perception was categorised as below this, namely:

- *commercial awareness*
- *verbal communication*
- *handling data*
- *written communication*

It is fundamental that students are able to identity where they have developed specific competencies during study, largely to ensure they can articulate their competencies well in job applications and assessments but also to draw on their experiences for use in the workplace.

A summary 'passport' confirming where *elements* are included in module content, generated from the curriculum mapping of Study D has been constructed, initially issued to those completing degree study in June 2018 and presented in the next Chapter. For future cohorts it is planned for

students to understand more about their competency development during actual studies rather than retrospectively. Ideas currently in development include, slide templates for each module introduction session, key information by module UoN's e-learning platform 'Moodle' (n.d.-d), and also a reflective session at the end of each academic year. Endeavours already commenced for inclusion of CFGC into careers education and degree teaching at UoN and other HEIs, will be discussed in subsequent Chapters.

In future years measuring feedback could be gathered mid-study from cohort's possessing greater knowledge of CFGC and development of each *element* during course study. Evaluations can be made on the clarity and effectiveness of teaching.

7.6 OVERVIEW AND IMPLICATIONS OF STUDY D

7.6.1 Reflections on the mapping process applied to Study D

The reviewing team were generally satisfied with the approach undertaken for curriculum mapping in Study D. The modified Biosciences 'TLA' system (Table 7.2) for module mapping, was logically followed by module convenors due to prior experience. However it was collectively agreed that the term 'learned' was not correct for the content included in the category, even though the definition developed to support it was considered appropriate. 'Learned' infers a broad summary of what has been understood by the student (Harden, 2001a). However in Study D the code 'learned' was applied more accurately to capture what the student is practising or developing beyond direct 'teaching', for example in practical activity or self-directed study. As the process was managed carefully by the mapping team emphasizing the

adjusted definition with convenors, confidence was maintained regarding the quality of the outputs of Study D. However 'learned' was not thought an appropriate choice of term for future use. It creates confusion with a number of widely referenced models, Harden's (Figure 2.3), includes that which has been tested whereas Kelley *et al*. (2008) describe 'learned' as what a student has experienced, which is nearer to the definition employed in Study D. The initial proposal is to use the term 'practised' in future.

7.6.2 Strengths and limitations of Study D

7.6.2.1 The finite status of curriculum mapping

It is appreciated that discrete curriculum mapping has its limitations; this type of activity is a snapshot of events and may miss some detail or reality of a particular module or course. Efforts were made to reflect, if necessary on current status, past experience and future strategy within debate and plans (section 2.3.3). In addition education is not a 'static environment' (Hale, 2018), any future changes cannot be predicted and will not be automatically captured (Bath *et al.*, 2004). Module convenors have been asked to inform the researcher of any future amendments so they can be captured. Undertaking a repeat mapping activity in perhaps three years' time may also be prudent.

7.6.2.2 Collating and quantifying curriculum mapping data

All module mapping was performed using documentation and one-to-one interviews with staff. Observational audits (Hege *et al.*, 2007, Arafeh, 2016) were not included, however reality and effectiveness of inclusion was aimed to be captured by gathering student perception as an alternative.

The method of quantifying levels of inclusion of an *element* in a module was developed using characteristics of a selection of past mapping activities (Sumsion & Goodfellow, 2004, Kelley *et al.*, 2008, Spencer *et al.*, 2012, Joyner, 2016). No universal scoring system for curricula quantification is available for reference, so past practitioners have developed a 'tailored' method that is appropriate and sensible for their context. This tailored approach was employed in Study D for mapping of course and also classification of student feedback and employers desirability of *element*s and is thus considered suitable. However it is understood this approach may not be applicable for other studies with other aims or circumstances. Credibility and contextual transferability of Study D could be evaluated by repeating the mapping exercise at another food science degree provider.

When mapping each module, interrelationships between other modules were not considered with respect to development of an *element*. Data was discrete and consideration of sequential growth of a competency was not made. This is contrary to some approaches where levels of competency are layered through a course from 'introductory' to 'mastery', aligned to 'Bloom's taxonomy' (Morgan *et al.*, 2006, Joyner, 2016), or the learning trajectory tracked in some form (Wijngaards-de Meij & Merx, 2018). Discrete mapping of each module was undertaken to allow flexibility for any future change, but it prevented this opportunity. However the quantification provided in Study D could be used to provide an indirect measure of the amount of opportunity to master competence in an *element.*

7.6.2.3 Student perception

Alumni had graduated 6 or 18 months before the date of the first surveys in spring 2017, so there was a risk of recall bias (Ramia *et al.*, 2016) possibly expressed in difficulty in remembering exactly what *element*s may have been included and where. This was understood but unavoidable for these cohorts. For graduates of 2017 and the future, survey participation has and will be encouraged at the point of graduation. Surveys sought participant's perception and therefore not factual data (Bath *et al.*, 2004), and each cohort will receive a slightly different experience as module content can be developed and refined. It was reassuring to find limited use of 'don't know' responses (though more in 2017 cohort) and otherwise, little difference between data from the three cohorts was found.

7.6.2.4 Wider stakeholders

Aligned to the general project stakeholder considerations, with respect to course mapping and review there are a number of stakeholders to consider beyond the initially obvious student and teacher. Study D focussed on CFGC and not the formal food science degree course LOs supporting the formal QAA subject benchmark statement (2016), which underpins routine QA of degree courses. The formal consideration of an external examiner's viewpoint may not be crucial, but could have been embraced in the review stages. Other stakeholder consideration could have been to accrediting bodies (IFST) and potential students.

7.6.2.5 Effectiveness of inclusion of material for competency development

Section 2.6.4 introduced approaches to integrating guidance from a framework into teaching activities, and this can be in the development of

elements themselves or for use in careers education. Future surveys of cohorts completing degree study with some familiarity of CFGC may start to support this type of investigation. Capturing the viewpoints of students during the course of their study, rather than on graduation may be of interest to validate the effectiveness of inclusion. However it could be argued it risks being just a short term recitation of the signposting provided by academics. Alternative types of validation methods could be considered for current students, perhaps in depth reviews or discussions, rather than surveys.

7.6.3 Reflections of recording mapping data

The use of the proprietary mapping system accessible at UoN had limited benefits for this project. The effort of input is likely to be more worthwhile for vocational programmes where a high number of prescriptive learning outcomes are required to be linked to individual sessions or timetabled activities. Undeniably in use for some degree courses at UoN, recent studies at the University of Utrecht (Wijngaards-de Meij & Merx, 2018) observe these type of systems can be difficult to integrate into staff and student use. It may have been helpful if CFGC mapping was directly linked to programme LOs alone, and thus any information could be cascaded readily. Whilst numeric data generated could be downloaded to a spreadsheet, the inability to print or download the heat map reports was a key drawback when visually reviewing or displaying levels of content of *element*s across modules or programmes of study. The intended 'heat map' reports had to be manually reconstructed in spreadsheets, thus data interpretation activity centred there.

7.6.4 Agreed status of courses and action plan

Results indicate congruency for the majority of *element*s in CFGC with respect to desirability and course content. As illustrated in Table 7.8, 19 of the 48 *element*s were in some form imbalanced, of which 15 *element*s had less course content than desirable to employers. Any specific areas of 'imbalance' were analysed and where actions deemed necessary, appropriate plans agreed by the reviewing team. Five of the imbalanced *element*s have been proposed as peripheral to core food sciences degree curricula, however students will be directed to where they can develop these *element*s in a wider context than core modular teaching. From a food science perspective, Morgan *et al.* (2006) assert teachers should emphasise development of 'success skills' (IFT) both throughout the curriculum and in extracurricular activities. An action plan summarised in Appendix XV was constructed and the initial activity to complete tasks is underway and described in the next Chapter.

7.6.5 Comparison to other food science curriculum mapping

Reviewing food science educational research on degree curricula, most papers investigate what ideal competencies should be in a degree course as discussed in Chapter 6 (Morgan *et al.*, 2006, Flynn *et al.*, 2013b, Johnston *et al.*, 2014, Joyner & Stevenson, 2017). Similar to Study D, a few studies seek to establish what competencies students' perceive they have developed from studies. LeGrand *et al.* (2017) use student reflective reports and surveys to explore how their Vietnamese cohort believe they have developed the seven 'IFT Success Skills' (2016) during participation in new field-based activities. Outcomes from this work are unclear due to the variable nature of students'

learning experiences. Bohlsheid and Clark (2012) also use a survey to capture alumni feedback on 'career preparedness' for the USA workplace against the detailed 'outcomes' in the IFT core competencies (2016 and Appendix I). Limitations to this survey are the inevitable recall bias from capturing data from graduates over ten years, however use of such a wide sample may help illustrate where possible improvements have been made in 'career preparedness' of cohorts over time.

A Europe-wide survey to current undergraduate and postgraduate students was conducted as part of the ISEKI scheme (Flynn *et al.*, 2017), by utilising the 'soft skills' list (Table 2.3) already developed in previous studies (Flynn *et al.*, 2013b). The survey suggests students were satisfied with their 'training' in 'working with others' and 'being responsible', and more so than training in 'solving problems', 'communication' and 'positive attitude'. As ISEKI 'soft skills' are not directly comparable to CFGC it is difficult to judge similarity. It is estimated against CFGC using terms provided, that 17 of the *elements* are encompassed in the detail of ISEKI 'soft skills' (Table 2.3). From these only one*, cultural sensitivity* was considered low in course content and UoN student perception (Figure 7.9). The rest are all medium level in inclusion, with the exception of *teamworking* and *collaboration* being judged as 'high' inclusion. It is difficult to form any accurate type of conclusion from this comparison, except that the ISEKI 'soft skills' are included in UoN course content and well regarded by students for inclusion levels.

Hartel and Gardner (2003) reflect on the benefits of curriculum mapping and recommend use of the IFT framework (2016) as a standard, to change or develop curricula. Joyner (2016 and Appendix I) undertakes such an exercise

some years later, and learnings from this work have been embraced during this project. Exploring the outcomes of four comparison studies to the IFT standard in the USA (Appendix I), one is looking for desirable competencies (Morgan *et al.*, 2006), whilst three others (Bohlscheid & Clark, 2012, Johnston *et al.*, 2014, Joyner, 2016) search for gaps in courses or graduate skills. However as all are based at differing institutes, data cannot be accurately compared, only inferred.

Indications suggest a high requirement for 'critical thinking' (and general problem solving skills), and also 'professionalism' in the first paper (Morgan *et al.*, 2006), with possible corresponding gaps found in content of such competencies in the three other investigations presented. A relatively high desirability for 'handling multiple tasks and pressures' was also noted. Comparison with CFGC notes that for *critical thinking, decision making* and *professionalism,* all were noted with 'medium' desirability and they meet or exceed this scoring in course content and student perception. For *working under pressure*, this is considered 'high' in desirability and as discussed earlier, does not yet have the equivalent level of course content at UoN, and action plans are in place to address this. Other possible gaps were 'communication' and 'group dynamics', neither a current concern in UoN course provision, supported largely by the problem based learning and product development modules (D224F0 and D23BF2 respectively).

It is recognised this section is reflecting on a small amount of literature, so there are limitations to any inferences made; however this further emphasises the need for more work in the field and justification for development of the CFGC framework.

7.6.6 Reflection on terminology for curriculum mapping

7.6.6.1 Proposals for future categorisation of curriculum categories

To ensure correctness of terminology, it is proposed for a modification to the 'TLA' categorisation of course / module content (School of Biosciences, n.d.). The proposal is to replace the term 'learned' with 'practised' but keep the definitions developed for Study D (Table 7.2). TLA; taught, learned, assessed would be replaced with 'TPA', taught, practised, assessed. This terminology will be used within the Division of Food Sciences henceforth and a proposal to be made for a more general amendment to the School of Biosciences system.

Reflecting on the overall process employed and learning gained, a new curriculum model is proposed (Figure 7.10) to illustrate learning during UoN food sciences degree courses. The aspects tagged with an asterisk (*) have been included in the curriculum mapping of Study D.

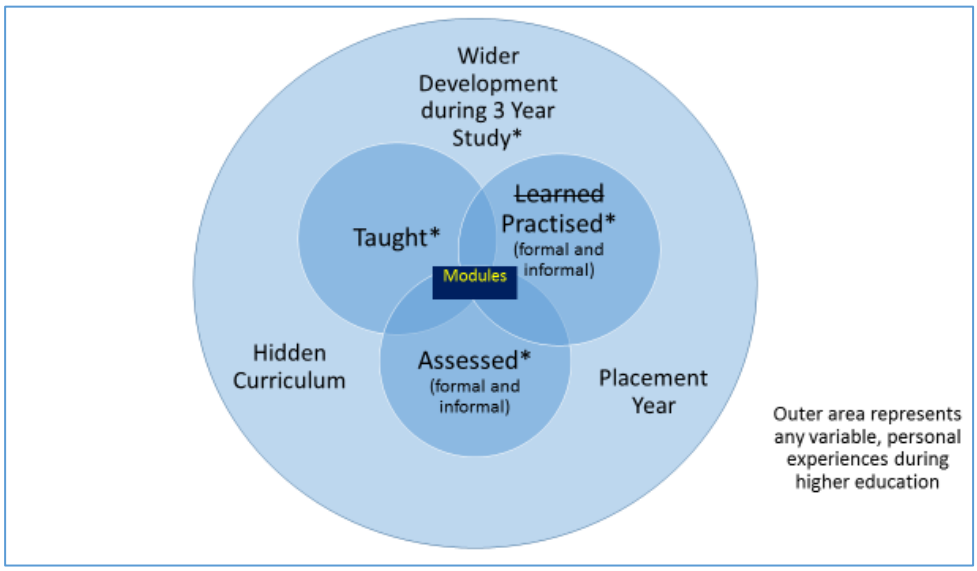


Figure 7.10 Proposed curriculum model of learning for food science degree courses. * denotes aspects included in Study D curriculum mapping.

Unlike previous work (Harden, 2001a, Mossop *et al.*, 2013, Vinten *et al.*, 2016), this overall learning model based on development by a central core of modular teaching activities, surrounded by an overarching sphere of opportunity and influence from wider factors. Using this approach, 'assessed', 'practising' and 'teaching' are incorporated in 'learning'.

7.6.6.2 Development of curriculum mapping terminology

Focussing on curriculum mapping terminology, referring to the original diagram in Figure 2.17, the process undertaken to inform and complete Study D was to firstly to understand curricula and how to categorise and map programmes in Chapter 2. Next, Chapter 3 concluded that the consideration of the student and employers should be built in to a process that can enable quantification, using a modified version of the current School 'TLA' system (Figure 3.6). Finally in this Chapter, the detail of methodology for Study D was established, and following mapping curricula of the two core food science programmes against the CFGC framework, reflections have been made. Figure 7.11 provides the updated version of the project terminology diagram.

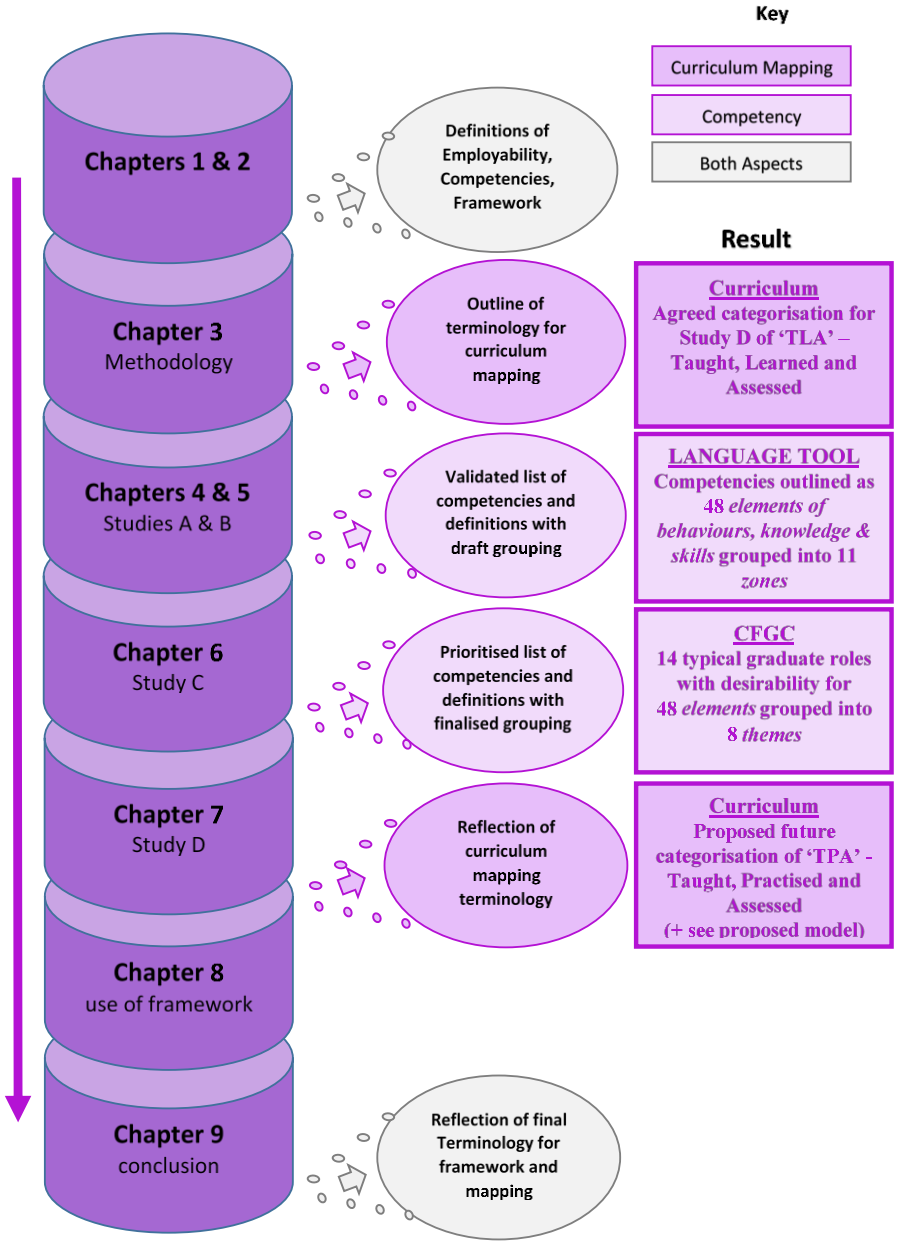


Figure 7.11 Diagram updated to illustrate the progress in development of terminology and classification during the project after completing Study D.

Following experience gained during the Study, the terms used in Study D for categorisation of material in curricula (Table 7.2) have now been adjusted for future use, primarily by rewording the category 'learned' to 'practised'. A revised table is presented in Table 7.15.

Table 7.15 Proposed terms to use for categories in curriculum mapping.

Category	Definition proposed for future use
Taught (T)	Items 'provided' to the students; a lecture, document, video, discussion, tutorial, facilitation, coaching, practical session, instruction, training, procedure.
Practised (P)	An activity that is self-directed; study, practical task or investigation (note if group or individual). Also included are opportunities to 'rehearse' something, e.g. *English proficiency* is developed by the group work or *listening* developed in a viva voce.
Assessed, Formative (AF)	Some type of assessment included in module teaching which is not contributory to final 'mark'.
Assessed, Summative (AS)	Some type of assessment included in module teaching which contributes (whole or in part) to final 'mark'.
Formal	Explicitly specified in modular specification, documentation, assessment criteria or timetabled activities.
Informal	Agreed present in some form, however not explicit in learning outcomes (LOs), formal documentation or assessment paperwork. Or perhaps the development opportunity is variable or only open to a certain proportion of students, for example a chance to lead a team.

7.6 CONCLUSION

The mapping of food sciences courses at UoN has been undertaken in a thorough and contextual way. Results indicate that curricula provide the majority of employer's requirements with respect to CFGC. Immediate work, described in the next Chapter, primarily focusses on completion of the action plan to address specific areas of imbalance. Looking longer term, the influence of the hidden curriculum and optional year-long placement is hoped to be considered. It is also recommended that a similar mapping process be undertaken at another HEI for comparison purposes.

There are no previous studies undertaken to inspect or review food science degree curricula for inclusion of employability-based competencies in the UK. However mapping results appear to suggest both courses tend to provide an encouraging level of opportunities for students to develop *elements* desirable in the workplace and thus fit for purpose. An overview of the work to refine course inclusion of CFGC during the 2017/8 academic year is outlined in the next Chapter. Initial endeavours to cultivate UoN student understanding of CFGC to support careers education is also explored, alongside development of an online tool for wider student access to CFGC.

Chapter 8 Initial use of CFGC

8.1 INTRODUCTION

The development of CFGC by Studies A, B and C has been described in Chapters 4, 5, and 6 respectively, and addresses the first research question. Research question 2 was addressed in the previous chapter, where an understanding of the inclusion of *elements* of CFGC in core curricula at UoN was established, and preliminary recommendations for future development proposed. Although not a fundamental part of the research project, it was considered worthwhile to introduce work undertaken to date on curricula development and also 'careers education', centred on identifying career opportunities and desirable competencies for typical graduate pathways. This chapter presents the initial endeavours of using CFGC from autumn 2017 to the end of 2018, aiming to support further validation of the framework.

Initial inclusion of CFGC to provide enhanced careers education at UoN is evaluated. Additional activity undertaken in developing an open access support 'toolkit', designed to support education of a wider population of students on the nature of career pathways for food sciences graduates, is introduced. At a similar time period within the project, modifications to course curricula at UoN were progressing, reflecting on the outcomes of the mapping exercise presented in the previous chapter. Examples of such undertakings are also provided.

8.2 USE OF CFGC IN CAREERS EDUCATION TEACHING AT UON

For logistical convenience and simplicity of execution, a UoN cohort was selected to introduce undergraduate students to the CFGC. It aimed to

improve understanding of the nature of career opportunities for food science graduates and provide a valuable opportunity for each student to be able to evidence and articulate (Cole, 2017) desirable personal competencies for roles that may be of interest to them.

8.2.1 Teaching inclusion for careers education

There are many considerations for the inclusion of 'employability' based teaching into discipline specific content; first to be considered is whether the aim is development of competencies, or support in career planning and job applications, namely 'careers education' (section 2.8.2). Choice of integration of material into core subject-based modules or to provide separate development opportunities is also required. As demonstrated in the results of the curriculum mapping process (Chapter 7), food sciences programmes at UoN are constructed to develop these competencies, now classified as *elements* in the CFGC, within discipline specific teaching. With regard to career development, self-reflection and practise for effective job applications, the approach has primarily started in year two, by encouragement in, and support for year-long placement applications. Next in final year, through participation in a core module (D235F8) focussed on personal and professional development, students draw learnings from study and experience together explicitly.

As the purpose of the exercise was careers education, methods were required to inform, but also encourage student reflection to enable success in their future actions. The approach was decided to develop functioning knowledge (Biggs *et al.*, 2011) in the provision of a reflective learning environment (Brockbank & McGill, 2007, Colomer, Pallisera, Fullana *et al.*, 2013).

CFGC outlines the types of *elements* that may be important for success in gaining and succeeding in employment as a food science graduate which has wide application for directly informing a variety of stakeholders. However during the student learning process, personal reflection will be required to facilitate self-understanding (Fernández-Peña, Fuentes-Pumarola, Malagón-Aguilera *et al.*, 2016). In planning the exercise, opportunities were added for students to gain understanding of CFGC, to reflect on personal suitability to the range of food sciences graduate opportunities, and then develop evidence of the right competencies to apply for a suitable role.

A classic model to understand how a person learns from experience is Kolb's experiential learning theory (Figure 8.1) (Kolb, 2015, Tomkins & Ulus, 2016).

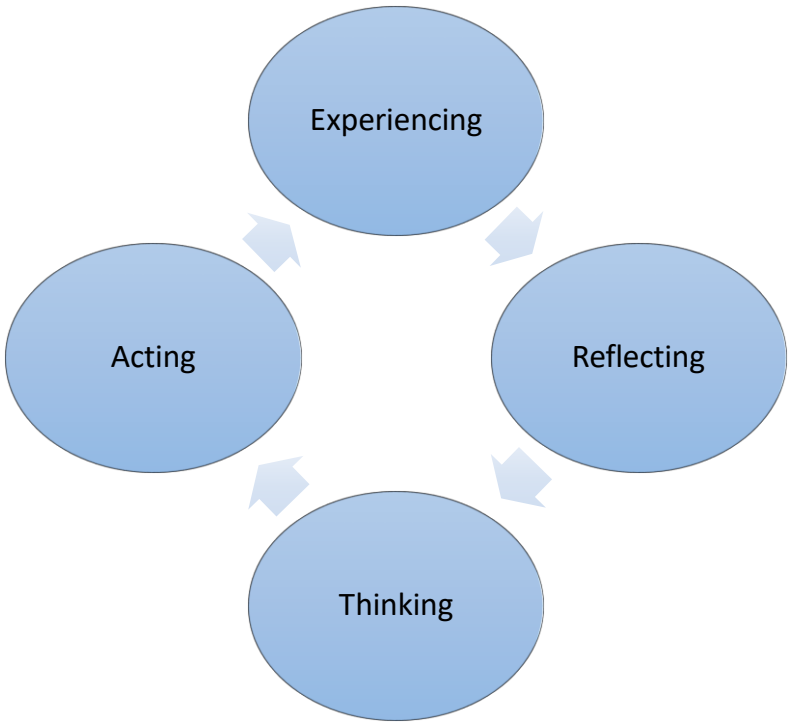


Figure 8.1 Simplified illustration of Kolb's experiential learning theory (Kolb et al., 2015, p.140).

The model has been utilised in teaching and learning development at most HEIs, including UoN, underpinned by the importance of engagement of the student by a variety of means to ensure deeper learning. The students may benefit from engaging with CFGC by a mixture of group and individual activities or experiences, to facilitate shared learnings and private reflections in order to analyse personal capabilities (Colomer *et al.*, 2013). By inclusion of a variety of modes of learning it is also hoped to engage the interests of a variety of learners in a typical cohort.

Development of effective teaching should be approached in a professional and reflective way. Cyclical consideration of planning, delivery, assessment and evaluation should be undertaken, keeping the student at the heart of decisions. Encouragement to imagine oneself as 'the student' can facilitate plans for effective learning (Ramsden, 2003). Capturing detailed student feedback was pivotal for effective evaluation of how the exercise has been received, and could be improved (Kandiko Howson, 2015).

8.2.2 Case study design and content

The core module D235F8 - Personal and Professional Skills for Food Scientists was chosen for introduction of the CFGC to students at UoN during the autumn semester, 2017. D235F8 has direct relation to the subject matter and has a suitable mode of delivery, comprising weekly, three hour workshops as opposed to formal lectures. The current module learning outcomes (LOs) are as follows:

LO1 Demonstrate a range of professional behaviours.

LO2 Synthesise your skills and capabilities into a targeted portfolio.

LO3 Evaluate your performance at networking, interviews and assessment centres.

LO4 Construct an action plan for personal and professional development to build on strengths and develop areas of weakness.

As the module is delivered in autumn semester of final year, students are likely to be receptive, considering their futures, and may already be making plans or applications for the next stage in their career. Integration of CFGC complements the existing module's characteristics of informing, experiencing and reflecting in both content and assessment.

By constructing appropriate, detailed learning objectives (OBJ) for the exercise, specific intentions could be outlined (Advance HE, n.d., Imperial College London, n.d.) supporting the module LOs:

OBJ i To introduce students to CFGC.

OBJ ii To encourage students to explore the types of graduate roles available to food science graduates.

OBJ iii To develop students' ability to reflect what competencies in CFGC they may possess and therefore typical graduate roles that may be suitable for them.

OBJ iv By targeted activities and coursework, to provide opportunity for students to test the use of CFGC for application processes and reflect on experiences.

The plan was to provide a mix of activities, some new but many adaptations of those existing in the module. Table 8.1 illustrates the relationship between the activities, specific learning objectives (OBJ) and module LOs.

Table 8.1 Illustration of interactivity of planned activities with specific objectives (OBJ) and the existing module learning outcomes (LOs).

Week	Activity	Learning objectives (OBJ)	Link to module LO's
2	CFGC introduction session – lecture Students to reflect on introduction in advance of week 3	i	2
3	*Group* discussion to review roles and *Individuals* to select those of interest to most suited	i, ii, iii	2
3	Mapping of desirable *elements* and *themes* from a CFGC role to own perceptions and evidence of personal competencies	i, iii	2
3-end	Development of tailored CV (curriculum vitae), and cover letter to demonstrate suitability to chosen CFGC role	iii, iv	2
6-8	Preparation for mock interview by providing evidence to articulate competencies in chosen CFGC role	iii, iv	3
10	Engagement in mock interview against a CFGC role and reflection on verbal feedback from interviewer	i, iii	
end	Reflection of feedback from summative assessment of portfolio tailored to the CFGC role chosen	iv	2, 4

In summary the process comprised an introduction to the CFGC and after initial review of material (Appendix XVI), both in groups and individually, each student was required to select a role they may desire or be best suited for. Activities continued through the semester to: build a tailored CV, letter of application and personal development plan in a portfolio and prepare and undertake a targeted mock interview. Prior understanding and experience of

assessing reflective portfolios (Fernández-Peña *et al.*, 2016) provided value to the student in providing a summative mark in addition to constructive open feedback by module convenors, and thus opportunity for reflection by the student (Holmes, 2017). All activity was delivered by the researcher and fellow module convenor.

A paper based in-class questionnaire was presented to the final year cohort in December 2017, and a student group interview organised the following January. The primary aim of the questionnaire was to supply a later volunteer populated, student group interview, with broader perspectives from the whole cohort.

8.2.2.1 Cohort student evaluation

A paper evaluation questionnaire was completed in the last teaching session of the semester (week 11) and designed in three sections; firstly to verify whether the student was considering a career in the food industry, as it was understood a few students were planning careers in other fields and it was desirable to be able to filter data accordingly. The next section comprised ten questions or 'statements' for a fixed response using a 'Likert style' scale as presented in Figure 8.2, to obtain quantitative perceptions on levels of comprehensibility and usefulness of the CFGC.

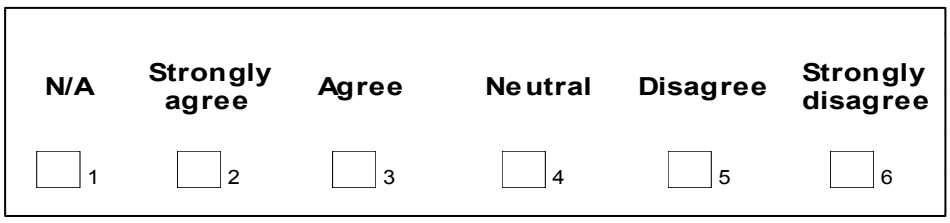


Figure 8.2 Scale used in student questionnaire to assess introduction of CFGC into undergraduate careers education.

Finally five open text questions (Table 8.2) were presented to gather richer data to both support earlier questions and obtain any wider views from the students, and this section prompted the use of a paper questionnaire.

Table 8.2 The five open questions included within the student questionnaire.

What did you like about the CFGC?
What would you improve about the CFGC?
What did you like about how the CFCG was included into the Personal and Professional Development for Food Scientists module?
Do you have any suggestions of how to improve the inclusion of CFGC into the Personal and Professional Development for Food Scientists module?
Please use this space for any further comments you would like to make about the CFGC

Results were manually collated in a spreadsheet and as data were primarily to inform discussion, basic evaluation was undertaken. Responses were grouped into: 'challenging' if any participant selected 'strongly disagree' to a statement; 'affirmative', where the most common responses were 'agree' or strongly agree'; and any remaining questions were 'neutral'. Comments from open questions were inspected and grouped where any one response matched others, and a summary sheet of all responses prepared.

8.2.2.2 Student group interview

The choice and general design of a 'formal field group interview' is described in section 3.2.4. Participants were volunteers whose timetables permitted attendance and the session was facilitated by a prepared colleague. Having worked closely with the students over the past semester on the subject to be reviewed, students appreciated the close connection the researcher had to

CFGC, thus employing an independent facilitator was considered favourable for gathering honest and open feedback (Franz, 2011).

Materials prepared for use in the interview were introduced to the facilitator carefully, including a pre-sessional strategy (Figure 8.3), similar to that developed for Study B (Chapter 5), alongside a detailed time plan and guidance document which contained the key questions to use (Appendix II) and suggestions for supporting discussions regarding any challenging parts of the questionnaire feedback.

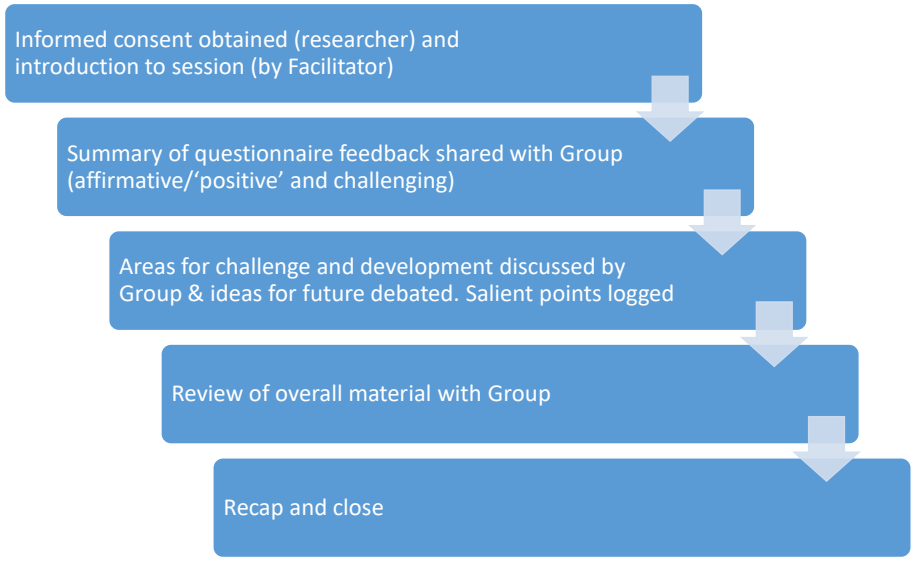


Figure 8.3 Pre-session strategy for student field group interview session to review CFGC teaching inclusion.

During the group interview, after an introduction, gaining informed consent and the departure of the researcher, students were given time to review the questionnaire summary sheet. The active part of the session commenced with consideration of 'affirmative' responses to capture any further viewpoints. Following this the 'challenging' responses to the survey were introduced and discussions steered to capture further perspectives and debate any possible

improvements. The session was terminated by a review and summary from the facilitator.

As described in Chapter 3, data were recorded by the facilitator on flipchart sheets and an additional note taker (with audio recording facility) was present. The use of two flipchart sheets to log salient items agreed by the group as significant (affirmative/positive and challenging) was decided to be the core point of reference. Following transcription by the note taker, the facilitator reviewed all material, and discussed with the researcher. Evaluation was undertaken by use of the notes taken from the session to guide further interpretation of the salient points captured.

8.2.3 Results

The cohort size for the module in 2017 and thus the study was 32. From a teaching perspective, the integration of the CFGC concept and material into the module content was comfortable. Informal feedback during the semester from students was positive, with a number of students keen to find out more about specific roles. All engaged well with use of the role profiles to develop their portfolios and prepare for their mock interview.



Figure 8.4 Students reviewing CFGC role profiles during a teaching session (autumn 2017).

8.2.3.1 Student questionnaire evaluation

After securing informed consent, a total of 26 students completed the questionnaire in teaching week 11. An initial review of data confirmed two students were not considering a career (work or study) in the food industry, so the final data set was confirmed as 24. Analysis of the ten questions with Likert style responses (Table 8.3) indicated CFGC has been well received by students in terms of understanding and perception of usefulness.

Table 8.3 Grouping of Likert style responses to the 10 statements in the student questionnaire (n=24).
NB: 'Moodle' is the UoN online learning platform.

Questionnaire statements with 'affirmative' responses
I am confident from explanation given of the research undertaken, that the CFGC reflects food industry requirements for graduate competency.
The terms and language used in the material is understandable to me.
Having 14 different roles outlined for graduates entering the food industry has been useful.
I found using one of the roles for starting build examples and evidence for specific competencies useful.
I found using one of the roles as a basis for preparing for my mock interview helpful.
Overall the CFGC has been a useful inclusion to teaching with regard to supporting my future career planning and job applications.
Questionnaire statements with 'neutral' responses
With regard to the detailed information on Moodle noting suggestions on providing examples for an 'element' - I will find this useful for my job/interview preparation.
Questionnaire statements with any 'challenging' responses *(x) = number of comments with 'strongly disagree'*
I have found the information on what is desirable for each of the roles useful in considering what the most appropriate first graduate roles are for me *(2).*
I found using one of the roles for developing a tailored CV during the autumn simple to do *(2).*
With regard to the detailed information on Moodle noting suggestions on providing examples for an 'element' - I have found this useful for my future personal development plans *(1).*

With regard to open comments, much of the data supported the positive responses in earlier questions. Comments about what was liked about the CFGC were encouraging and included,

> *"Easy to follow and understand what job roles are available in the industry."*

"I liked how it can be a[cc]essed[25] online so can access it outside of the University site."

"The simple and understandable format."

"Useful insight into employers' requirements."

There is therefore some appreciation of the relevance of the CFGC to the reality of employment on graduation. There were a number of comments regarding appreciation of the practical use for job application processes. The provision of detailed career pathways in the CFGC was also valued,

"Having a list of elements that are required for a specific role is practical when preparing for a job application."

"Helped me to see which roles weren't right for me and where to focus on improving before applying to jobs. Helped me to tailor my CV for job applications."

"I liked that it gave me more of an idea to which jobs are available to food scientists that aren't necessarily the jobs you would be initially thinking of."

As anticipated from previous informal comments, the approach to inclusion into the module complemented the existing structure and content,

"It was well integrated into the module."

[25] Comments have been taken from the questionnaire verbatim and only demonstrably corrected if required

"Helped us work through CV and personal statement, also mock interview"

"It was very useful for mock interview."

Additional feedback of note suggests more time to consider initial information may be required,

"Create more discussion at the start about each of the roles so they're fully understood by everyone and ~~ppl~~ give them proper thought."

"Maybe have a short session each role to uns[d]erstand each better."

Comments regarding other suggested improvements supported some of the 'challenging' responses. For example, the question statement 'I have found the information on what is desirable for each of the roles useful in considering what the most appropriate first graduate roles are for me', generated two responses of strongly disagree and five of disagree. Two interesting threads were generated from the open comments; the first two comments below represent a desire for some students to remain more general in approach,

"Although some competencies are more important for some roles than others, I think all should be considered throughout."

"..rather than picking one role~~s~~, may be beneficial to consider others too."

Next, another two demonstrate requirement for material in a wider field than food science,

> *"Maybe more 'general' jobs."*

> *"Maybe include a couple of non-food science careers."*

One suggestion was specifically about relevance for international employment, likely provided by one of the six overseas students (18%) in the cohort,

> *"Can also include some roles which targeted for international students or like in a separate class for students who are interested finding jobs overseas."*

Surprisingly only one comment was retrieved in relation to sourcing evidence of competency development from degree study,

> *"Better analysis into what strengths/weakness one had, particularly with module inclusion."*

Key points were collated for discussion in the group interview. It was a reasonably straightforward process to assign material from the five open comment questions (Table 8.2) to the groupings outlined in Table 8.3, as appropriate. The three page summary sheet (Appendix XVII) comprised data in relation to positive or affirmative feedback and aspects that were more challenging, each including pertinent quotations from student comments.

8.2.3.2 Student group interview

Nine volunteers attended the group interview session which lasted one hour and 30 minutes. The session focussed on discussion around topics within the

summary sheet although a number of additional, unprompted items were recorded. The facilitator reported the group was relaxed and all present appeared confident in expressing viewpoints and undertaking active discussion. Salient items are reproduced in Figures 8.5 and 8.6.

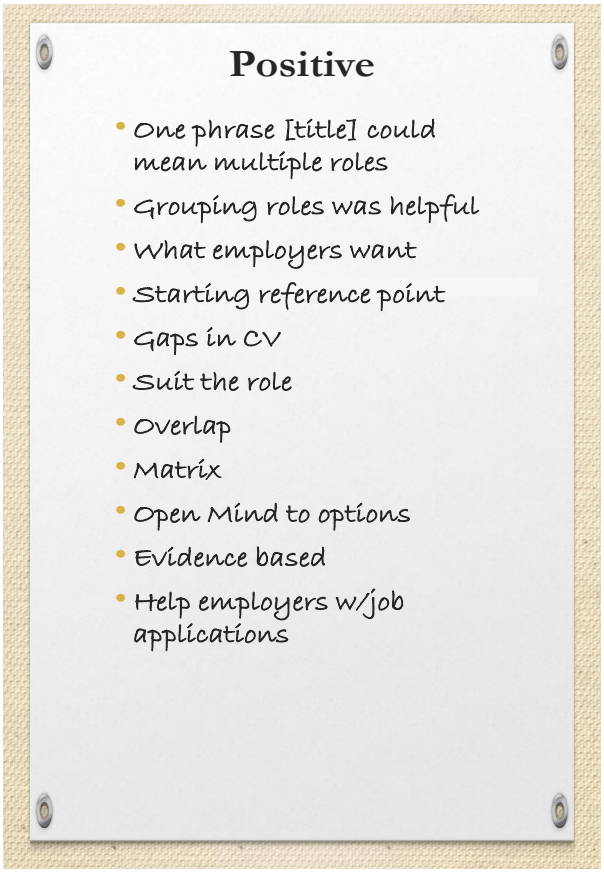


Figure 8.5 Flipchart list of salient 'positive' or affirmative comments from student group interview (January 2018).

Positive group opinions gathered (Figure 8.5) supporting cohort questionnaire data included, usefulness for finding out more about role types and what may be suitable for each person. For example, grouping job titles with each role was valued. Details such as "what employers want" and "evidence-based" confirm appreciation of the involvement of employers in the development of the CFGC. Students may lack confidence in actually getting a job, even when appreciating the growth of their own ability as undergraduates (Beaumont *et*

al., 2016), so supplying a credible tool to use could provide useful assurance. The use of the matrix supplied to map the desirable competencies to roles (Figure 6.9 and Appendix XVI) was noted as particularly useful in finding cross-over or similarities between roles, and was suggested to be added to the online accessible material.

A final comment in the flipchart list was linked to a discussion around difficulties in understanding the nature of vacancies. Job advertisement or specification consistency was raised as an issue when looking for a good graduate role, and a vision of employers using 'templates' for advertising roles was suggested. Consideration of this topic will be discussed in the next Chapter.

Students appreciated the accessibility of CFGC on the IFST website (Weston, 2018a) for use within teaching sessions or remotely. However comments were made that it contained "too many links", with one for each role (Figure 6.21 and Appendix XII). Suggestions were made including numbering them, providing some type of flowchart, or provision of a whole document or single webpage to improve navigation. The two comments from questionnaires asking for inclusion of more general or non-food science roles was posed in the session by the facilitator but it was recorded that this idea was "not useful".

It was established that not all students present had engaged with the 'full language book' (example in Figure 4.5) which included, for each *element*, quotations from stakeholders on the importance of the *element* and examples of how it could be evidenced by a student. To avoid overloading the students with new material, this document was purposely introduced later in the semester, selecting initially to share simpler documents (Appendix XVI) and

the IFST webpage mentioned above. Indeed one comment captured from a student in the notes was that each poster (infographic) had “enough information”, supporting the initial level of detail issued had provided sufficiency for some.

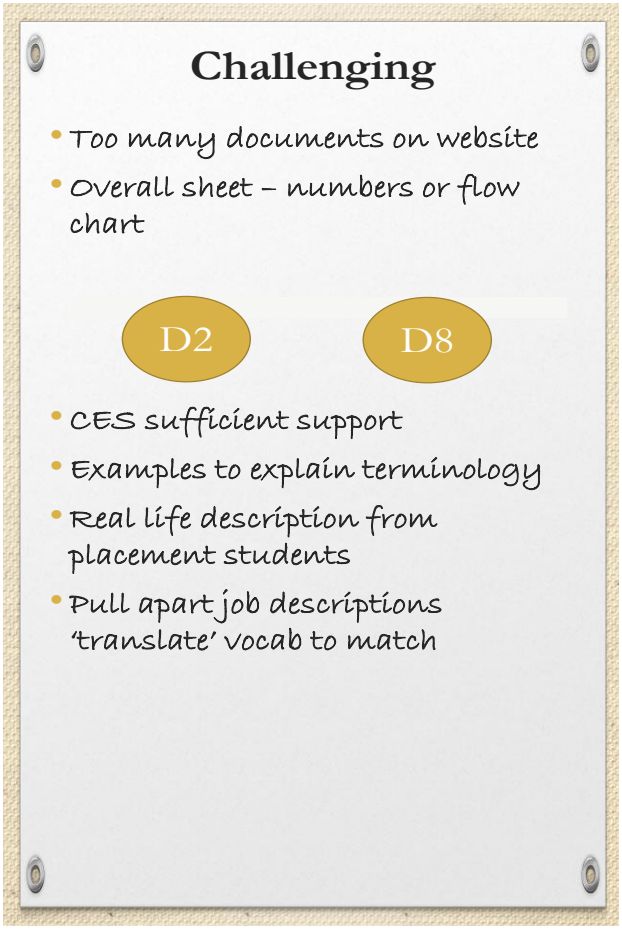


Figure 8.6 Flipchart list of salient ‘challenging’ comments and suggestions from student group interview (January 2018).

When inspecting the ‘full language book’ in the group session, some students confirmed the examples provided were useful and an idea was recorded of constructing ‘mock questions’ to support each *element*. The inclusion of ‘D2’ and ‘D8’ as symbols, in the list in Figure 8.6 captured a comment that these two *themes* in CFGC named, *appreciation of the wider world* and *the business world,* respectively (Table 6.7 and Figure 6.18), were “not

necessarily personal skills". This signifies the students appreciate these *themes* and their contents are more based on acquisition of knowledge as opposed to other *themes,* in which personal competency development is more prevalent (section 6.6.3). Additionally the group pointed out they would like to understand requirements for 'levels' of competency in the *theme* D8 - *the business world* and also the *elements* within that *theme* including *commercial awareness*.

The comment raised about international context of CFGC was not explored in the session as participants were all UK residents (one confirmed international student cancelled just before the session).

Two interesting suggestions also emerged. The first, associated with the last point listed in Figure 8.6, was a recommendation was to "pull apart" existing job specifications linked to a CFGC role and "translate" and understand similarities between the specifications and a CFGC role profile. The second suggestion proposed that it would be beneficial to have real-life descriptions from placement students or graduates for each role type or include a profile of an "average day". Further discussion was captured about the usefulness of the CFGC for students in year two with regard to placements. Those present who had chosen a placement year, agreed that using CFGC would have "helped decide" what placement type to choose and "give an idea of what to expect".

8.2.4 Discussion

Wider discussion and implications with respect to this work are included at the end of this Chapter and the subsequent one, however the introduction of CFGC to an undergraduate student cohort at UoN was well received.

8.2.4.1 Strengths and limitations of exercise

Reflecting on the process of evaluation, the use of an independent facilitator to conduct the group interview provided confidence in the feedback being accurate, full and valuable (Foddy, 1994). However a limitation of this work is clearly that the activity to date has only been centred on one institution. This is aimed to be addressed in future by engaging with universities that have been involved in the project previously, and ideally new ones, to share learnings from UoN and evaluate the effectiveness of inclusion in teaching elsewhere and thus transferability (Braun & Clarke, 2013). This has commenced and is discussed in the next Chapter. Whilst data was captured in the cohort questionnaire, the absence of representative international students in the group interview was unavoidable (mainly due to timetabling) but future development work will aim to engage this cohort wherever possible.

8.2.4.2 Reflections of the exercise and developments for the future

Reflecting on feedback gathered, the following suggestions for refinement of use of CFGC in careers education in teaching are proposed.

It is planned for an earlier introduction of CFGC in year two, for both activities associated with a placement year and in spring semester teaching, where students can start to experience some type of control of their career (Artess *et al.*, 2017). This will provide support for those choosing and applying for a placement as suggested in the group interview but also ensure all students have an understanding of CFGC before concerted utilisation begins at the start of the final year. In addition, methods of collecting feedback can be argued in themselves as opportunities for the students to conduct further reflection.

Reflecting on the exercise in autumn 2017, the following has been adjusted for careers education in the following year. The proportion of international food science students within the cohort at UoN varies from 10-20%. Although the researcher believes CFGC is a useful support tool in a global context, industry data sourcing was restricted to UK and the Republic of Ireland. The targeted session on international context in autumn 2018 explicitly asked students considering working outside of the UK to talk to the researcher to review transportability of particular role types. Promisingly some associated queries were raised by individual students in the timetabled one-to-one sessions in week four.

Inclusion of CFGC in detail began slightly earlier in the autumn 2018 semester (week two) and a session to compare real job advertisements and specifications with CFGC was included. From formative assessment of CVs it appears many have embraced the technique of tailoring their content to a role in CFGC.

Comments from this year's cohort (2018) indicate similar levels of interest and engagement in the CFGC, as a tool for exploration, reflection and support in module activities,

> *"Helped me to gain insight into career areas I hadn't previously considered."*
>
> *"I liked the key competencies for each role as it gave me an understanding of skills required and then whether I had the skills relevant."*
>
> *"Opportunity to think about potential roles and understand how can use placement and modules in competency evidence."*

"I liked how they were used alongside mock interviews and incorporated into CV practice."

(D235F8 student cohort, autumn 2018)

From the few comments about suggested improvements, the following was of particular interest, in light of previous cohort's feedback,

"Structured submission of competency examples from students [now graduates] would be good practice."

(D235F8 student cohort, autumn 2018)

Future development work is envisaged to include gathering some type of 'day in the life' or commentary from recent graduates working in a particular role, to supplement existing CFGC material. Similar types of inclusion have been made in some of the food science role descriptions in Hartel and Klawitter's book (2008), as introduced previously. There will also be considerations made on reformatting the IFST-based webpage (Weston, 2018a) to a more streamlined design.

Comments from the 2017 questionnaire regarding development of more general profiles or those unrelated to food science was not encouraged by the group interview participants and will not be pursued. Reasons include the inability to predict alternative roles that may interest future cohorts and lack of familiarity of needs of employers in other fields to support production of valid material.

8.3 INTERACTIVE ONLINE TOOL

8.3.1 Requirement and approach

When ratifying the final CFGC in summer 2017, the stakeholder group debated future, wider applications of the framework (section 6.5) to provide careers guidance and personal development support for all food science students and new graduates. It was agreed to scope and possibly develop an interactive open access CFGC web tool.

A feasibility prototype was developed by a colleague specialising in website development, within the School of Biosciences during the summer of 2017. Final year food science students were invited to test the prototype in the following autumn. When issuing the questionnaire detailed earlier in December 2017, students were asked to make any comments regarding the prototype in the final open section. Over the same time period, in collaboration with the School of Computer Sciences, a group of five undergraduate students undertook a project as part of a year two module (G52GRP) to develop a more refined version of the prototype during the 2017/8 academic year.

Progression of the project was centred on the G52GRP module outcomes and the researcher took the role of the project ‘client’ and followed the routine process of the project briefly comprising: review of client requirements and data supplied, scoping and development of product, regular reviews with client (2-3 weekly intervals) and finally formal handover and presentation of the webpage at a module showcase day.

8.3.2 Contextualising interactive tool development

Pertinent comments for online resources gathered from open comments in final year food science student questionnaire in 2017 (see earlier in the Chapter) included,

> *"A more interactive online tool that is more user friendly."*
>
> *"Could there be a questionnaire/test that helps select which desirable elements you have and then link th[e]se to see which role would really suit you?"*
>
> *"use of quiz tool" (when asked about suggested improvements for inclusion into D235F8 module)"*

To support information provided by the client (researcher) and provide perspectives better associated to future users, a food science student focus group was co-ordinated by the computer sciences student team.

8.3.3 Results and discussion

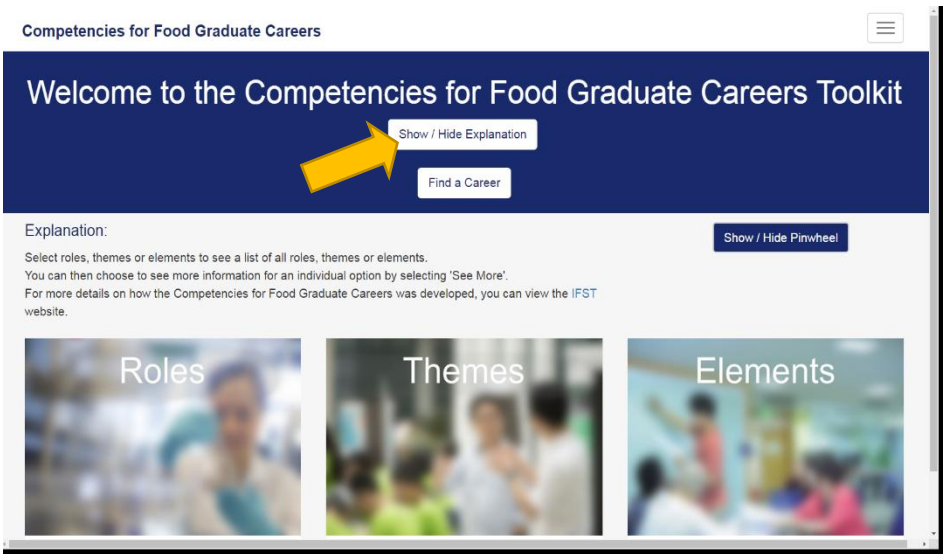
The final version of the Competencies for Food Graduate Careers Toolkit was handed over to the researcher in May 2018 as part of the G52GRP module showcase event (Figure 8.7).



Figure 8.7 Computer science student team presenting their CFGC online interactive toolkit (May 2018).

The simple open access toolkit resides on UoN website (n.d.-e). A screenshot of the home page is displayed in Figure 8.8 with interchangeable links to navigate between the IFST webpage (Weston, 2018a) as highlighted by pointers in the figure.

The tool was designed to allow students to navigate and explore the details of each of the 14 roles, 8 *themes* and 48 *elements* of the CFGC by selecting items on the scroll down page (See Figure 8.8b). In addition, users could set up queries to find which of the typical roles were most suited to them.



(b)

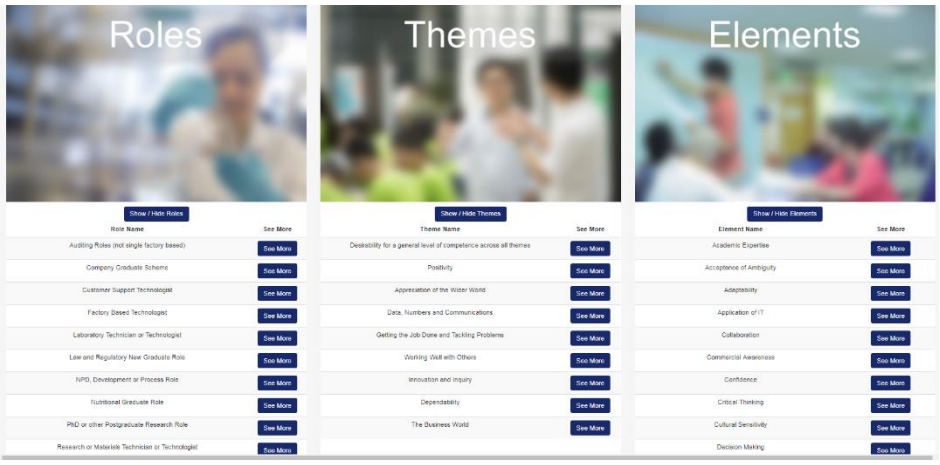
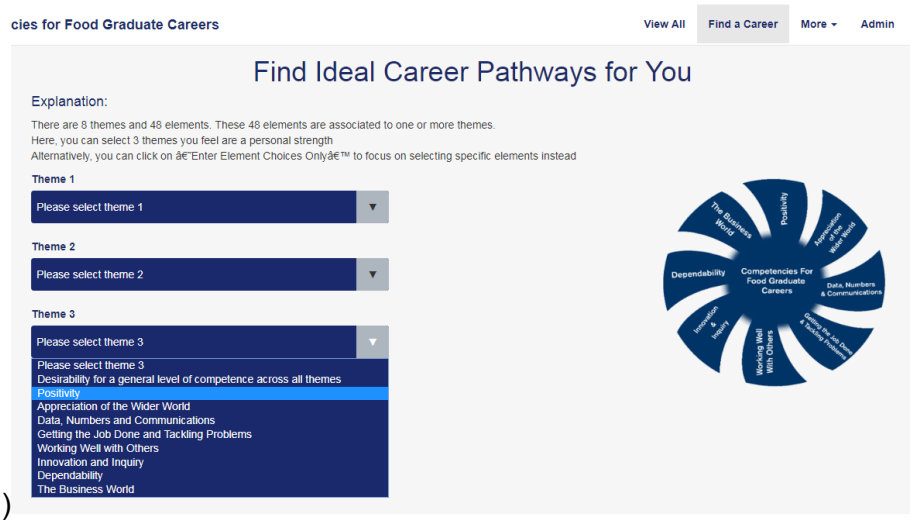


Figure 8.8 (a) The front page of the CFGC Careers toolkit. The yellow arrow points to button to use interactive feature. (b) A view of the main page scrolled down with access to detail of each roles, *themes* and *elements* (available at: http://www.nottingham.ac.uk/go/foodcareers).

A button at the top of the page 'Find a Career' (See Figure 8.8a) navigates the user to the page shown in (Figure 8.9a). Reflecting on their personal strengths, a combination of three *themes* and associated *elements* can be selected or alternatively the user can select purely *elements* they believe they possess (Figure 8.9b).

(a)



(b)

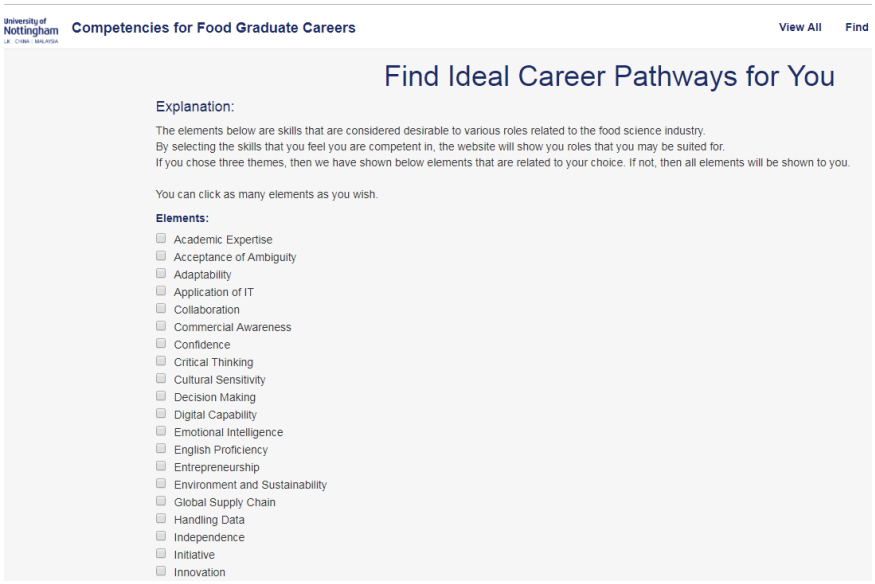


Figure 8.9 Sections of the CFGC toolkit noting options for personal strengths in terms of (a) *themes* or (b) *elements* (available at: http://www.nottingham.ac.uk/go/foodcareers).

Once items have been selected, a list of desirable roles are presented to the user as exemplified in Figure 8.10. The user can then select any roles of interest.

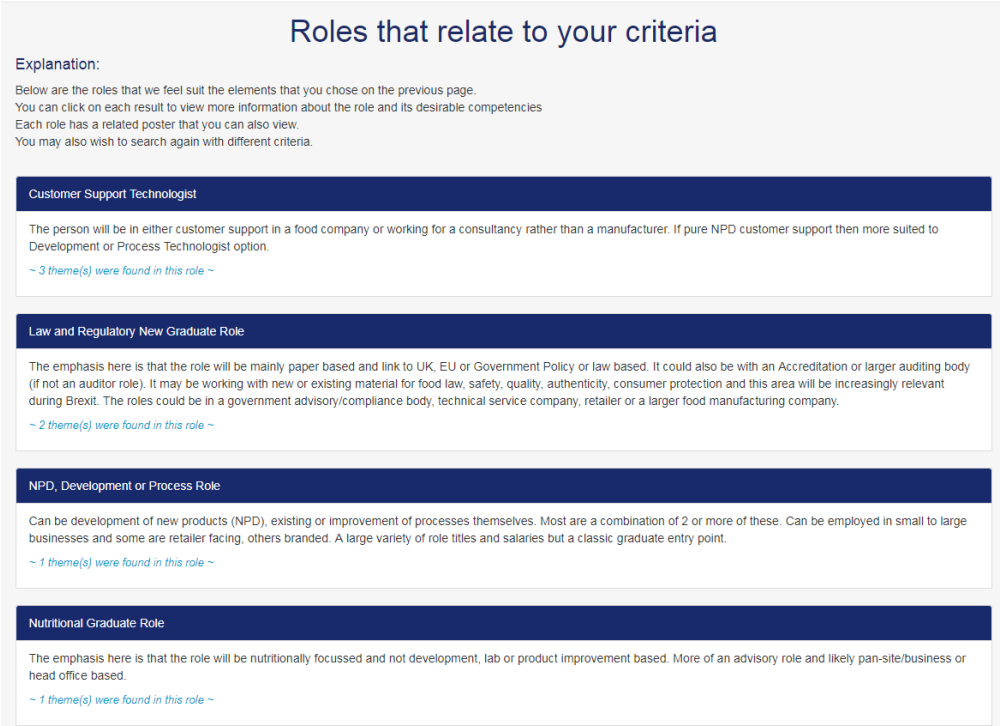


Figure 8.10 Results of a search using CFGC toolkit (available at: http://www.nottingham.ac.uk/go/foodcareers).

Further information is provided for roles chosen: as either displaying the standard infographic poster (Figure 6.20) for reference or printing, or creation of a colour coded ‘profile’ (Figure 8.11), highighting in green where items have been identified by the user as a strength and the other items in red to denote areas of possible development.

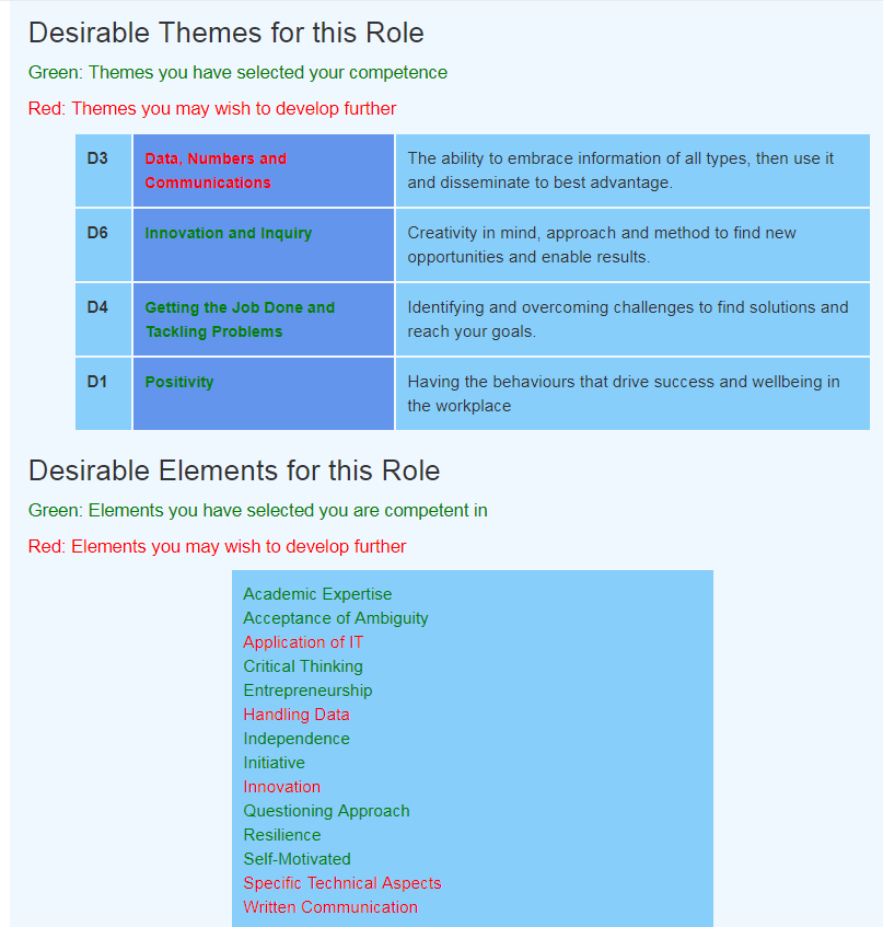


Figure 8.11 Extract of a colour coded profile given to a user from CFGC toolkit demonstrating areas of strength and development (available at: http://www.nottingham.ac.uk/go/foodcareers).

The toolkit provides open, interactive access to food scientists regarding the type of careers and desirable competencies for each role in industry regardless of location, or whether in study or having subsequently graduated. The link to the tool on the IFST webpage (Weston, 2018a), and online UoN course pages (n.d.-b) is providing an initial direction to the webpage, but more focussed dissemination is due to commence in 2019.

With respect to performance of the current toolkit, when undertaking a search using personal strengths a fairly broad list is currently generated including roles that have perhaps only minor links to strengths chosen, although the

number of *themes* matched to each role is displayed. Limitations were appreciated based on scope and timescale of the student project. However the student group developed a robust, accurate, navigable tool with a positive, professional image, and with the time afforded for the project is to be commended. Developments undertaken in future could include refinements of the search criteria, and more detailed feedback will be gathered from target users to best inform any improvements undertaken.

8.4 CURRICULUM DEVELOPMENT AND CFGC

On completion of the curriculum mapping exercise outlined in Chapter 7, steps to address the agreed short term actions commenced (Table 7.14), primarily in readiness for teaching in the 2018/9 academic year. An example was addressing the proposal of creating new content or 'teaching' connected to development of *working under pressure* and *resilience* for students at the early stages of study (section 7.5.4). A suitable approach and material for a short workshop was prepared in collaboration with the 'Let's Live Well Rushcliffe' team (Nottinghamshire County Council, 2018). A 'Study Well' session was delivered in welcome week (September 2018) by seven current final year students with prior training from the 'Let's Live Well' team.

Feedback obtained was that first year students found the session useful especially during small table discussions, however the week was exceptionally busy which may have affected impact of the session. Plans for 2019 are to include it in the early weeks of teaching instead. Interestingly the final year students themselves commented they found the process of training and delivery affected them personally, reflecting on their own wellbeing and sharing experiences: "There are good days and bad days but there are many

different ways of dealing with this" (final year student, personal communication, 2018).

Discrete new sessions have been also been included within modular teaching for example, *teamworking* for first year (module D211F4), and *leadership* for final year students (D235F8). Finally minor amendments continue, one example is documentation development for the final year research project (D23PRO) with the aim to ensure students have a more explicit understanding of their competency development.

The student questionnaire feedback earlier in the Chapter, included a comment on association of competencies developed in module content with what a person may now possess. Over a number of years, careers and job application support in food sciences at UoN has encouraged students to reflect on their degree study to evidence competencies, as well as drawing from wider pursuits and experiences. Having gathered detailed information for food sciences courses during the curriculum mapping, a simple matrix or 'passport' has been constructed to provide students with an indication of where competency development opportunities have been present during their study. Figure 8.12 presents the passport for core modules in BSc (Hons) Food Science. The passports were presented to final year students at their End of Course Review in June 2018 and informal feedback was positive. Subsequently this has been shared with cohorts in the 2018/9 year to allow them to track past and view future opportunities of competency development whilst in study.

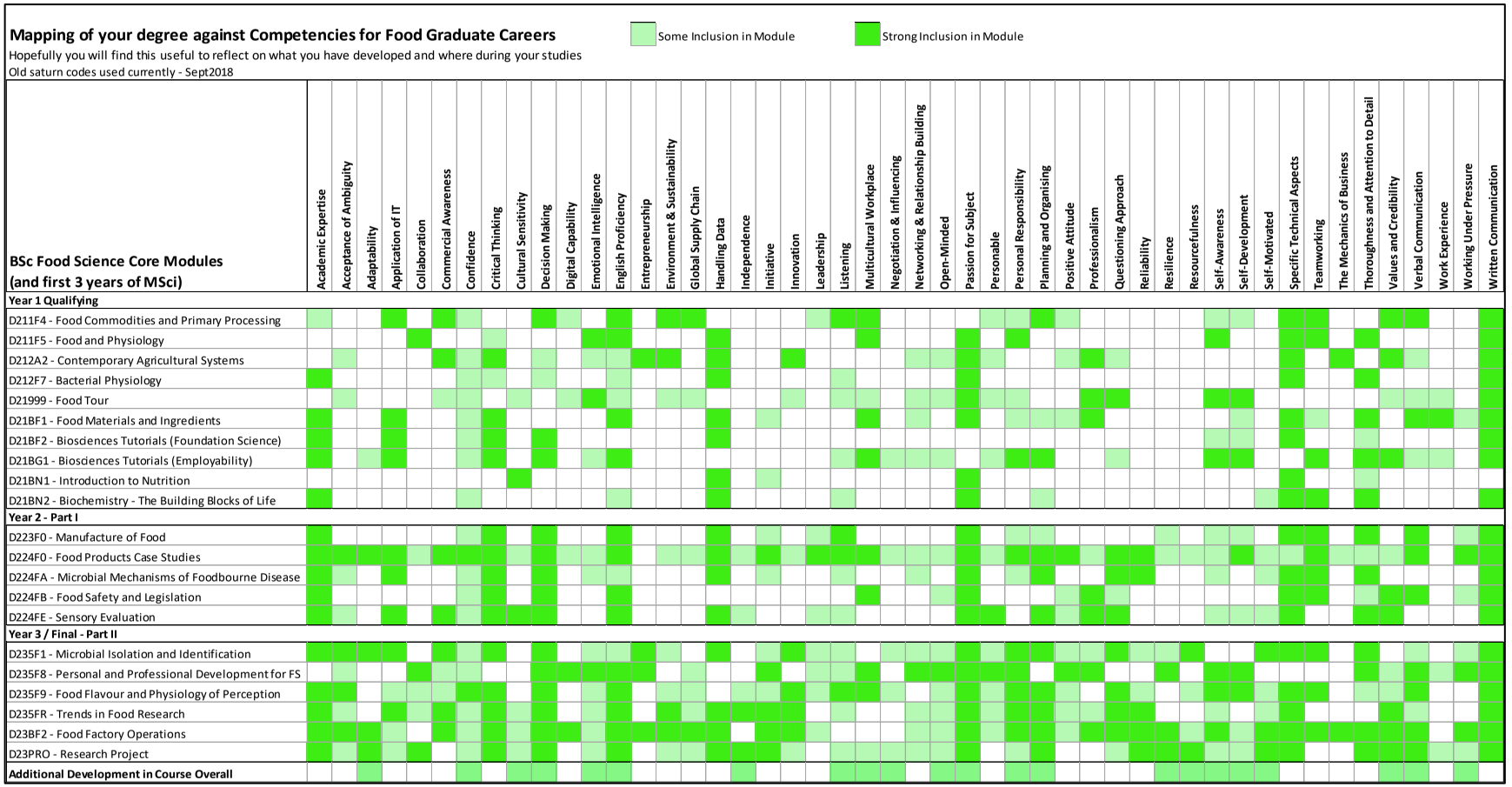


Figure 8.12 Copy of the BSc (Hons) Food Science passport issued to graduating students in June 2018.

8.5 OVERVIEW AND IMPLICATIONS OF CHAPTER 8

Activities described in this Chapter serve to further support the validity of the CFGC. Overall there is an appreciation of the relevance of CFGC, matching with the reality of employers' requirements for graduates (Hartel & Gardner, 2003), which justifies the significant consideration and effort undertaken throughout the project to capture viewpoints of employers both within the project stakeholder group and the far wider gathering from the industry survey.

In particular, practical use (Dacre Pool & Sewell, 2007, Dacre Pool, 2017, Holmes, 2017) of CFGC with a simple, understandable format for job application processes has been captured from student feedback. Using CFGC in preparation for the mock interview sessions has been especially well regarded, suggesting the CFGC may be of tangible use in providing focus and structure in preparation for real-life job interviews.

Improvement of comprehension during activities in module D2358 – Personal and Professional Development for Food Scientists, should be addressed by introducing students to CFGC earlier in degree study (Yorke & Knight, 2004, Artess *et al.*, 2017), to gain some familiarity before commencing their final year. Aside from careers education, by utilising results of the curriculum mapping exercise (Chapter 7), students are already gaining from the short term actions undertaken during this academic year to refine and develop modular content (Joyner, 2016), to provide targeted competency development.

Encouraging comments were also gathered in usefulness of online accessibility; the IFST-based webpage (Weston, 2018a) has been a welcome

addition to these stakeholders. The launch of the new interactive toolkit on the UoN website (n.d.-e) has provided another open access point and an opportunity for basic interaction with CFGC outside of structured teaching sessions. Importantly, these websites provide access to stakeholders beyond UoN. Increased awareness and use of the CFGC by other institutes, students and employers is a key future initiative and this will be explored in the next Chapter.

Chapter 9 Discussion

Previous chapters have discussed specific outcomes and limitations of the work undertaken, however a summary of project findings is presented in this Chapter. A reflection of the overall process of development of CFGC, along with its use and impact to date at UoN is undertaken. Current and potential impact of CFGC in the wider HE community and for employers is introduced. Suggestions are outlined regarding future changes in environments of higher education and graduate employment. Finally, proposals for the wider value of CFGC to support improvement of the food industry talent pipeline are also presented.

9.1 OUTLINE OF STUDY TO ADDRESS RESEARCH QUESTIONS

The aim of the project was to respond to the project research questions sequentially, as originally introduced in Chapter 3 (Table 3.1),

> *Question 1. What are the key competencies desirable and required for food science graduates to be successful in their career in the food industry?*

Research question 1 has been addressed by Studies A, B and C, as presented in Chapters 4, 5 and 6 respectively (Table 9.1).

Table 9.1 Illustration of how research question 1 was addressed.

Question 1 Sub-question	Study
1a. What is the universally understood language of the terms to define the key competencies?	Study A – development of language tool Study B – testing validity of tool
1b. What are the typical roles Food Science students undertake after graduation?	Study C – industry survey
1c. What do employers believe are the key competencies for a Food Science Graduate?	Study C – industry survey

Work was centred on the development of the CFGC framework itself, and justifiably required the highest level of involvement by wider industry stakeholders. This has been kindly and readily provided by employers, alumni, educators and students alike, enabling the production of a useful and credible resource for future users in all of these categories.

Research question 2 has been addressed in full by Study D in Chapter 7 (Table 9.2),

> *Question 2. Using a case study at University of Nottingham do current vocational degree courses provide these competencies?*

Table 9.2 Illustration of how research question 2 was addressed.

Question 1 Sub-question	Study
2a. How are the key competencies included in course teaching at University of Nottingham?	Study D – curriculum mapping
2b. What recommendations' to curricula design may be made for the future?	Study D – curriculum mapping

In comparison to the previous research question, stakeholder involvement has been centred at UoN with the academic team, and by harnessing feedback from course alumni.

Each question has been approached with sufficient in-depth consideration to ensure that appropriate methods were utilised. Validity has been increased by industry-wide viewpoints to develop CFGC, and this has been underpinned by the researcher's previous experience of both the food industry sector and HE to ensure positive, constructive communication and progress with all stakeholders. It has also allowed for appropriate, contextual choices to be made in data interpretation.

Equally in addressing research question 2, the selection of suitable methodology to conduct curriculum mapping and interpret findings required extensive evaluation of a wide variety of previously used approaches. Collaboration with selected colleagues to perform the study and involvement of individual module convenors for detailed mapping, underpinned by graduate feedback on course experience, allowed for completeness of results. Contextualising these results with employers' desirability of elements (from Study C) provided a realistic output to share with students and steer priorities for curricula development.

The project has addressed the two main research questions and succeeded in filling a gap in the knowledge of food science graduate careers. There have already been opportunities to introduce the final framework to student and employer stakeholders. As described in Chapter 8, this work has allowed the CFGC to be tested by end users in a thorough and timely fashion. Responses from users to date have been most encouraging.

9.2 LIMITATIONS OF THE PROJECT

9.2.1 Time-bound nature of Studies

Development of CFGC captures contemporary viewpoints of stakeholders using a snapshot in time over 2015 – 2017. Correspondingly the curriculum mapping undertaken depicts the status of degree programmes during the 2017/8 academic year. With societal and technological changes, the landscape of graduate employment in the future is unclear, and predicting the types of competencies required from food science graduates in five or ten years' time is difficult. Whilst appreciating this reality, the priority remained to produce the first tailored, credible framework for food sciences students to utilise.

9.2.2 Qualitative research

Considering the qualitative aspects of this mixed methods project, evaluation of Studies A and B are included in Chapters 4 and 5 respectively, and reflections on appraisal of teaching inclusion are found in the previous Chapter. In developing the language tool in Study A, a series of 12 semi-structured interviews were conducted with industry stakeholders. Although this is a comparatively small sample size from the UK food industry, representatives were chosen carefully using a purposive stratified sampling technique, to secure the range of knowledge and experience desired (Cohen *et al.*, 2011). Taking an iterative approach (Mossop, 2012), transcripts were initially inspected from the first six interviews to identify any gaps for focus or questions to address in future sessions and improve the level of saturation (Braun & Clarke, 2013). Resulting thematic analysis supported by triangulation (Golafshani, 2003), an external auditor (Creswell, 2014), and

finally respondent validation (Mays & Pope, 2000) using a consolidation process, provided confidence in the approach undertaken. Further validity was obtained by field group interviews (Heide & Simonsson, 2015), with student cohorts at three Universities.

9.2.3 The role and influence of the researcher

As introduced in Chapter 3, when undertaking qualitative research it is important to consider 'reflexivity', or the role or impact of the researcher on the process and project (Braun & Clarke, 2013, Creswell, 2014). Having considerable experience as both employer in the food industry and educator in HE, the researcher possesses useful understanding of both stakeholder perspectives, however this could pose risks with the researcher viewing data from a personal perspective, and create bias in some form (Braun & Clarke, 2013). Mindful of this potential risk, study designs have been selected to prevent such bias shaping the project unduly. For example, thematic analysis (Study A - Chapter 4) included steps such as triangulation of the code book, independent coding of one of the transcripts, and use of a final stakeholder group for 'respondent validation'.

Care was also applied when designing protocols for the field group interviews in Study B and for review of teaching inclusions in Chapter 8. The literature suggests relationships between facilitator and participants be neutralised, to limit any effects on responses (Foddy, 1994). Student group sessions were conducted at three Universities (including UoN) by the researcher during Study B (Chapter 5) and, later in the project, an additional student session was conducted by a colleague to gather feedback from students at UoN (Chapter 8). For Study B, the use of a structured pre-sessional strategy was

adhered to in all three sessions to limit any impact of variability of group size in sessions, and also any possible influence of prior relationships with UoN students (although, at this time students had no knowledge of CFGC, see section 5.4.2). Steps taken are recommended for approaching studies with similar circumstances.

For the final group interview described in the previous Chapter, it was considered important to select and train an independent session facilitator. The scope of the session was entirely based on recent sessions delivered by the researcher, so presence at the group interview could restrict open and honest feedback.

9.2.4 Quantitative analysis

As outlined in Chapter 6, the choice of survey methodology for Study C was designed to accommodate a wide group of untrained, but contextually informed industry participants remotely, invited to respond to a large set of questions. Resulting ordinal data restricted the choice of analytical methods, however the use of descriptive analysis and PCA aimed to yield the best results possible given these limitations. Other possible limitations to the survey include an inability of participants to comprehend requirements or retain attention during completion. These were mitigated by the use of inclusive language, sub-sections, and worded encouragement in the contents and a pilot study; however this risk may not have been completely removed.

The survey results yielded data sets for the 14 individual roles ranging from 3 to 55 (see Table 6.3). It was expected that some roles would not receive high levels of participation based on limited ‘vacancies’ compared to others, but it was felt important to keep all data within reported outcomes. Steps were

implemented to ensure careful treatment of small data sets in interpretation stages and when reporting data in final outputs such as the infographic posters and comparison diagrams (Figure 6.17).

9.2.5 Curriculum mapping

The use of a formal curriculum mapping process, involvement with module convenors and progressive review, provided accurate and consistent results from Study D (Chapter 7). Considering limitations in section 7.6.2, whilst accepting the risk of recall bias and also minor programme variability between cohorts (Bath *et al.*, 2004, Ramia *et al.*, 2016) when conducting graduate surveys, the summarised data served to provide guidance on reality of experience to compare with stated inclusion of competency development. However, to support this, additional observation of teaching in practice would be recommended in future, if resources and time permitted (Hege *et al.*, 2007, Arafeh, 2016). The choice to map each core module discretely to allow for future module flexibility limited capturing the 'trajectory of learning' over an overall course for each *element* (Wijngaards-de Meij & Merx, 2018). Future use of the quantified data obtained for the course could be utilised as an indirect measure of level of mastery of an *element* in future.

9.2.6 Initial inclusion of CFGC for careers education

Feedback from teaching in autumn 2017 (Chapter 8) has been obtained from the whole cohort by the use of a questionnaire, and was broadly positive. However, the absence of representative international students in the subsequent group interview prevented capture and debate of a broader range of student viewpoints. Although anecdotal evidence has been gathered from CMU, currently the only formal feedback on the usefulness of the CFGC is

from UoN students. In order to effectively establish the transferability of the framework for use in undergraduate careers education, more formal feedback should be obtained.

9.3 COMMENDABLE FINDINGS FROM THE PROCESS OF DEVELOPING CFGC

Building a lexicon or language book with employers (Study A and B) for use in a subsequent survey targeting the same stakeholder group (Study C) is an effective approach to use. The requirement of a clear language for *elements* and their definitions was an important factor in the overall project to prevent misunderstanding by all stakeholders, students, employers and educators, both during the studies and in use of final material (Suleman, 2018). Prior to this project, there was no clearly defined list or framework of desirable *elements* for food scientists to refer to, when considering undergraduate education and recruitment of graduates.

In particular, the creation of a modified Delphi process in Study A to gain consensus with a geographically diverse stakeholder group was considered a key success. Modern web-based forums are now commonplace within social media, and increasingly in research and other work environments. The forum platforms can be easily adapted for this purpose. Application of 24-hour windows for each topic allowed for free debate and flexible participant access around busy work commitments. Yet they provided a structure to achieve timely consensus.

Whilst appreciating the limitations of the curriculum mapping exercise in Study D, capturing perceptions of competency development within degree teaching

by recent graduates helped to support the validity of staff perceptions of inclusion and should be encouraged in future studies of this nature. Use of survey data from Study C provided an employer's perspective, and thus an indication of recommended levels of inclusion of each *element* into an ideal curriculum. Contextualising the mapping results with employers' desirability offered an optimal and convincing plan for future programme development for educators and students.

Initially, use of the approaches taken in this project would be valuable for development of food science frameworks in other parts of the world. The curriculum mapping process developed could also be utilised, perhaps with CFGC as the reference framework. Additionally, academics in many other related vocations could take learnings from this project to build equivalent competency frameworks for their graduates' career pathways. Other disciplines may benefit from creating a clearly agreed competency language associated with their typical graduate pathways. Initial suggestions for applicability would be other biosciences disciplines, such as nutrition or agriculture, but many other applied science or humanities-based courses may find the approaches taken in this project use of use.

9.4 IMPACT OF PROJECT TO DATE

This section outlines the impact of the project to date. Since final stakeholder ratification of CFGC in summer 2017, the framework has been integrated into UoN teaching (illustrated in Figure 9.1), initially within careers education the following autumn.

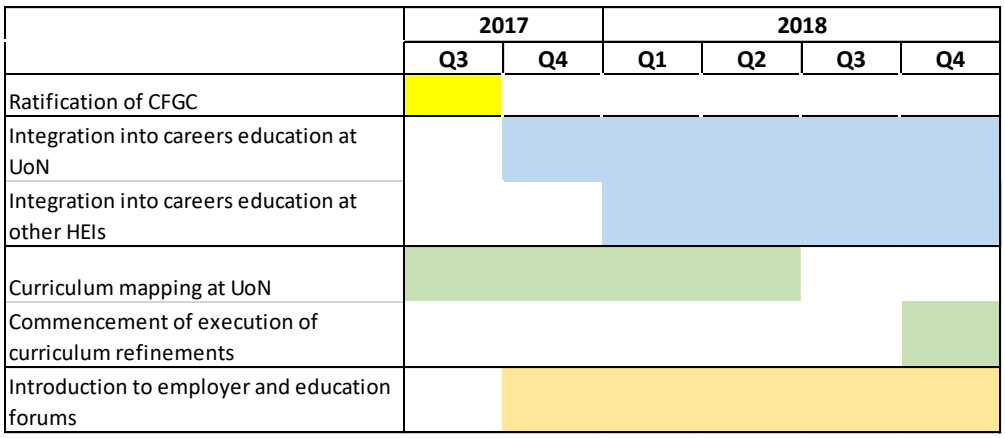


Figure 9.1 Timeline for introduction and integration of CFGC.

Following the curriculum mapping exercise completed in spring 2018, refinements of programme curricula have commenced. From a broader perspective, other HEIs have initiated use of the framework. In addition wider broadcasting of CFGC commenced with the launch of the IFST-based webpage (Weston, 2018a), and acceptance of invitations to share the framework with employers in industry fora and also with other educators. Uptake and interest to date further demonstrates the value of the framework.

9.4.1 Undergraduate education at UoN

CFGC is now embedded into undergraduate teaching for careers education at UoN (Chapter 8). Feedback from the first cohort to experience CFGC in teaching (autumn 2017) was promising, and comments from this year's cohort (autumn 2018) provides further confidence in the usefulness of CFGC and the appropriateness of inclusion in teaching at UoN.

CFGC has also assisted the shaping of curricula to ensure fit for purpose with respect to industry careers. Planned short term actions (Table 7.14) for content refinement and generation of more explicit module documentation

have been undertaken. Longer term refinements will continue to be undertaken, to optimise the relevance of food sciences education.

The IFST-based webpage (Weston, 2018a) and interactive online toolkit on UoN website (n.d.-e) have provided open access to the detail of CFGC. Developments of these tools will be considered as appropriate, while being mindful of user feedback both from UoN and a wider field.

9.4.2 Utilisation of CFGC to date at other HEIs

Other HEIs have now commenced use of the CFGC for supporting student career development. A particular example is Cardiff Metropolitan University (CMU), who supported the student group interview process in Study B (Chapter 5).

Recent feedback gathered from an academic at CMU (Setarehnejad, 2018) has outlined the incorporation of CFGC into stages of their three year course and in particular at the start of year one. Their year one session is aimed to inform students of the range of opportunities in the industry on graduation,

> *"...we run an activity asking students what you think you can do when you are graduate. Most of the time we end up with very limited answers. Then we refer to your documents with "The 14 Typical Roles for Technical Graduates Entering the Food Industry…"* *(Setarehnejad, 2018)*

Observations are that the students "feel excited" (Setarehnejad, 2018) about the number and variety of jobs to choose from. A brainstorming activity follows where students can suggest what the industry expectations of graduates may be, as exemplified in Figure 9.2.

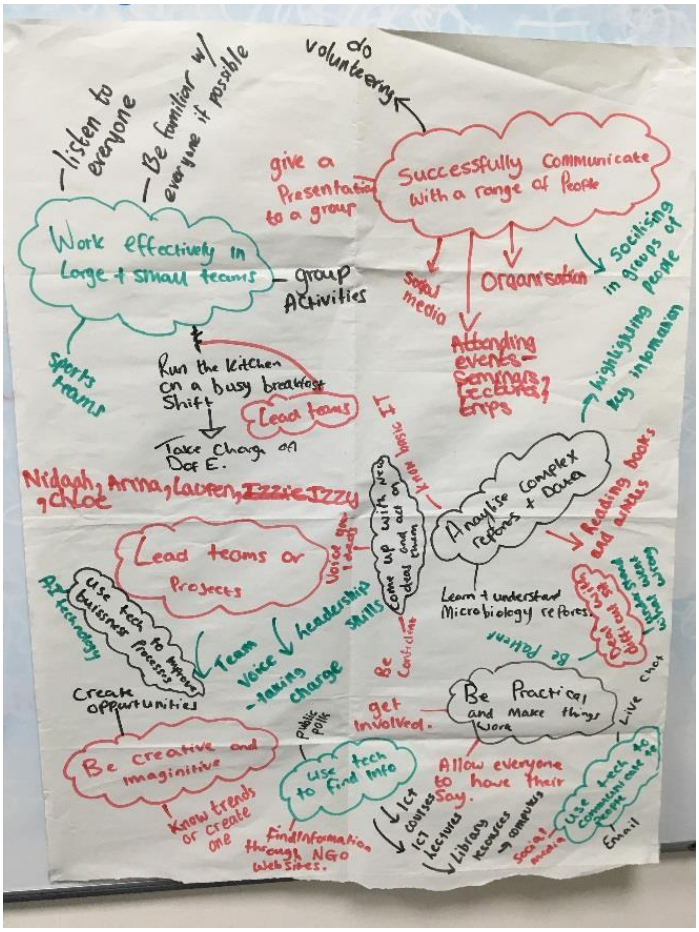


Figure 9.2 Example of brainstorming activity undertaken by first year undergraduate students at Cardiff Metropolitan University within a session using CFGC (Setarehnejad, 2018).

Staff assist students in comparing their outputs with 'desirable *elements*' for CFGC roles. They conclude the session by encouraging students to consider developing these types of competencies at university.

> *"This activity gives students confidence that there are plenty of opportunities available after graduation, secondly it introduces them to skills that they have to remember and to develop, improve while they are at university."* *(Setarehnejad, 2018)*

Staff continue integration of CFGC material during industry placement applications in year two, and in sessions on careers development in final year.

Another University engaged in Study B were Queen's University Belfast (QUB). Since receiving the final CFGC framework in 2017, they have focussed its use in supporting placement applications,

> *"I personally highlight and draw attention to your project and the IFST website where that sits with the Level 2 students in the support sessions during semester 1. This is aimed at helping students think about options and roles within industry."*
>
> *(Gallagher, 2018)*

A recent survey to HEIs providing degrees holding IFST accreditation (n.d.-a, n.d.-b), gathered responses from 10 of the 17 currently approved providers. A three-option multiple choice question was included "Have you reviewed your programme(s) in light of research into sector skills requirements, such as Competencies for Food Graduate Careers or similar" (Gardner, 2018). Half of the responses were affirmative, four responded that they planned to conduct a review, and only one responded with 'no plans to conduct a review'. Although not targeted explicitly for CFGC, this indicates an increasing trend to reflect broader industry requirements in degree education. To support this encouraging data, it was recently confirmed that the University of Reading, an established provider of food sciences courses in the UK, is using CFGC in their careers education. Sheffield Hallam University, who provide a traditional degree course and also deliver the new part time degree apprenticeship programme, have also started to use CFGC in a similar vein.

Each autumn, IFST arrange a series of Student Launchpad events for food science students across the UK (n.d.-d), providing careers advice and opportunities for networking with potential employers. This year, material presented by the IFST team included reference to the CFGC and the webpage (Weston, 2018a) as illustrated in Figure 9.2, indicating that CFGC is emerging as part of discourse in relation to food science careers advice.



Figure 9.3 Image of the IFST team sharing CFGC with UK students at a Careers Launchpad session (November 2018).

The initial point of engagement with the CFGC by other HEIs appears to be in the provision of careers education. The framework clearly portrays, for the first time in the UK, the range of food science graduate career pathways and associated desired competencies. It is therefore natural to use CFGC for support in obtaining in-study placements and final graduate employment, and will be encouraged in the wider UK environment by future promotion and discourse, as outlined in later sections.

9.4.3 Employers

Employers have been vital in supporting the development of CFGC. It will be valuable to communicate to these stakeholders how the framework is in use to develop 'oven-ready graduates' by targeted careers education and refinement of degree curricula content. However, an interesting possibility is the use of CFGC to drive employers' effective and targeted recruitment (Chartered Institute of Personnel and Development, n.d.).

In the early stages, as part of Study B (Chapter 5), two employers reviewed the language tool against their own competency frameworks or skills requirements for graduates, with a view of possible use in recruitment processes. An example of feedback includes,

> *"…an excellent additional tool to underpin our competency framework to assist recruitment of graduates from Food Science and related disciplines."* *(LCO stakeholder, Study B, 2017)*

The industry survey in Study C (Chapter 6), generated wider employers' interest and appreciation for the project, as exemplified by the following open comments from participants,

> *"Thank you for the opportunity to participate."*

> *"I am glad to see an appreciation of the "how" of business as well as the "what". We interview on the how more so these days. Universities teach skills, but we want people with great competencies as we can teach the skills."*
>
> *(Project survey data, Study C, 2017)*

Following ratification of the final CFGC framework, external broadcasting of CFGC commenced with the launch of the IFST-based webpage (Weston, 2018a) and also engagement with industry employers at the Campden BRI (n.d.) Training and Development group meetings (section 6.5.3). The sessions have initiated dialogue on, and support for the importance of developing graduates that are 'fit for purpose', and the possibility of using CFGC to support improved recruitment has also been explored.

As introduced in Chapter 1, the food industry has a skills shortage including graduates, which generates correspondingly strong competition to recruit the best candidates (Weller *et al.*, 2015, LeGrand *et al.*, 2017). There could be significant value in employers using CFGC and the profiles of 14 typical roles to refine their selection and recruitment processes. This could include activities such as writing targeted clear job advertisements, building role profiles, and developing tailored criteria for all stages of interviews and selection. Activity has already commenced with a selection of industry employers to review their job advertisements or specifications against CFGC to understand such possibilities.

9.4.4 Wider dissemination and impact

A number of areas of promotion and publication have been completed during the project. A paper has been published presenting the process of developing the CFGC language tool in Study A (Weston, Crilly, Mossop *et al.*, 2017). Following completion of the final CFGC framework and launch on the IFST-based webpage (Weston, 2018a), there have been further points of dissemination.

The possible use of CFGC to encourage young people to choose food science as a subject for degree study is under discussion. In February 2018, the researcher accepted an invitation to speak and sit on a panel at the BRC Food Safety Europe 2018 conference, London. Delegates expressed interest in provision of systems and approaches to further improve graduate quality and additionally as a tool to attract future students. Subsequently, an article was published in the June 2018 edition of 'Food Science and Technology' magazine (Weston, 2018b), describing CFGC and sharing experiences on its use in careers education in two Universities (UoN and CMU). The article also suggests the use of the interactive online tool (University of Nottingham, n.d.-e) to inform and engage potential applicants in secondary education. Introduction of CFGC has been part of UoN open days since 2017 to inform and enthuse potential applicants on the wealth of career options in the food industry and to highlight the targeted content of food science courses at UoN. Outreach visits made to local schools refer to CFGC, and the simple presentation of 14 typical career pathways for food science graduates is particularly effective.

The researcher was recently invited to represent HE in a new education and careers forum instigated by IFST (Ridler, 2018), with the initial session at 'Food Matters Live' 2018 (n.d.) in London, where the CFGC was presented. Other perspectives were shared, such as a message from the new Food and Drink Sector Council[26] (n.d.) that a key priority is to secure a future 'world class workforce' (Food and Drink Federation, n.d.-a). The forum aims to

[26] The Food and Drink Sector Council in current form was established in January 2018.

improve the technical talent pipeline entering the food industry at a number of levels, including graduates. Outcomes of the encouraging preliminary session are due to be shared by the IFST; meanwhile, the Agrifood Training Partnership (n.d.) have reported details of the first session online, highlighting emphasis made by the researcher on requirements to attract and develop work ready talent into the food industry.

An additional result of this project has been the initiation of dialogue and the building of relationships between UK food science degree providers and with the European ISEKI project team. Not only has this provided credible and useful outputs, but it is also a foundation for future collaboration.

9.4.5 Review of terminology development during project

Figure 7.11 shows a diagram of the final summary of terminology development throughout the project. When developing the language tool (Study A and B), the qualitative process undertaken generated a set of 48 terms and definitions (*elements)* that have served well throughout the project, whether for developing the final CFGC framework (Study C), use in curriculum mapping (Study D), or careers education (Chapter 8). However, the initial grouping of *elements* to form some type of structure, was adapted to embrace the *themes* generated from PCA analysis of the industry survey data (Study C). This altered the initial segregation of *behaviours* from other *elements* in the framework; however it was judged preferable to use the affinities found within the survey data, as opposed to rational group choices developed by the researcher. The extended definition of 'competency' still holds as 'a set of knowledge, skills and behaviours that are required to successfully perform in a given role' (Table 4.3).

During curriculum mapping, after reviewing previous approaches and confirming categorisation and codes, an iterative approach (Vinten *et al.*, 2016) was undertaken for the process itself. One change for future use of the mapping structure was recommended (with no perceived challenge to the robustness of Study D output), but the remainder appears to be appropriate for the function of mapping food science courses.

As to be expected in a project aiming to address original research questions, openness may be required for revision of initial plans or structures following the learning and experience gained from performing the work. Having no prior theories to test, the inductive methods (Creswell, 2014) for Studies A and C in particular, were of an exploratory nature. The updated diagram employed through the chapters (Figures 2.17, 3.6, 4.6, 6.23 and 7.11), has served to provide a reference point for the journey of the project. Confidence in results has been maintained and future recommendations have been captured.

9.5 FUTURE-GAZING

The value of CFGC at UoN, other HEIs, and for use in wider contexts has been presented in this Chapter. Whilst undertaking this project it was important to be mindful of possible, future changes to graduate employment, employability and higher education itself. Employability initiatives and competency frameworks must be effective in the environment of use (Holmes, 2017) and CFGC has been designed to reflect current industry requirements of the broader competencies required in a food sciences graduate, and is

anticipated to be adaptable for future developments in the field. Consideration of these possible developments[27] is introduced now.

9.5.1 Forecasting risks and opportunities in graduate employment

A recent article from the USA (Krakovsky, 2018) debates the impact of technology on future job markets, including outcomes of research by Deming, a Harvard Economist (2017) finding that employment levels of 'social skill-intensive' occupations such as healthcare, teaching, lawyers and management grew by 11.8% between 1980 and 2012. Krakovsky supports the assertion that technology and artificial intelligence will replace many jobs, but not those requiring 'human' capabilities such as creativity, compassion and also detailed, analytical competence.

It is also understood that the modern UK employment environment is rapidly changing (Chartered Institute of Personnel and Development, n.d.). Taking a global view, but centred in the UK, The Independent's 'Business Insider' featured an article (Dodgson, 2018), based on exclusive material supplied by 'Indeed', the global job website. This outlines nine 'future proof' career pathways, including reference to the 'gig economy' and subsequent increase in flexible working or contracts. It is also forecast that demand for social and culinary experiences will remain, requiring the creativity and dexterity of chefs. Supporting Krakovsky's (2018) predictions, other roles that should be 'safe', include healthcare professionals and educators, but also careers in marketing (creativity and critical thinking), human resources (emotional intelligence) and cyber security. Data scientist roles are also predicted to be safe (Dodgson,

[27] Please note the focus of this section is primarily regarding the UK and thus not necessarily including the Republic of Ireland.

2018) as, “there's only so much a machine can do with algorithms and code” (para.22). It is argued that those with scientific ability will be required to interpret data. This reflects the emphasis placed by graduate employers data from this project on continued need for *handling data* (in Table 6.8, six of the 14 roles include this *element* as specifically desirable). Additionally it is interesting to note in this project, *digital capability* was only selected as desirable in a single graduate role and thus relatively low (see Chapter 7, Figures 7.7 & 7.9). This is suggested to change in the future.

Investigations have elicited that respondents from the food industry to 10th CBI/Pearson Education and Skills Survey 2017 numbered only 2% of the total (n=340) (Confederation of British Industry, 2018), which is disappointingly unrepresentative, and has been seen in a past study (Miller *et al.*, 2001). However, a brief interpretation of results was undertaken (Table 9.3). On asking all employers about future recruitment levels of highly skilled workers (such as graduates), 73% stated an increase in need; for food employers it was 43% (the remaining 57% stated it would stay the same).

Table 9.3 Extract of some responses to the 10th CBI/Pearson Education and Skills Survey 2017 (Confederation of British Industry, 2018)

Summary of responses to questions regarding to highly skilled workers (such as graduates)	Total respondents	Food industry respondents (2% of total)
Requirement for future increase in recruitment levels	73%	43%
Confidence in skills availability	31%	57%

With respect to confidence in skills availability for these highly skilled workers, 31% were confident, whereas for food employers, the result was 57%.

Although this can only provide an indication with such low sample size, it could be suggested that these food industry roles may continue to be available at current levels. In addition, confidence in availability of workers is higher than the broader national picture. This concurs with a food industry report (Hermansson & Lillford, 2015) predicting that 'thought leaders' will still be in demand to innovate, interpret data, make decisions and manage teams. In conclusion, the need for food sciences graduates should, at a minimum remain as it is currently.

However, it becomes more pressing to ensure graduates have a range of competencies beyond traditional technical skills so they can compete and succeed in an uncertain world, but one appearing to demand higher levels of social or interpersonal abilities. CFGC is centred squarely on provision of such a graduate.

9.5.2 UK universities

Much debate has occurred with regard to funding and type of provision of HE for the future. Uncertainty continues regarding prospective income for higher education, with the current review of post-18 education and funding due to be reported in early 2019 (Department for Education, 2018b, Russell Group, 2018). The full impact of the Higher Education and Research Act (Universities UK, 2017), which came into effect in April 2017, has yet to be seen. Plans are to "develop the detail of how these powers are used, for example through further consultation on the detail of the regulatory framework that will govern the HE sector" (Department for Education, 2017, p.3). Supporting this, the new Office for Students (OfS, see Footnote 4) purports to be positioning the student as, 'the consumer' (Aldred & Richardson, 2018).

Confirmed areas of focus include provision of a more open market for new degree providers to provide more choice and competition, and stricter regulations to ensure compliance to conditions of registration for degree providers.

Akin to this aspiration, some UK Universities and subject areas have considered alternative provision to traditional three year full time degrees with aims to increase accessibility and value. The employers 'apprenticeship levy' (Department for Education, 2018a), enacted in 2017 with subsequent approval of appropriate degree programme standards, has led to the launch of new part time degree programmes for those already in work, supported by many large UK-based food businesses. At the time of writing, the new 'Food Industry Technical Professional degree' is offered by four Universities.

The OfS plans to promote 'value for money' for the student (Universities UK, 2017, Aldred & Richardson, 2018). Their imminent proposals include establishing some link between TEF performance (section 2.2.2) and permissible fee levels (Universities UK, 2017); however it cannot be foreseen how university fees may be structured in future. An emerging challenge could be the supply of shorter, cheaper, more intense undergraduate degree programmes than the traditional three years, with long summer vacations. Headlines have resumed discourse (Coughlan, 2018), whereby the Universities Minister (at the time), Sam Gyimah stated that, pending parliamentary approval of a higher annual fee, accelerated 'two year degrees' should be encouraged to provide a cheaper, more flexible offering.

Conversely, there is some increase in demand for four year integrated master's degree courses, something already established in subject areas

such as engineering. Popular with international students (Prospects, 2018b), the appetite for such courses in food science fields appears to derive from employers in certain countries, largely in Asia and the USA (Hartel & Klawitter, 2008) asking new recruits to possess some form of 'Master's' qualification as a minimum. Additionally in other areas of Europe (including the Republic of Ireland[27]), there are comparatively longer first degree courses on offer, sometimes culminating in master's based degree titles, and a trend indicating an increasing proportion of graduates in Europe possessing a higher level of degree than bachelor's (Flynn *et al.*, 2017). However UK food industry employers still appear satisfied with bachelor's level graduates for most posts and would arguably prefer a student to have completed a placement year in work instead of a fourth year of study. Since 2017, UoN (n.d.-b) has offered 'MSci' integrated master's options with an additional 'research focussed fourth year' for both food science bachelors courses, targeted at international students and those considering a career in research.

This project has ensured that both the employer and the student were key stakeholders in the development and testing of CFGC. This philosophy should continue in successful degree course development at University, a viewpoint shared by food science educators, Bohlscheid and Clark (2012),

> *"To meet the needs of students and employers, a systemic feedback loop is necessary to evaluate the efficacy of a programme and provide information on specific deficiencies."(p.8)*

Plans for provision of other, new forms of degree education will no doubt be embraced in future strategy at UoN (2015), particularly within the planned replacement of 'Global Strategy 2020'. How degrees are offered in future

may take many forms, in turn adaptations to content and associated approaches to teaching will be required. Changing landscapes should be embraced in future work on CFGC.

9.5.3 Employability education

Reflecting on the changes and developments in UK HE, meeting the future needs of the student will be pivotal. This includes understanding the nature of student participation in the 21st century and thus consideration of optimum approaches to teaching (Gallacher & Parry, 2016). Appropriateness and effectiveness of teaching is not part of the focus for this project but should be considered pertinent for future research. Holmes' (2017) 'manifesto' for future research calls for greater theoretical underpinning of research and initiatives linked to enhancing employability. This includes appreciating the differences between employability and employment and justification of where any work in the former provides an impact on the latter. Suleman (2018) suggests the uncertainty in what 'employability skills' should be is caused by employers' lack of understanding of needs. In summary, the relatively new topic (in educational terms) of employability is now moving further into the realm of traditional subject matter that requires rigor and validation to justify inclusion. Part of this rigorous process requires involvement of the right stakeholders, including employers, which has been fully encompassed in this project.

Work placements are outside of the scope of this project and outside of formal studies, but should not be left out of any debate on personal and employability development. The benefits of undertaking a year-long work placement during degree study are well documented (Brooks & Youngson, 2014, Dacre Pool, 2017), and should support a food scientist's development of a range of

elements in CFGC. From a US perspective, a survey by Bohlscheid and Clark (2012) found that supervised internships (not stated a specified length) are highly regarded for predicting job success in food science graduates, confirming Selke's previous assertion they are one of the most important factors in hiring graduates (Selke, 2008). However in the UK, reflecting on the CFGC framework, *work experience* is identified as an *element* in the framework itself, but individually is only noted as specifically desirable for the 'NPD or Process Development' role; perhaps from an employer's perspective, the absence of experience does not routinely preclude selection of a candidate for interview.

Finally it is worth reflecting on the part the wider world will play in employability of graduates. It is understood that every student will arrive with prior attitudes, experiences and interests that may impact on their learning (LeGrand *et al.*, 2017). Suleman (2018) argues socio-economic factors will transcend any efforts made by HEIs to provide graduates with useful competencies. Unsurprisingly, she cites the broader employability models designed by Hillage and Pollard (1998), and also McQuaid and Lindsay (2005) (section 2.5). Suleman suggests that individual factors cannot be accounted for effectively, however educators should be mindful of external influences on graduate employment prospects within their discipline areas as a minimum, to ensure this is factored into messages and content encompassed in degree studies.

9.6 FUTURE WORK

9.6.1 Using the CFGC framework

The prospect of using consistent terminology for articulating desirable competencies for graduate roles, and delivering undergraduate food sciences teaching to best support development of these competencies, could serve to increase the employability of graduates entering the industry and realise the researcher's vision of developing 'oven-ready' graduates. To ensure job-readiness, food sciences degree providers need to ensure course content reaches beyond the science and technology of the subject matter and encourages the development of the associated personal competencies that make a great graduate for the industry across the range of initial roles they could choose.

CFGC is now serving these functions at UoN, and a selection of other HEIs are already using the framework for careers education. Work has commenced with other degree providers, and awareness at other HEIs is aimed to increase in future, by utilising the networks established during the project. The aim is for CFGC to be part of both careers education and competency development. Viewpoints on the usefulness of CFGC will be gathered from students during this process to verify transferability. As other institutes undertake mapping of food science programmes against CFGC, it would support general alignment of course content to meet industry requirements, and also serve to provide confidence in the suitability of process used for Study D.

Utilising CFGC as a reference tool, to support compliance in IFST degree accreditation (n.d.-a) for aspects such as employability, competency

development and careers education would seem appropriate. Through discussion with the IFST Professional Development Forum, it is hoped that inclusion of CFGC into criteria will be approved in 2019. The impact would be a drive in consistency of competency development in UK degree courses beyond compliance to the technical aspects already outlined in the appropriate QAA benchmark statement (2016).

Within the framework's current status, those *elements* centred on knowledge acquisition should be managed appropriately in future (see Chapters 5, 6 and 8). At UoN, provision of a greater understanding of depth or level of competence is made discursively and in context, for key *elements* perceived as knowledge-based, largely encompassed in *themes* D2 (*appreciation of the wider world*) and D8 (*the business world*) (Figure 6.18). Particular points of inclusion include mapping job specifications against CFGC roles (new for autumn 2018) and reviewing *elements* individually during final year teaching.

Wider use of CFGC beyond education has already been suggested; in particular for improved graduate recruitment and selection, and also to inform and enthuse young people to study food science degrees. Progress has already begun to educate and inform employers on the benefits of using CFGC to develop targeted job advertisements, taking the form of reviews with individual employers and taking opportunities to engage with a wider communities such as at conferences and forums; this will continue.

9.6.2 Further developments of CFGC

As this project took a snapshot of stakeholder views, it would be prudent to re-engage with stakeholders in future, possibly 4-5 years hence, to ensure the 48 *elements* are representative and satisfying 'market needs' (Perera *et al.*,

2016). This would also apply to verifying the types of roles food science graduates are typically employed in. In addition, it is advised that the industry-wide survey be repeated a few years hence using the same approach as in Study C, with an aim to test repeatability, but also to gauge if employers have altered opinions of the desirable competencies for typical food science graduate roles.

Additional factors that are under consideration, include the mapping of the research-focussed fourth year of the relatively new MSci integrated degree option for both programmes (University of Nottingham, n.d.-b). Any fundamental changes in course content, delivery or assessment will also be reviewed with respect to CFGC inclusion. Whilst a revisit of the CFGC in future years will establish currency, the impact of any changes will also need to be reflected in degree programmes. Recently Wijngaards-de Meij and Merx (2018) highlighted the importance of curriculum visibility with mapping at its heart, in addition to positive communication of 'learning trajectory' to educators and students.

The proposed curriculum model for understanding types of student learning and development during study of food science degree courses is illustrated in Figure 7.10. The model encompasses the understanding of the curriculum from detailed inspection of modules and consideration of the wider development anticipated during degree study at UoN. Subsequent activities, some already undertaken to address areas of curricula refinement, are detailed in Chapter 7. However, it is worth considering the potential impact of the other aspects, namely the optional industrial placement year and the hidden curriculum. It is understood the impact of a placement would be

difficult to predict consistently; each student will have a unique set of experiences and subsequently develop different *elements* to varying levels of proficiency. A generic list of *elements* in CFGC typically developed during the year could be constructed, however this is in opposition to the intentions of the project. It is suggested that reports submitted during placement by a student be adapted in such a way to facilitate individual reflections on development against CFGC. This will be explored in future with the School Placement Officer.

The issue of the hidden curriculum discussed in Chapter 2, could have a greater impact on development of competencies that are less factual and more behavioural for example, *personable* or *confidence* (Hafferty, 1998, Mossop *et al.*, 2013). This could potentially limit the usefulness of the framework in curricula, in that students may experience behaviours and attitudes of role models in food science that do not align to these values, inhibiting their own development. The nature of the hidden curriculum within food sciences degree study could therefore be explored, and its possible relationship to other factors. This may facilitate deeper understanding of student personal development in future and allow better integration of the framework.

Finally exploring the possibilities of utilising CFGC in some manner to support 'careers education' for postgraduate students is also worthwhile. It is not uncommon for postgraduates at MSc level to enter the food industry by graduate roles (Oreopoulou *et al.*, 2015, Weller *et al.*, 2015), and there is increasing requirement for PhD students to possess more qualities that are attractive 'outside' of academia (González-Martínez *et al.*, 2015). There

should be benefit in understanding more about the range of food science-based career pathways in the food industry (Figure 6.5). The approaches introduced with final year undergraduates (Chapter 8) to establish competency requirements for a given role, and understand how to articulate personal competency during job selection processes, have universal appeal.

9.6.3 Other possible future work

The process developed in Study D for mapping of core degree content against CFGC was undertaken in a measured and thorough manner. A specific outcome was the proposed change of terminology used by the School of Biosciences (n.d.) for all curriculum mapping criteria, replacing 'taught, learned and assessed' or 'TLA' with 'taught, practised and assessed' or 'TPA' (section 7.6.6). This is under review with the Director of Learning and Teaching.

The scope of this project was food sciences graduate employment in the UK and the Republic of Ireland. It is argued, from feedback to date that all students are gaining from the clarity of the message, refined degree courses and improved careers education during study regardless of their destination of graduate employment in the world. However, an understanding of the transportability or conversion of the CFGC to other countries, languages and cultures would be a worthwhile endeavour, while being mindful there may be some geographical variation (Flynn *et al.*, 2013b). Targeting could commence in Europe or overseas countries that regularly recruit UK food sciences graduates, such as China. If conclusions are reached that CFGC is not of direct initial use in other countries, perhaps due to language and

terminology differences, the application of the processes used in the project to build another framework should be of value.

Finally the status of the food industry was presented in Chapter 1 as, a rewarding career with a high degree and breadth of opportunity, associated with a disproportionately low image. In encouraging young people to choose to study food science, timing is apposite, as the industry as a whole is looking to improve the food industry talent pipeline (Ridler, 2018). CFGC could provide a springboard for attracting talent at secondary level during school visits. The recent IFST forum has included school outreach as a consideration for promotion of the food industry as a superb career choice. School interaction is a key enabler to generate curiosity, possibly supported by social media campaigns. Use of the CFGC directly in such promotion, and introduction of online resources such as the interactive toolkit (University of Nottingham, n.d.-e), should support marketing of HE pathways. Associated development of the interactive toolkit could be undertaken in future, to refine the content and features to best suit target users.

9.7 CONCLUSION

Prior to the commencement of the project, the core aim was to support the targeted development of food sciences graduates for successful entry into the UK industry. There was limited guidance on workplace ready competencies specifically for food science graduates. The creation of CFGC to support the development of 'oven-ready' graduates is believed to have provided the guidance required. Already the benefits have been realised in optimisation of degree course structure at UoN to better reflect the competencies employers' desire in graduates. It is also in use extensively at UoN for careers education

and increasingly at other institutes. The 14 typical graduate pathways and new, tailored profiles can be accessed by students wherever they may be based, facilitated by the two online resources available on the IFST and UoN websites.

With increasing competitiveness for demonstrating value and vocational opportunity in degree course study, possession of a framework of graduate career pathways and demonstration of targeted programme content to facilitate employable graduates should be a point of advantage. Other subject areas may choose to develop such frameworks and the methodology developed for in this project may serve to support future endeavours.

In summary, CFGC is a tool with immediate possibilities for supporting food science degree students' career choices and job application processes. It can also underpin development of programmes better aligned to the needs of the today's food and drink industry. However, there is more that can be done; this project has provided UK industry with a valuable instrument to assist their endeavours in attracting and engaging new talent to join the food industry.

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Appendices

Appendix I – Selected studies with IFT 'success skills'* comparisons.

				Morgan *et al.*, 2006	Bohlsheid & Clark, 2012		Joyner, 2016	Johnston *et al.*, 2014
	* Specifically 'Success Skills' are one part of five in a core competencies framework (Institute of Food Technologists, 2016).			Employers **desirability** for food science programme outcomes	Survey - **career preparedness** of graduates (1998-2008)		Academic curriculum **content** mapping	Modified Delphi **review of curriculum** - industry professionals
					Graduates (n=58), Employers of graduates (n=27)			
				Purdue University	Washington State University & University of Idaho		University of Idaho	North Carolina State University
Outcomes under 'success skills' competencies				ranked in order	Agreed areas to improve		gaps stated	skills lacking
Communication	• Demonstrate the use and practice of different levels of oral and written communication skills. This includes such skills as writing technical reports, letters and memos; communicating technical information to a non-technical audience; and making formal and informal presentations.			4	Yes		specific aspects e.g. phone etiquette~	Lacking
Critical thinking	• Be able to develop a process for solving and preventing reoccurrences of ill-defined problems; know how to use library and internet resources to search for quality information, and solve a problem; and make thoughtful recommendations.			1				Lacking
	• Apply critical thinking skills to new situations.			7				Lacking
Professionalism	• Commit to the highest standards of professional integrity and ethical values.			2			more required	
	• Work and/or interact with individuals from diverse cultures.			9				
Life-long learning	• Explain the skills necessary to continually educate oneself.			13			more required	
Interaction skills	• Work effectively with others.			6		group		
	• Provide leadership in a variety of situations.			10		dynamics		
	• Deal with individual and/or group conflict.			8		specifically		
Information	• Independently research scientific and non-scientific information.			11				
	• Competently use library resources.			N/A				
Organisation skills	• Manage time effectively.			5				
	• Know how to facilitate group projects as well as be a good team member.			12				
	• Handle multiple tasks and pressures.			3				

*Two questions asked : Oral communication 87.9% graduate 96.3% employer, Written communication 96.6% graduate 96.3% employer

~ additional feedback from industrial professionals

Appendix II - Questions and Statements prepared for group interviews.

(Areas in *italics* are statements not explanations)

Are there any aspects that are unclear to you?

I can log anything you have noted on this clipboard and we can then review each point one by one.

Let's have a look a XXX zone, first of are the names of the elements understandable to you?

Do the definitions make sense to you?

Would you agree with XXX person's suggestion of an alternative explanation?

Does that extra explanation help you?

Can you explain in what way you did not understand that part?

Can you suggest an alternative way of describing this element?

Are well all in agreement on that suggestion?

I will write suggested amendments on these sheets, do let me know if they are not correct based on what we discussed.

Appendix III – Example of an approved information sheet and consent form



School of Biosciences
Associated to ***School of Sociology and Social Policy***
Approval Code: SSP 01 - SB1516/06 Staff Weston

Information for Participants

Common Language for Graduate Skills

The main researcher in this study is Emma Weston, from the Division of Food Sciences and below is aimed to answer your queries regarding the interview research you are being asked to participate in

What the study is about?
The questions for this study are:

1. What are the currently held definitions for the commonly used terms for denoting graduate skills or attributes?
2. Can a common language be established for the purposes of further research?

What will I have to do?
The process for this study will be to interview selected representatives of key sectors of the Food Industry.
3 weeks in advance of the interview I will ask you to collect information (if any) held by the company regarding skills lists used for role profiles and job descriptions as well as any definitions of those skills used to support the list. This may be held by specific department or the Human Resources function. It is hoped this can be brought to the interview session.

The interview itself will be on a 1:1 basis and in private. It is not anticipated to last longer than 1 hour and 15 minutes and will be audio recorded and additional notes taken by the interviewer.

What are the benefits of participating in the study?
The aim is to start to define what the key skills may be for common types of role that a Food Science graduate may wish to undertake in the UK after their studies. However before starting this work a common language for the skill terms needs to be established.

These interviews planned with key stakeholders in the food industry are aimed to provide this common language.

Are there any foreseeable risks to me if I participate in the research?
No risks to the participants are anticipated and interviews are planned to be held in the participant's place of work or at the University of Nottingham. Data recorded is of a purely of a professional nature and represent those of the individual and their context in their current place of work and past career experience.

Are there any costs or inducements to taking part in the research?
There are no costs anticipated or inducements provided to participants in the research

Is participation voluntary at all stages?
Participation in this research is completely voluntary and you can decide not to participate. You can stop the interview at any time if you wish. Finally you can also choose to retract your interview material from the study at any point in future if you wish.

What happens to the collected information?
The information will be transcribed and formal thematic analysis undertaken to allow for robust results. All recorded data and resulting analytical results will be securely stored and kept within the Division of Food Sciences and by the researcher for the duration of the project. If a participant wishes to see the transcript before thematic analysis this can be arranged.

What are the research outputs?
These results will be aimed to be the basis of the 'common language' which is one of the earlier stages of a larger project undertaken by the researcher. It is also envisaged this study may be published as a separate piece of work subject to appropriate approval.

What other sorts of people are being asked to take part, and how are they being identified/selected?
Other stakeholders from the UK Food Industry have been asked to take part. These include representatives from Higher Education (both Academic & also Student Careers Service), Food Manufacturing Companies, Retailers, Food Research Institutes, Recruitment Organisations and Graduate Students.

What if I have further Questions at this stage
Please do not hesitate to contact the researcher using the details below.

Contact details
Researcher: *Emma Weston, 0115 951 6214,* ***emma.weston@nottingham.ac.uk*** or write to address*:*
School of Biosciences
Division of Food Sciences, Sutton Bonington Campus, Loughborough LE12 5RD
Supervisor: Tim Foster, 0115 951 6246, tim.foster@nottingham.ac.uk or write to address as above.
Complaint procedure
If you wish to complain about the way in which the research is being conducted or have any concerns about the research then in the first instance please contact the Supervisor.
If this does not resolve the matter to your satisfaction then please contact
Prof. Tim Foster (tel. 0115 951 6246, email tim.foster@nottingham.ac.uk or write to address above); or contact the School's Research Ethics Officer, Dr Kate Millar (tel. 0115 846 7767, email kate.millar@nottingham.ac.uk or write to the School of Biosciences, Sutton Bonington Campus, Loughborough, LE12 5RD.

The University of Nottingham
UNITED KINGDOM - CHINA - MALAYSIA

Consent Form and Risk Assessment Forms

School of Biosciences

Associated to **School of Sociology and Social Policy**

Approval Code: SSP 01 - SB1516/06 Staff Weston

Participant Consent Form

'Common Language for Graduate Skills'

In signing this consent form I confirm that:

I have read the Participant Information Sheet and the nature and purpose of the research project has been explained to me.	Yes	☐	No	☐
I have had the opportunity to ask questions.	Yes	☐	No	☐
I understand the purpose of the research project and my involvement in it.	Yes	☐	No	☐
I understand that my participation is voluntary and I may withdraw from the research project at any stage, without having to give any reason and withdrawing will not penalise or disadvantaged me in any way.	Yes	☐	No	☐
I understand that while information gained during the study may be published, any information I provide is confidential and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party. Identity is confidential subject to desired acknowledgement.	Yes	☐	No	☐
I would like to be acknowledged as a participant of this study in any publication or presentation of work	Yes	☐	No	☐
I agree that extracts from the interview may be anonymously quoted in any report or publication arising from the research	Yes	☐	No	☐
I understand that the interview will be recorded using audiotape/electronic voice recorder	Yes	☐	No	☐

I understand that data will be securely stored and kept within the Division of Food Sciences for the duration of the project.	Yes	☐	No	☐
I understand that the information provided can be used in further study by the researcher which have ethics approval, but that my name and contact information will be removed before it is made available to other researchers.	Yes	☐	No	☐
I understand that I may contact the researcher [or supervisor] if I require further information about the research, and that I may contact the Research Ethics Officer of the School of Biosciences, University of Nottingham, if I wish to make a complaint relating to my involvement in the research.	Yes	☐	No	☐
I agree to take part in the above research project.	Yes	☐	No	☐

Participant's name (BLOCK CAPITAL)	Participant's signature	Date
Researcher's name (BLOCK CAPITAL)	Researcher's signature	Date

All details of researcher, supervisor and ROC on study information sheet

Appendix IV- Example of a discussion thread from online forum

MONDAY - BEHAVIOURS GROUP Display replies in nested form ▾

Move this discussion to ... ▾ Move

Confidence - Refining Definition

by RESEARCHER Monday, 16 May 2016, 6:52 AM

Forum 2016 - Beh - Confidence.docx

The definition suggested: **'Having the self-assurance to process information and situations and then undertake the required actions, communications or justifications assertively/resolutely'** (detailed information attached).

Question – Should the definition end with 'assertively' or 'resolutely' or neither?

Edit | Delete | Reply

Re: Confidence - Refining Definition

by PERSON A Monday, 16 May 2016, 12:29 PM

I would stop at required actions and not include anything else

Show parent | Edit | Split | Delete | Reply

Re: Confidence - Refining Definition

by PERSON B - Monday, 16 May 2016, 1:01 PM

I agree

Re: Confidence - Refining Definition

by PERSON C Monday, 16 May 2016, 3:43 PM

I **assertively agree**

Show parent | Edit | Split | Delete | Reply

Re: Confidence - Refining Definition

by PERSON D Monday, 16 May 2016, 4:42 PM

Assertively suggests a degree of force, I would choose resolutely over assertively but agree it would be best to remove

Show parent | Edit | Split | Delete | Reply

Re: Confidence - Refining Definition

by RESEARCHER - Monday, 16 May 2016, 5:01 PM

this looks fairly much agreed. Don;t add either words to the end. thank you

Show parent | Edit | Split | Delete | Reply

Re: Confidence - Refining Definition

by PERSON E - Monday, 16 May 2016, 5:03 PM

neither

Show parent | Edit | Split | Delete | Reply

Re: Confidence - Refining Definition

by RESEARCHER Tuesday, 17 May 2016, 5:54 AM

Proposal here then is: **Having the self-assurance to process information and situations and then undertake the required actions.**

Show parent | Edit | Split | Delete | Reply

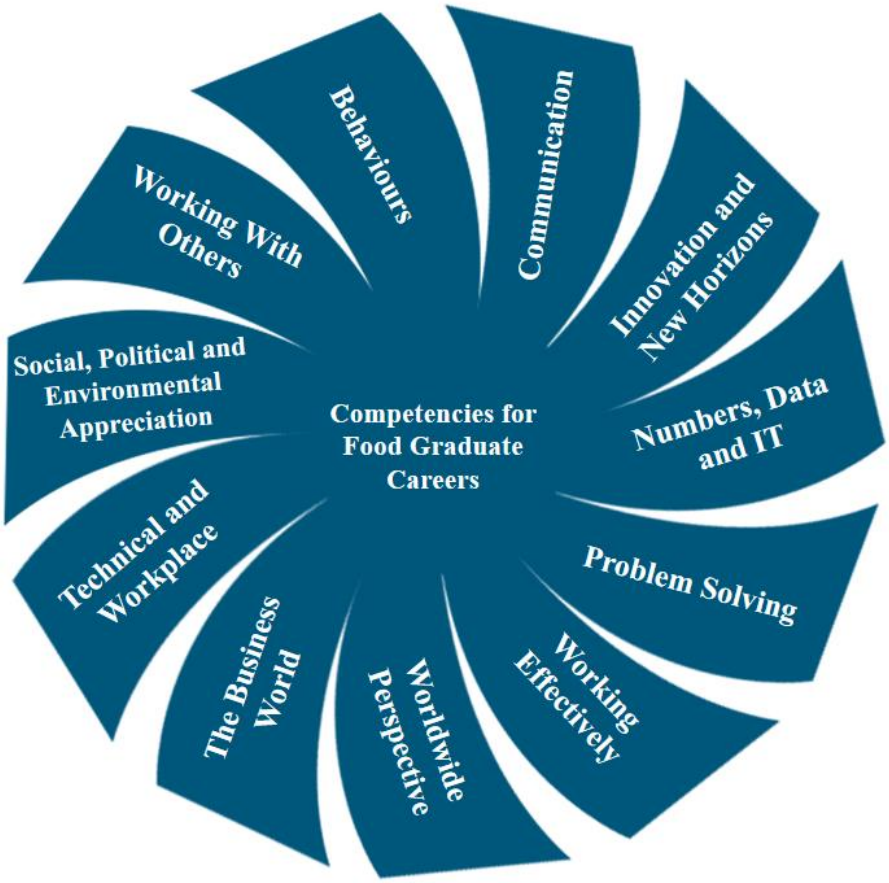
Appendix V – CFGC summary resulting from Study A.

Competencies for Food Graduate Careers



Summary

This is as completed from Study A. However the 3 minor changes to element's names and definitions from subsequent work have been made



Language Book Structure and Terms

There are 11 'Zones' containing defined 'Elements'.

- **1 x Zone** **Behaviours**
- **10 x Zones** **Knowledge and Skills**

Supporting this…..

Abilities are inherent qualities that can influence the speed or effectiveness in developing or gaining skills, knowledge and behaviours.

Competencies

A set of knowledge, skills and behaviours that are required to successfully perform in a given role

Behaviours

These are elements of how a person conducts themselves and operates in the workplace. They can be described as 'mindset' elements of a competency framework … 'This person has/is X'. For example: *'this person has confidence or is self-motivated'*

Examples:

1. Going the extra mile to find out more about a subject within a module to establish the actual facts that were not clear
2. Excellent standard of presentation in a meeting, conference or interview

Knowledge and Skills

All other zones are in this area and contain elements associated with…'This person has skills/knowledge in X'. For example: *'This person has skills in decision making'*

Knowledge

A theoretical or practical understanding of a subject. It does not means a person can actually perform a task but they should be able to describe it or write about it correctly.

Examples

1. Able to describe how a Gas Chromatograph operates but not actually trained or able to use it.
2. Articulation of the key skills needed for a factory auditor role but not having undertaken the task personally or had any practical training.

For the most part 'Knowledge' requirements are outlined by QAA requirements for Food Sciences based degrees (the Quality Assurance Agency) however there are some included in the C for FGC. For example in the zone 'technical and workplace' - specific technical aspects'

Skills

These tend to be learned proficiencies and indicate the capability to be able to carry out an operation or task. They can be innate but in general can be improved on with development opportunities (such as experience, teaching or training).

Examples

1. Trained and competent in the use of a Gas Chromatograph
2. Demonstration of team working by success in group project activity (perhaps with supporting evidence of own contribution)
3. Completing an in-tray exercise requiring significant decision making skills

Behaviours (page 1 of 2)

"How someone goes about the business of working is as important as what they do."



Acceptance of Ambiguity	
	Appreciation that there may be different ways of achieving a result or more than one positive outcome.
Adaptability	
	A constructive approach to handling change.
Confidence	
	Having the self-assurance to process information and situations and then undertake the required actions.
Emotional Intelligence	
	Understanding yourself, others and the situation then adapting how you work for best results.
Initiative	
	Taking active steps when you see it's needed, without prompting.
Open-Minded	
	Willing to consider new ideas or the points of view of others.
Passion for Subject	
	Finding the Food Industry fascinating.
Personable	
	Social qualities that are likeable to others in a variety of contexts.

Behaviours (page 2 of 2)

"How someone goes about the business of working is as important as what they do."



Personal Responsibility	
	Being fully aware of what you are accountable for and owning all outcomes, good or bad.
Positive Attitude	
	Proactive and constructive in communications and tasks.
Professionalism	
	Having personal presentation and behaviours appropriate for your business.
Questioning Approach	
	Taking genuine interest in finding out the answer or challenging the status quo.
Reliability	
	Trustworthy, consistent in meeting objectives and never letting you down.
Resilience	
	Responding positively to adverse situations and persevering.
Self-Motivated	
	Delivering energy and just getting on with it!

Communication

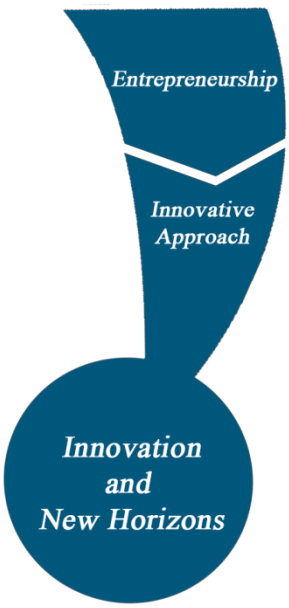
"…whether they actually want to share and make the food industry better."



English Proficiency	
	Possessing the required level of English understanding to give effective communication of all types.
Listening	
	Providing the correct environment to allow for engaging discourse and ensuring the required comprehension has been gained.
Verbal Communication	
	Consciously choosing the content and style of your delivery to suit the target audience whatever the size and context. Checking your message has been understood.
Written Communication	
	Producing clear structured work in a precise way that can be clearly followed by the intended audience.

Innovations and New Horizons

"Great ideas into reality."



Entrepreneurship
To see an opportunity and exploit it for beneficial effect.
Innovation
Generating an idea or item that's better or original.

Numbers, Data and IT

"Collecting that body of knowledge and synthesising it to create a single view."



Application of IT
The ability to work confidently with spreadsheets and other computer packages and have additional skills with other software, databases or systems as the role requires.
Digital Capability
The ability to work effectively and communicate using all available technology for maximum impact.
Handling Data
The ability to understand, manipulate and present data with confidence (this may include handling large and complex data sets).

Problem Solving

"…because problems are going to come up all the time, you might as well accept that now and understand how you are going to mentally, physically react to problems."



Critical Thinking	
	Objectively analysing the facts and situations of an issue to form an evaluated judgement.
Decision Making	
	Making a considered response to an issue. Taking direct action or escalating as appropriate to gain traction on the matter.

Social, Political and Environmental Appreciation

"The World is One"



Environment and Sustainability
Feeding the world, looking after the planet.
Values and Credibility
Understanding and respect for ethical and social considerations pertinent to the larger food industry and your specific sector; this includes authenticity matters.

Technical and Workplace

"Yes, and that's back to the interest in the whole food industry and wanting to be part of the whole industry."



Academic Expertise	
	Evidence of the required level of academic ability whether by degree calibre, further study or specific competencies such as research, evaluation, speaking or writing.
Specific Technical Aspects	
	Demonstration of experience or knowledge in your field or a particular scientific area the employer deems essential or desirable to fulfil the role.
Work Experience	
	Proven record of relevant employment, to demonstrate understanding of workplace expectations (this may be stipulated as food industry based).

The Business World

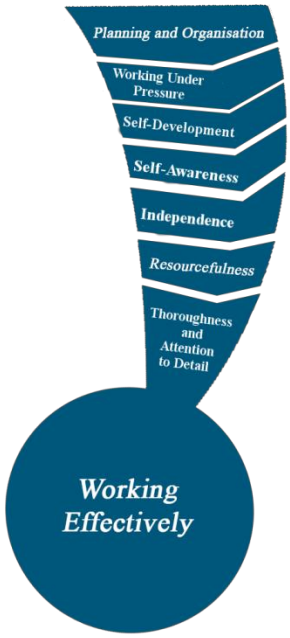
"…that's why these roles exist, that's why people are in business; you go into work to earn a wage that's the whole point."



Commercial Awareness
The required skills to develop a competitive business in terms of supply chain efficiency, market performance, product development & costings.
The Mechanics of Business
Appreciation of generic commercial aspects of handling money such as types of costs, profits, reports & risk.

Working Effectively

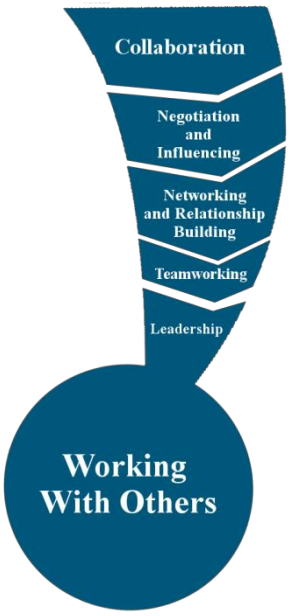
"So you're accountable for your own actions and you're responsible for the results. I think there are degrees of difference but they fundamentally talk to the same piece which is you own what you do but you don't own it in a vacuum."



Independence	
	Capacity for self-directed operation.
Planning and Organising	
	Remaining in control of activities under your responsibility and completing tasks to agreed deadlines.
Resourcefulness	
	Finding a way to achieve your goals and overcome problems.
Self-Awareness	
	Understanding what you can do well and how you may be perceived by others and then developing your contributions and behaviours positively.
Self-Development	
	Owning your own future development in your current role and beyond.
Thoroughness and Attention to Detail	
	Meticulous, careful and accurate.
Working Under Pressure	
	Establishing your personal approach to balancing demands and challenges in working life.

Working with Others

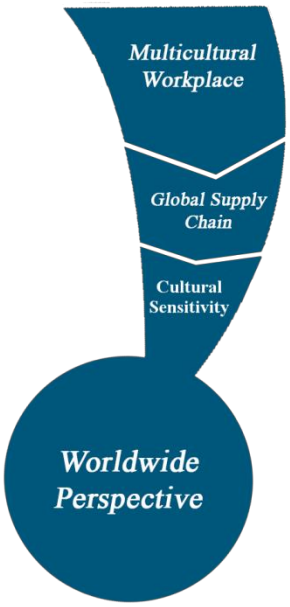
"…nobody in the food industry works on their own. "



Collaboration	
	Working with others for mutual benefit.
Leadership	
	The ability to gain the respect, trust and confidence of others, which realises the best in people to deliver success in the workplace.
Negotiation and Influencing	
	Getting the best outcomes for all parties by being persuasive in your approach when working towards an objective.
Networking and Relationship Building	
	Positive approach to establishing suitable internal and external contacts and then nurturing these links to allow for optimum working connections.
Teamworking	
	Valuing the contributions of others and being committed to getting the best out of working together towards a common goal.

Worldwide Perspective

'It's about not seeing the world as the country that you grew up in'



Cultural Sensitivity	
	Appreciation of different cultures and practices that impact on ways of working and customer needs such as religious and dietary requirements.
Global Supply Chain	
	Appreciation of how to operate a successful food business across nations, commercially, in light of current issues and most importantly ensuring robust transparency.
Multicultural Workplace	
	Ability to embrace and maximise the benefits of working with colleagues and associates from all over the world.

Appendix VI – Example of communications sent before group interviews

(Email sent via students' own academics to CMU and QUB 2 weeks before the session date)

Title: Graduate skills research project
Dear XXXXX
As discussed please find the information for sending to the students attached.

……
Hello

Student Information for the Day
I hope you will find it a useful experience for you as well as supporting active research on graduate skills, thanks in advance!
For participating in the survey I am happy to provide a sentence to add to your CV explaining that you have participated in the project.

Context of the project
Prework: Could you try and make time before the session to read the attached pdf document 'Competencies for Food Graduate Careers…..'

This is a model that has been developed following involvement and input of food industry employers and alumni and is designed to support students, academic and employers. The language and terms are aimed to be tailored to use in the food industry.
I am part way through activity is to see which elements are most valued for particular graduate jobs.

But at this stage I also wanted to present the data to students themselves to see what they think; that's you!

Action - Pre-reading of Document

- Can you look at the overall structure and see what you think
- Also most importantly can you look at each term e.g. listening, and then the associated definition and think about whether it helps you understand the term. If you can note your thoughts for each term (or just comment on any aspects of note) that would be great.
- For ease on Tuesday I will hand you out a printed copy to work on but please make some notes to bring with you if you like.

During the Session

- You will work together to discuss the document as a whole
- But also we can focus on a few of the elements in more detail. I have a couple I would like to choose but if you have any other to add, do let me know.

Any questions in advance please do let me (or Anita) know and thank you in advance for your support
I look forward to meeting you all at the session.
Best regards

Emma Weston
Division of Food Sciences, School of Biosciences, University of Nottingham

UoN Food Sciences Graduate Skills Survey

Extracts have been taken for the appendix
Total pdf was 86 pages long

Welcome

Welcome to this University of Nottingham survey, thank you in advance for spending the time to complete it, if you have any questions the contact details are below and at the end of the survey.



Sorry this first page is a bit long but some of you will not have full details of the project; please bear with it!

At the Division of Food Sciences we have identified that unlike many other graduate employers, our food industry does not have a cohesive competency framework. This survey is part of the current work to build this new framework.

As you are part of food industry, your participation in the survey is highly valued. We hope it will provide you with a useful tool for future recruitment and selection processes. It is also aimed to support the development of students for the workplace, again valuable to you.

Survey Focus

- **What competencies are desirable in food sciences students for the initial roles they undertake after graduation?**
- Food Sciences graduates' includes all related degree course routes

We are asking all types of stakeholder to complete the survey:

- employers of recent food sciences graduates
- recruitment consultants
- recent food sciences graduates

The survey asks you to assess the value of certain competencies for 'roles' that you identify with directly. Please note supervisors of postgraduate research students are also classed as 'employers'.

(If you do not believe you are aligned to one of the stakeholder groups then please do not complete the survey and do feel free to contact us).

Basic Information:

- The survey is completely anonymous.
- Likely to take **15 minutes** to review 1 graduate role. It will take longer if you choose to answer questions for additional roles.
- Please follow instructions in each section and ensure you finish the survey completely to ensure the data is captured correctly.

We appreciate this takes time out of your busy day but we hope the results will be worthwhile to all.

Thank you
Emma Weston
Assistant Professor, Division of Food Sciences, The University of Nottingham
Contact details *emma.weston@nottingham.ac.uk , 0115 951 6214,* or School of Biosciences, Division of Food Sciences, Sutton Bonington Campus, Loughborough, LE12 5RD
Alternative contact sbztjf@nottingham.ac.uk. *School of Biosciences Associated with School of Sociology and Social Policy* Approval Code: SSP 01 - SB1516/06.

Survey Information and Confirmation to Proceed

Before you complete the survey can you please read the survey information by and clicking on **'more info'** below.

Please then click 'Yes' to confirm you understand and agree with the process of the study.

What if I have further Questions at this stage?
Please do not hesitate to contact the primary researcher (Emma Weston)
emma.weston@nottingham.ac.uk

Agreement:
I understand the purpose, scope of the survey and the planned use of the data gathered and am happy to participate in the project ✱ *Required*

More info

- Yes
- No

Industry Context

Firstly could you please confirm for the purposes of this survey whether you wish to be classed as the following (choose only 1 option see 'more info' below): ✱ *Required*

More info

- ○ Recent Food Science graduate
- ○ Recruiter of Food Science graduates in your business - HR/Personnel
- ○ Line manager/employer of Food Science graduates in your business
- ○ Postgraduate research student supervisor
- ○ Recruitment consultant or part of similar business
- ○ Other

If you selected Other, please specify:

Now we'd like to find our more about your business please

If you are a recruitment consultant can you confirm the type of business you normally support. (please select all that apply):

Please select at least 1 answer(s).

- ☐ Retailers or Food Service Suppliers
- ☐ Manufacturers - Large
- ☐ Manufacturers - SME (Small to Medium Enterprise)
- ☐ Technical Services/Testing Company or Consultancy
- ☐ Restaurants or Catering
- ☐ Higher Education
- ☐ Other

If you selected Other, please specify:

Demographic questions continue for a number of pages

Choice of Role to Consider

Let's start with which role you would like to review.

- In this survey you can complete the review for up to 3 roles.
- If you wanted to complete for more than 3, for example as a recruitment consultant, you could start another survey after completing this one.
- Please choose only roles that you would currently recruit for or employ.
- If you are a recent graduate please choose the role you first undertook in the Food Industry after graduation.

To help you choose the right role, opening the 'more info' option below gives you an outline of each role listed and the type of job titles and names used.

Please a choose a role below:
If you cannot see the suitable role below please contact us for an alternative way to participate on *emma.weston@nottingham.ac.uk* ✱ *Required*

More info

- ○ Auditor (not based in a single factory)
- ○ Customer Support Technologist
- ○ Factory Based Technologist
- ○ Company 'Graduate Scheme' Role
- ○ Laboratory Technician/Technologist
- ○ Law and Regulatory New Graduate Role
- ○ NPD, Development or Process Role
- ○ Nutritional Graduate Role
- ○ PhD or other Postgraduate Research Role
- ○ Research or Materials Technician/Technologist
- ○ Retail Technologist
- ○ Sensory Technologist Graduate Role
- ○ Specifications or Quality Systems Technologist
- ○ Sustainability, Environmental, Ethical and Threat Management Role

Rating the Elements for a/an [FIRSTROLE]

Now you will see a number of competency 'zones' presented in Alphabetical order. ***There are 14 pages to review.*** Each zone has a number of elements outlined in it with definitions provided to the right hand side to help you understand the term.

You will be asked to rate each of the elements according to how desirable they are for the role you have selected to review: [FIRSTROLE]. The options are laid out to reflect the classic terminology for role profiles or advertisements where some skills are noted as desirable (good to have) and others essential (must haves).

It is possible for us all to feel so many skills and competencies are very important for a role and rate them all highly. But please consider carefully which ones are really required (desirable) and from these which are essential. This will help us map out what are the most important competencies for each type of role in the industry.

Explanation for using the scale:

Choose the first option on the left if the element is **not desirable** for a [FIRSTROLE].

The next 3 are to give an indication of the importance of a **desirable** element for a [FIRSTROLE].

The final right hand option is where the element is believed in your opinion to be **essential** for a [FIRSTROLE]**.**

This explanation can be seen at any stage by clicking on 'more info' in subsequent pages.

Accessibility Feature of BOS Survey Design
For each question there will be option to switch the view from an answer grid format to a list of questions (reversible).
*However please note that the question reformats by displaying the 'name of the competency/skill' **vs** 'the definition'. This is unavoidable with BOS surveys.*

Behaviours Zone (part 1) - page 1 of 14

This first section starts to look at the Behaviours zone for [FIRSTROLE]. Can you please consider how important each of the element below are for this specific role using the definitions on the right hand side of each row (please see the more info button for help on the scale use). ✱ *Required*

More info

	Not specifically desirable for the role	Slightly desirable	Moderately desirable	Very desirable	Essential for the Role	
Acceptance of Ambiguity	☐	☐	☐	☐	☐	Appreciation that there may be different ways of achieving a result or more than one positive outcome.
Adaptability	☐	☐	☐	☐	☐	A constructive approach to handling change.
Confidence	☐	☐	☐	☐	☐	Having the self-assurance to process information and situations and then undertake the required actions.

Survey continues to ask questions for all zones and elements in subsequent pages

Next

This completes the review of [FIRSTROLE].

Opportunity to choose to review another role and thus survey repeats (up to 3 times).

If you have any comments to add about the review of [FIRSTROLE] please feel free to add them here:

Would you like to review another role that you or your company employ graduates in?

- Yes
- No

Completion

Final 2 pages of the survey

Have you any other comments you would like to make before ending the survey? If so please enter here:

Ending Page

Thank you very much for taking the time in completing the survey, we hope the final results will be of real use to all in the Food Industry.

Results are hoped to be issued later in the year.

If you have any questions please contact us

emma.weston@nottingham.ac.uk

Thank you, Emma Weston, Food Sciences Division, the University of Nottingham

Appendix VIII – Questionnaire used for pilot of industry survey

Information and Considerations for the Pilot Survey – Dec 2016
Emma Weston – Competencies for Food Graduate Careers

Suggestion Please perhaps print this off (or use a second screen if you are fancy) to think through whilst doing the pilot survey work.

Can you please time yourself each time you complete the survey

You can complete the survey multiple times with the same URL
Can you complete the survey for 1 role, then restart with 2 or 3 roles making different choices of classification of person each time e.g. HR/personnel, employer, recent graduate, recruitment consultant etc.. and then different roles to review etc..

Can you consider the questions below and add any comments you wish to make to this sheet and either save and email back (or scan a hard copy and email)

How long did each run of the survey take?

Were there any error messages or glitches in any of your routes?

Were there any frustrations?

Did you understand how to choose your Industry context?

Did you use/use the 'more info' to help you choose a graduate role and if so was it useful?

Were there any stages where there was a lack of information content or clarity?

Were there any areas of ambiguity or double-barrelled terms?

Were there any areas of needless repetition?

Were pages clear in terms of amount of information and ability to complete questions?

Did the survey hold your attention, if not any ideas on improvements?

Currently only the open text questions are optional, all others are mandatory. Any thoughts on this?

Should I remove the 'Other' field from the Role Choices, I am thinking of doing so.
(Reason – it will pull through the survey as 'other' in all the text and using the information given there should be a place for each type of job)

Technically (if you can answer) are there any categories missed in the background of participants (Industry Context) and the roles under review?

When reviewing each element do you think there needs to be a 'don't know' category?
(out of preference am thinking that not specifically needed for the role should cover this)

I have tried to add information so the progress bar is not misleading and demotivating and also numbering the first role pages x of 14. Does this help?

Did the survey feel suitable in length completing a review of 1 role?

Did the survey feel suitable in length completing a review of 2 or 3 roles?

Any other Comments?

Key points of note
I am not looking for completion in the real survey of academics and their review of jobs out there. Only looking for academics as PhD supervisors; employers. So there are no options for this in some of the categories

Thanks Emma

Appendix IX - Survey data presented by element and graduate role type

Role No.	Role Type		Acceptance of Ambiguity	Adaptability	Confidence	Emotional Intelligence	Initiative	Open-Minded	Passion for Subject	Personable	Personal Responsibility	Positive Attitude	Professionalism	Questioning Approach	Reliability	Resilience	Self-Motivated	English Proficiency	Listening	Verbal Communication	Written Communication	Entrepreneurship	Innovation	Application of IT	Digital Literacy	Handling Data	Critical Thinking	Decision Making	Environment and Sustainability	Values and Credibility	Academic Expertise	Specific Technical Aspects	Work Experience	Commercial Awareness	The Mechanics of Business	Independence	Planning and Organising	Resourcefulness	Self-Awareness	Self-Development	Thoroughness and Attention to Detail	Working Under Pressure	Collaboration	Leadership	Negotiation and Influencing	Networking and Relationship Building	Teamworking	Cultural Sensitivity	Global Supply Chain	Multicultural Workplace	Averages of all 48
	Zone and Subpage		Behaviour's - Subpage 1							Behaviour's - Subpage 2						Behaviour's - Subpage 3			Communication - Subpage 4				Innovation & New Horizons - Subpage 5		Numbers, Data & IT - Subpage 6			Problem Solving - Subpage 7			Social, Political & Environmental Appreciation - Subpage 8		Technical and Workplace - Subpage 9			The Business World - Subpage 10		Working Effectively - Subpage 11						Working Effectively - Subpage 12			Working with Others - Subpage 13						Worldwide Perspective - Subpage 14			
1	Auditor	median	4.00	4.50	5.00	4.00	4.50	4.00	3.50	4.00	4.50	4.50	5.00	5.00	4.50	4.50	4.00	4.00	5.00	4.50	4.50	4.00	3.00	4.00	3.00	4.00	4.50	4.50	1.00	3.00	4.00	4.50	4.00	1.50	1.50	4.00	5.00	4.00	4.50	4.00	2.50	4.50	4.50	4.00	4.00	4.00	4.00	4.00	4.00	2.50	2.50	3.83
	(not based in	mean	3.83	4.33	4.67	4.17	4.33	4.17	3.50	3.83	4.33	4.33	4.67	4.83	4.50	4.29	4.17	4.00	4.67	4.50	4.50	4.44	4.02	4.10	4.15	4.37	3.54	3.17	3.00	4.00	4.33	4.50	3.66	3.98	4.24	2.63	3.80	4.17	4.33	4.67	4.17	4.50	4.50	4.17	4.17	4.33	4.17	4.00	3.83	2.67	2.67	3.80
	single factory)	sdev	1.07	0.75	0.47	0.69	0.75	0.69	0.96	0.69	0.75	0.75	0.75	0.37	0.50	0.50	0.50	0.47	0.76	0.50	0.50	0.59	0.97	0.66	0.58	0.69	0.76	0.69	0.76	1.37	1.15	0.69	1.34	1.07	1.83	2.17	1.07	1.00	0.47	0.75	0.58	0.75	0.50	0.50	0.69	0.37	0.47	0.37	0.82	0.69	1.49	0.75	0.73
	6	min	2.00	3.00	4.00	3.00	3.00	3.00	2.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	2.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00	3.00	2.00	2.00	3.00	1.00	3.00	3.00	2.00	2.00	3.00	4.00	4.00	2.00	4.00	4.00	3.00	3.00	4.00	4.00	4.00	3.00	1.00	2.00	2.77
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.71
2	Customer	median	5.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	4.00	2.00	2.00	4.06
	Support	mean	4.67	4.33	4.67	3.67	4.33	4.00	3.67	4.33	4.33	4.67	4.00	4.00	5.00	5.00	4.67	4.67	4.67	4.67	4.67	4.33	4.67	4.00	4.00	4.33	4.33	4.33	4.00	4.00	4.00	4.00	4.00	4.33	3.67	4.33	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.33	2.33	3.00	4.08
	Technologist	sdev	0.47	0.47	0.47	1.25	0.47	0.82	1.25	0.47	0.47	0.47	0.82	0.00	0.00	0.00	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.94	0.94	0.82	0.94	0.47	0.94	0.94	0.94	0.00	0.47	0.47	0.47	0.82	0.82	0.47	0.47	0.47	0.47	0.47	0.47	0.82	0.82	1.25	0.47	0.66
	3	min	4.00	4.00	4.00	2.00	4.00	3.00	2.00	4.00	4.00	4.00	3.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00	2.00	2.00	4.00	4.00	3.00	3.00	3.00	3.00	5.00	4.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	3.00	2.00	2.00	3.35
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.83
3	Factory	median	4.00	5.00	4.00	4.00	5.00	4.00	3.50	4.00	4.00	4.00	4.00	4.50	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	3.50	4.00	4.00	4.00	4.00	4.00	3.00	2.00	2.00	4.00	5.00	4.00	4.00	4.00	3.00	5.00	5.00	4.00	4.00	4.00	5.00	4.00	4.00	3.00	3.00	4.00	3.93
	Based	mean	3.79	4.38	4.21	3.83	4.46	4.00	3.46	3.50	4.04	4.33	4.67	4.83	4.63	4.29	4.17	4.00	3.96	4.08	4.13	3.50	2.38	4.46	4.04	4.37	3.93	3.63	2.71	3.92	4.25	4.58	4.04	3.83	3.29	2.67	2.29	4.00	4.58	4.33	3.92	3.54	4.58	4.42	4.50	3.79	4.13	3.54	4.42	3.54	2.42	3.38	3.82
	Technologist	sdev	1.08	0.90	0.96	0.80	0.64	0.58	0.96	0.96	0.79	0.55	0.61	0.58	0.56	0.68	0.62	0.82	0.73	0.95	0.76	0.81	1.17	0.95	0.73	0.95	0.76	0.81	1.17	0.95	0.83	0.57	1.07	1.02	1.25	1.02	0.76	0.57	0.69	0.70	0.64	0.64	0.57	0.50	0.96	0.67	0.87	0.76	0.87	1.35	1.22	0.83
	24	min	1.00	1.00	1.00	2.00	3.00	3.00	1.00	1.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	2.00	1.00	2.00	2.00	1.00	3.00	3.00	3.00	1.00	2.00	1.00	2.00	2.00	3.00	1.00	1.00	2.00	1.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	2.00	3.00	2.00	2.00	2.00	1.00	1.00	2.02
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.92
4	Company	median	4.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00	3.00	4.00	4.00	3.00	3.00	4.00	4.00	4.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	2.00	3.00	3.79
	Graduate	mean	3.83	4.61	4.15	3.66	4.34	3.98	4.12	3.98	4.24	4.44	4.02	4.10	4.15	4.15	4.37	3.93	4.07	4.17	4.02	3.54	3.07	4.10	4.15	4.37	3.98	3.49	3.05	4.25	4.05	4.24	3.66	3.98	4.05	2.66	3.63	3.80	4.20	3.85	3.90	3.95	4.24	4.24	4.24	3.73	3.49	3.90	4.41	3.49	2.46	3.51	3.81
	Scheme' Role	sdev	1.08	0.49	0.81	0.87	0.57	0.72	0.80	0.68	0.79	0.59	0.64	0.66	0.68	0.78	0.69	0.87	0.60	0.58	0.60	0.97	1.02	0.97	0.83	0.85	0.72	0.73	0.85	0.79	0.80	0.81	1.12	1.05	1.05	1.05	0.80	0.74	0.81	0.73	0.76	0.76	0.73	0.73	0.96	0.89	0.85	0.54	1.06	0.91	1.06	0.80
	41	min	1.00	4.00	2.00	2.00	3.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00	3.00	3.00	1.00	1.00	3.00	3.00	2.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	2.00	3.00	1.00	1.00	1.00	1.00	1.96
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
5	Laboratory	median	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	4.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	2.50	3.00	3.50	3.50	5.00	3.50	5.00	3.00	3.50	4.00	4.00	2.00	1.50	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00	3.00	4.00	3.00	1.50	3.00	3.63
	Technician/	mean	3.13	4.00	3.81	3.50	4.13	3.81	3.81	3.75	4.31	4.50	4.06	3.69	4.81	4.31	4.19	3.81	3.94	3.81	4.06	3.00	2.31	3.69	3.25	3.31	4.00	3.25	3.13	3.13	3.44	3.63	3.06	2.13	1.81	2.19	3.75	4.31	3.94	4.00	3.75	4.75	4.38	4.25	2.94	3.25	2.81	4.13	3.06	1.75	3.06	3.58
	Technologist	sdev	0.86	0.35	0.81	0.79	0.99	0.81	0.88	0.83	0.58	0.61	0.75	0.58	0.39	0.68	0.88	0.73	0.83	0.95	0.66	1.12	1.04	1.09	1.35	1.32	0.99	1.04	1.27	1.48	1.32	0.93	1.18	0.95	0.90	0.68	0.90	0.79	0.97	0.97	0.56	0.60	0.66	0.97	0.90	2.00	1.00	2.00	1.07	0.78	1.25	0.83	0.90
	16	min	2.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	2.00	3.00	4.00	3.00	2.00	3.00	2.00	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	3.00	3.00	3.00	1.00	1.00	2.00	1.00	2.00	2.00	1.00	1.00	1.00	1.90
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.85
6	Law and	median	3.00	4.00	5.00	3.00	4.00	4.00	5.00	3.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	3.00	4.00	4.00	5.00	2.00	4.00	5.00	5.00	5.00	3.00	2.00	2.00	2.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00	3.94
	Regulatory New	mean	3.00	4.00	4.67	3.67	4.33	4.00	4.67	3.00	4.67	5.00	4.67	5.00	4.67	4.67	4.33	4.33	4.33	4.67	4.67	4.33	2.00	3.33	4.00	4.00	3.00	3.33	4.00	3.00	4.33	3.33	2.00	2.00	1.67	4.33	4.33	4.00	4.00	3.67	5.00	4.67	4.00	4.00	4.00	3.67	4.00	4.33	4.67	3.33	3.00	3.67	3.91
	Graduate Role	sdev	0.82	0.82	0.47	0.94	0.47	0.82	0.47	0.00	0.47	0.00	0.47	0.00	0.47	0.47	0.47	0.94	0.47	0.47	0.47	0.82	0.00	0.47	0.82	0.82	1.41	0.94	1.41	0.47	0.47	1.25	0.82	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.00	0.47	0.47	0.82	0.82	0.82	1.25	0.47	0.47	0.94	1.63	0.94	0.67
	3	min	2.00	3.00	4.00	3.00	4.00	3.00	4.00	3.00	4.00	5.00	4.00	5.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	3.00	3.00	5.00	5.00	4.00	2.00	3.00	3.00	4.00	4.00	3.00	1.00	1.00	1.00	4.00	4.00	4.00	3.00	3.00	5.00	4.00	3.00	3.00	3.00	3.00	2.00	4.00	4.00	2.00	1.00	3.00	3.15
		max	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	3.00	3.00	2.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.65
7	NPD,	median	4.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	3.00	4.00	4.00	5.00	3.00	4.00	4.00	3.92
	Development or	mean	3.71	4.47	4.02	3.75	4.36	4.27	4.27	3.84	4.16	4.31	4.18	4.31	4.18	4.25	4.20	4.20	4.04	4.20	4.04	4.16	3.24	4.04	3.65	3.95	4.02	3.84	3.95	4.02	3.60	3.65	3.64	3.11	3.67	4.29	4.16	3.76	3.73	4.25	4.25	4.53	3.31	3.71	3.85	4.38	3.20	4.00	3.87	2.62	3.38	3.87
	Process Role	sdev	0.95	0.60	0.70	0.81	0.77	0.65	0.80	0.71	0.71	0.74	0.74	0.68	0.72	0.67	0.64	0.80	0.60	0.75	0.79	0.78	1.08	0.79	1.00	1.02	0.88	0.75	1.06	0.97	0.93	0.96	1.05	1.17	1.00	0.87	0.65	0.60	0.89	0.82	0.74	0.74	0.57	0.57	0.97	0.98	0.75	0.73	1.20	1.10	1.15	0.83
	55	min	1.00	3.00	3.00	2.00	1.00	3.00	2.00	2.00	2.00	1.00	2.00	3.00	2.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	1.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	3.00	2.00	2.00	2.00	3.00	3.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.79
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.98

Role No.	Role type		Acceptance of Ambiguity	Adaptability	Confidence	Emotional Intelligence	Initiative	Open-Minded	Passion for Subject	Personable	Personal Responsibility	Positive Attitude	Professionalism	Questioning Approach	Reliability	Resilience	Self-Motivated	English Proficiency	Listening	Verbal Communication	Written Communication	Entrepreneurship	Innovation	Application of IT	Digital Literacy	Handling Data	Critical Thinking	Decision Making	Environment and Sustainability	Values and Credibility	Academic Expertise	Specific Technical Aspects	Work Experience	Commercial Awareness	The Mechanics of Business	Independence	Planning and Organising	Resourcefulness	Self-Awareness	Self-Development	Thoroughness and Attention to Detail	Working Under Pressure	Collaboration	Leadership	Negotiation and Influencing	Networking and Relationship Building	Teamworking	Cultural Sensitivity	Global Supply Chain	Multicultural Workplace	Averages of all 48
	Zone and Subpage		Behaviours - Subpage 1					Behaviours - Subpage 2					Behaviours - Subpage 3					Communication - Subpage 4				Innovation & New Horizons - Subpage 5		Numbers, Data & IT - Subpage 6			Problem Solving - Subpage 7		Social, Political & Environmental Appreciation - Subpage 8		Technical and Workplace - Subpage 9			The Business World - Subpage 10		Working Effectively - Subpage 11				Working Effectively - Subpage 12				Working with Others - Subpage 13						Worldwide Perspective - Subpage 14				
8	Nutritional	median	3.00	4.00	4.00	4.00	4.00	4.00	5.00	4.00	4.00	5.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	4.00	2.00	3.00	4.00	3.00	4.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	3.00	4.00	4.00	4.00	5.00	2.00	4.00	3.83
	Graduate Role	mean	3.29	4.00	4.00	3.71	4.14	4.14	4.43	4.00	4.29	4.57	4.86	4.43	4.43	4.14	4.29	4.43	4.43	4.57	4.43	2.14	3.00	3.57	3.43	4.14	3.57	3.43	3.00	3.71	4.29	4.14	3.86	3.29	2.86	4.00	4.29	3.71	4.00	4.00	4.00	4.29	4.71	3.43	4.00	4.43	4.29	4.00	2.29	3.57	3.92
		sdev	1.03	1.07	0.93	0.88	0.99	0.83	0.73	0.76	0.70	0.73	0.35	0.49	0.49	0.83	0.70	0.49	0.49	0.49	0.49	0.83	1.07	0.90	0.49	0.64	1.05	0.90	0.76	0.88	0.70	0.83	0.64	1.39	0.99	0.93	0.45	0.88	0.93	1.07	0.53	0.70	0.45	0.49	0.76	0.49	0.45	1.41	1.03	0.90	0.77
	7	min	2.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	3.00	3.00	4.00	4.00	4.00	4.00	1.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	1.00	1.00	3.00	4.00	2.00	2.00	2.00	3.00	3.00	4.00	3.00	3.00	4.00	4.00	1.00	1.00	2.00	2.73
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	3.00	5.00	5.00	4.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	4.00	5.00	4.85
9	PhD or	median	4.00	5.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	5.00	4.00	5.00	5.00	4.00	4.00	4.00	5.00	3.00	4.00	4.00	4.00	5.00	4.00	4.00	3.00	3.00	5.00	5.00	3.00	3.00	2.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	3.00	4.00	4.00	3.00	2.00	3.00	3.88
	other Postgraduate	mean	4.41	4.47	4.06	3.59	4.47	4.24	4.18	3.41	4.24	4.35	4.29	4.65	4.29	4.59	4.59	3.82	3.65	4.29	4.59	3.06	4.06	4.00	3.65	4.59	4.47	4.12	2.82	3.41	4.53	4.41	2.82	2.35	2.06	4.35	4.47	4.18	3.65	3.76	4.29	3.76	4.12	3.24	3.12	3.76	3.53	2.94	2.24	3.18	3.86
	Research Role	sdev	0.60	0.61	0.54	0.84	0.50	0.55	0.92	1.03	0.88	0.59	0.75	0.48	0.67	0.49	0.49	0.71	0.76	0.57	0.49	1.21	0.64	0.69	0.68	0.60	0.50	0.68	1.04	1.09	0.61	0.69	0.98	1.13	1.06	0.48	0.50	0.71	0.76	0.81	0.75	0.64	0.76	1.11	0.90	0.64	1.19	1.16	0.94	0.92	0.76
	17	min	3.00	3.00	3.00	1.00	4.00	3.00	1.00	1.00	2.00	3.00	3.00	4.00	3.00	4.00	4.00	3.00	2.00	3.00	4.00	1.00	3.00	3.00	2.00	3.00	4.00	3.00	1.00	1.00	3.00	3.00	1.00	1.00	1.00	4.00	4.00	3.00	2.00	2.00	3.00	2.00	3.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00	2.42
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	4.00	4.00	4.88
10	Research or	median	4.00	4.00	4.00	4.00	5.00	4.00	4.50	3.00	4.00	4.00	4.50	4.00	5.00	4.00	4.50	5.00	4.00	4.50	5.00	3.00	4.00	4.00	3.00	4.50	4.00	4.00	2.00	3.50	4.00	4.00	4.00	3.00	2.50	5.00	4.00	4.00	4.00	3.50	4.50	4.00	4.00	4.00	3.50	4.50	4.50	3.00	2.00	3.50	3.93
	Materials Technician	mean	3.88	4.13	4.00	4.00	4.63	3.75	4.25	3.63	4.00	4.25	4.50	4.25	4.50	4.25	4.38	4.63	4.13	4.38	4.63	3.25	4.00	3.88	3.38	4.38	4.13	3.88	2.13	3.50	4.00	4.25	3.75	3.25	2.75	4.38	4.38	4.13	3.88	3.63	4.13	4.13	4.38	3.75	3.50	4.00	4.38	3.00	1.88	3.38	3.91
	/Technologist	sdev	1.27	0.60	0.50	0.50	0.48	0.43	0.83	0.86	0.71	0.66	0.50	0.43	0.71	0.66	0.70	0.70	0.78	0.70	0.48	0.66	0.50	1.05	1.11	0.70	0.33	0.60	0.93	1.12	1.00	0.66	0.66	0.83	0.83	0.86	0.48	0.60	0.60	0.70	0.93	0.60	0.48	0.83	0.87	1.12	0.70	0.87	0.78	1.11	0.73
	8	min	1.00	3.00	3.00	3.00	4.00	3.00	3.00	3.00	3.00	3.00	4.00	4.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	2.00	3.00	2.00	2.00	3.00	4.00	3.00	1.00	2.00	2.00	3.00	3.00	2.00	2.00	3.00	4.00	3.00	3.00	3.00	3.00	3.00	4.00	2.00	2.00	2.00	3.00	2.00	1.00	1.00	2.75
		max	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	3.00	5.00	4.85
11	Retail	median	4.00	4.00	5.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00	4.00	5.00	4.00	5.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	4.00	5.00	4.00	4.00	4.00	4.00	3.00	3.00	4.00	4.10
	Technologist	mean	3.82	4.36	4.55	4.45	4.45	3.91	4.18	3.91	4.18	4.27	4.36	4.55	4.36	4.45	4.36	3.73	3.73	4.18	3.91	2.91	3.82	3.64	3.64	3.82	4.18	4.55	3.82	4.55	3.45	3.64	3.82	3.82	3.45	3.64	4.36	4.27	4.18	3.64	4.45	4.36	4.45	4.00	3.91	4.00	4.27	3.27	3.09	3.82	4.01
		sdev	0.94	0.64	0.50	0.50	0.66	1.00	0.72	0.51	0.72	0.45	0.88	0.50	0.48	0.66	0.64	0.45	0.45	0.39	0.51	0.79	0.83	0.77	0.64	1.03	0.57	0.50	0.57	0.66	0.78	0.88	0.94	0.72	1.08	0.64	0.48	0.45	0.57	0.64	0.78	0.48	0.66	0.60	0.51	0.60	0.45	0.62	0.67	0.83	0.65
	11	min	2.00	3.00	4.00	4.00	3.00	1.00	3.00	3.00	3.00	4.00	2.00	4.00	4.00	3.00	3.00	3.00	3.00	4.00	3.00	1.00	3.00	2.00	2.00	2.00	3.00	4.00	3.00	3.00	2.00	2.00	2.00	3.00	1.00	2.00	4.00	4.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	4.00	2.00	2.00	2.00	2.85
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	5.00	5.00	4.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	5.00	4.85
12	Sensory	median	4.00	4.00	4.00	3.00	4.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	4.00	2.00	4.00	4.00	3.00	4.00	4.00	4.00	2.00	3.00	3.00	4.00	3.00	3.00	2.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	4.00	4.00	4.00	5.00	4.00	2.00	4.00	3.77
	Technologist	mean	3.73	4.09	3.82	3.64	4.00	3.36	3.64	4.27	3.64	4.27	3.91	3.91	3.91	4.00	4.18	4.27	4.45	4.45	4.09	2.27	3.09	4.00	2.91	4.18	4.00	4.09	2.00	2.73	3.00	3.55	3.00	2.91	2.36	4.09	4.27	3.82	3.91	3.36	4.09	4.09	4.64	3.55	3.55	3.27	4.45	3.73	2.09	3.45	3.67
	Graduate Role	sdev	1.05	1.00	0.94	0.77	0.85	0.88	1.23	0.62	0.88	0.75	1.08	0.90	0.90	0.85	0.72	0.62	0.66	0.78	1.00	1.05	1.08	0.85	1.00	0.83	0.60	0.90	0.85	1.14	1.21	1.30	1.28	1.00	0.88	0.67	0.62	0.72	0.67	0.98	0.67	0.67	0.48	0.78	0.66	0.96	0.66	0.96	0.79	1.30	0.88
	11	min	1.00	2.00	2.00	3.00	2.00	2.00	1.00	3.00	2.00	3.00	2.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	2.00	1.00	1.00	3.00	1.00	3.00	3.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00	4.00	2.00	2.00	2.00	1.00	3.00	2.00	1.00	2.08
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	5.00	4.00	5.00	5.00	5.00	3.00	4.00	5.00	5.00	5.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	5.00	5.00	3.00	5.00	4.75
13	Specifications or	median	3.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	5.00	2.00	3.00	4.00	4.00	4.00	4.00	4.00	2.00	4.00	3.00	4.00	4.00	3.00	2.00	4.00	5.00	4.00	4.00	3.00	5.00	4.00	4.00	3.00	4.00	4.00	4.00	3.00	3.00	3.00	3.79
	Quality Systems	mean	3.14	4.10	4.33	3.57	4.33	3.52	3.71	3.76	4.38	4.29	4.24	4.29	4.43	4.05	4.05	4.24	3.95	4.14	4.43	2.29	2.86	4.43	4.00	4.14	3.81	4.00	2.33	3.76	3.38	3.86	3.43	2.71	2.05	3.86	4.38	3.90	3.76	3.19	4.76	4.14	4.29	3.43	3.86	3.57	3.86	3.05	2.62	3.00	3.74
	Technologist	sdev	1.17	0.92	0.94	1.05	0.78	0.85	0.88	0.75	0.65	0.76	0.87	0.70	0.73	0.95	0.72	0.92	0.79	0.83	0.73	1.20	0.83	0.58	0.98	0.83	0.85	0.82	1.13	1.02	1.05	0.94	1.18	0.93	0.84	0.83	0.72	0.92	0.68	1.01	0.43	0.71	0.76	1.05	0.89	1.05	1.17	1.05	1.17	1.02	0.89
	21	min	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	3.00	2.00	1.00	3.00	2.00	1.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	3.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	2.00	3.00	2.00	2.00	1.00	4.00	3.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.60
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.90
14	Sustainability, Env,	median	5.00	4.00	5.00	4.00	5.00	5.00	4.00	4.00	4.00	4.00	4.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	3.00	3.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	3.00	3.00	3.00	4.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.25
	Ethical and Threat	mean	4.67	4.33	4.67	4.00	4.67	4.67	4.33	4.00	4.00	4.33	4.33	4.67	4.33	4.67	4.67	4.33	5.00	5.00	5.00	3.00	3.33	3.67	4.00	4.33	5.00	4.33	5.00	5.00	4.00	3.67	3.33	3.00	3.33	4.00	3.67	4.33	4.00	4.33	3.67	3.67	4.67	3.67	4.00	4.00	4.00	4.00	3.67	3.67	4.17
	Management Role	sdev	0.47	0.47	0.47	0.82	0.47	0.47	0.47	0.00	0.00	0.47	0.47	0.47	0.47	0.47	0.47	0.94	0.00	0.00	0.00	0.82	0.47	0.47	0.00	0.94	0.00	0.94	0.00	0.00	0.00	0.47	0.47	0.82	0.47	0.00	0.47	0.94	0.82	0.47	0.47	1.25	0.47	0.94	0.82	0.82	0.82	0.82	1.25	1.25	0.52
	3	min	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	5.00	5.00	5.00	2.00	3.00	3.00	4.00	3.00	5.00	3.00	5.00	5.00	5.00	4.00	3.00	2.00	3.00	4.00	3.00	3.00	3.00	4.00	3.00	2.00	4.00	3.00	3.00	3.00	3.00	3.00	2.00	2.00	3.54
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.71
	TOTAL	median	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	3.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00	3.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00	2.00	3.00	3.81
	226	mean	3.72	4.35	4.14	3.74	4.35	4.00	4.01	3.80	4.19	4.37	4.19	4.28	4.34	4.27	4.26	4.08	4.05	4.22	4.19	2.81	3.56	3.73	3.27	4.01	4.01	4.10	2.57	3.50	3.54	3.73	3.52	3.02	2.58	3.89	4.35	4.07	3.87	3.67	4.32	4.23	4.38	3.52	3.69	3.75	4.24	3.32	2.46	3.35	3.83
		sdev	1.06	0.72	0.80	0.86	0.73	0.77	0.92	0.79	0.75	0.66	0.76	0.68	0.69	0.74	0.70	0.82	0.71	0.75	0.72	1.11	1.01	0.85	1.03	0.94	0.85	0.83	1.14	1.08	1.08	1.00	1.02	1.22	1.11	0.83	0.65	0.76	0.78	0.87	0.74	0.71	0.66	0.97	0.91	0.91	0.83	1.11	1.11	1.12	0.87
		min	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.15
		max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Appendix X - Tables from PCA report with eight varimax rotations

Factor loadings by element

	D1	D2	D3	D4	D5	D6	D7	D8
Acceptance of Ambiguity	0.121	0.037	0.030	0.446	0.140	0.200	-0.226	0.206
Adaptability	0.464	-0.034	-0.012	0.206	0.227	0.209	-0.075	0.253
Confidence	0.669	-0.003	0.153	0.119	0.214	-0.028	-0.022	0.203
Emotional Intelligence	0.331	0.169	-0.091	0.140	0.528	0.016	-0.031	-0.025
Initiative	0.650	0.006	0.038	0.191	0.170	0.219	0.115	-0.013
Open-Minded	0.187	0.043	0.059	0.151	0.307	0.531	0.006	-0.086
Passion for Subject	0.164	0.260	0.114	-0.296	0.040	0.508	0.198	0.100
Personable	0.283	0.136	-0.048	-0.062	0.491	0.050	0.036	0.095
Personal Responsibility	0.551	0.089	0.028	0.080	-0.035	0.008	0.385	-0.165
Positive Attitude	0.549	0.072	0.048	-0.055	0.310	0.020	0.278	-0.036
Professionalism	0.317	0.147	0.267	-0.027	0.249	0.166	0.494	0.004
Questioning Approach	0.113	0.135	0.261	0.310	0.047	0.373	0.112	-0.405
Reliability	0.328	0.089	0.085	0.077	0.265	-0.062	0.524	-0.166
Resilience	0.559	0.183	0.146	0.347	0.033	0.083	0.171	0.039
Self-Motivated	0.597	0.126	0.169	0.031	0.004	0.093	0.076	-0.004
English Proficiency	-0.038	-0.206	0.357	0.007	0.457	0.123	0.154	-0.126
Listening	0.208	0.135	0.263	-0.039	0.591	-0.089	0.111	0.078
Verbal Communication	0.247	0.032	0.394	0.085	0.559	-0.030	-0.046	0.032
Written Communication	0.083	0.030	0.579	0.075	0.284	0.125	0.212	-0.229
Entrepreneurship	0.111	0.352	-0.084	-0.009	0.101	0.641	-0.098	0.250
Innovation	0.045	0.101	0.104	0.157	-0.061	0.726	-0.065	0.222
Application of IT	0.039	0.055	0.714	-0.033	-0.041	-0.026	-0.022	0.032
Digital Literacy	0.126	0.278	0.542	-0.085	0.131	0.016	0.057	0.059
Handling Data	0.078	0.061	0.633	0.139	-0.002	-0.026	0.061	0.008
Critical Thinking	0.013	0.208	0.213	0.626	0.003	0.188	0.003	-0.266
Decision Making	0.075	0.134	-0.010	0.718	0.047	0.017	0.083	0.060
Environment & Sustainability	0.120	0.739	0.034	0.061	-0.084	0.217	-0.026	0.115
Values and Credibility	0.133	0.701	0.049	0.106	0.028	0.162	0.100	-0.123
Academic Expertise	0.111	-0.094	0.568	0.141	-0.100	0.394	0.129	0.080
Specific Technical Aspects	0.098	-0.024	0.588	0.253	-0.021	0.081	0.314	0.065
Work Experience	0.054	0.089	0.155	0.126	0.125	0.135	0.499	0.261
Commercial Awareness	0.041	0.246	0.081	0.144	0.117	0.269	0.124	0.711
The Mechanics of Business	0.110	0.352	0.020	0.087	0.138	0.249	0.093	0.685
Independence	0.274	0.015	0.084	0.543	0.057	-0.052	0.173	0.027
Planning and Organising	-0.018	-0.105	0.193	0.504	0.168	-0.050	0.435	0.042
Resourcefulness	0.265	0.060	0.156	0.512	0.161	0.196	0.255	0.117
Self-Awareness	0.079	0.260	-0.014	0.345	0.463	0.057	0.248	0.006
Self-Development	0.084	0.299	0.036	0.093	0.192	0.372	0.306	0.059
Thoroughness and Attention to Detail	0.069	0.001	0.213	0.037	0.018	-0.073	0.685	-0.059
Working Under Pressure	0.206	0.067	-0.072	0.225	0.133	0.048	0.573	0.200
Collaboration	-0.066	-0.114	-0.020	0.096	0.523	0.360	0.275	-0.066
Leadership	0.139	0.101	-0.056	0.451	0.364	0.040	0.106	0.168
Negotiation & Influencing	0.094	0.033	-0.009	0.411	0.577	-0.081	0.179	0.203
Networking & Relationship Building	-0.056	0.143	0.235	0.318	0.477	0.293	-0.064	0.116
Teamworking	0.036	0.049	-0.148	0.120	0.615	0.251	0.236	0.112
Cultural Sensitivity	0.032	0.631	-0.047	0.109	0.402	-0.093	-0.004	0.153
Global Supply Chain	0.046	0.580	0.106	0.236	0.090	0.060	0.026	0.439
Multicultural Workplace	0.018	0.585	0.197	0.041	0.152	0.118	0.133	0.177

Communalities by element

	Communalities
Acceptance of Ambiguity	0.37
Adaptability	0.42
Confidence	0.57
Emotional Intelligence	0.45
Initiative	0.55
Open-Minded	0.45
Passion for Subject	0.50
Personable	0.36
Personal Responsibility	0.50
Positive Attitude	0.49
Professionalism	0.53
Questioning Approach	0.51
Reliability	0.50
Resilience	0.53
Self-Motivated	0.42
English Proficiency	0.44
Listening	0.51
Verbal Communication	0.54
Written Communication	0.54
Entrepreneurship	0.64
Innovation	0.63
Application of IT	0.52
Digital Literacy	0.42
Handling Data	0.43
Critical Thinking	0.59
Decision Making	0.55
Environment & Sustainability	0.63
Values and Credibility	0.57
Academic Expertise	0.55
Specific Technical Aspects	0.53
Work Experience	0.40
Commercial Awareness	0.70
The Mechanics of Business	0.70
Independence	0.41
Planning and Organising	0.52
Resourcefulness	0.50
Self-Awareness	0.47
Self-Development	0.38
Thoroughness and Attention to Detail	0.53
Working Under Pressure	0.49
Collaboration	0.51
Leadership	0.41
Negotiation & Influencing	0.59
Networking & Relationship Building	0.51
Teamworking	0.55
Cultural Sensitivity	0.61
Global Supply Chain	0.61
Multicultural Workplace	0.47
Average communality score	0.51
Average communality (%)	51%

Shaded areas denote communalities of <0.4. Average score >0.5

Cross loadings by element highlighted in *red italics*

Threshold	0.35	0.45	0.55	0.65

	D1	D2	D3	D4	D5	D6	D7	D8
Acceptance of Ambiguity	0.121	0.037	0.030	0.446	0.140	0.200	-0.226	0.206
Adaptability	0.464	-0.034	-0.012	0.206	0.227	0.209	-0.075	0.253
Confidence	0.669	-0.003	0.153	0.119	0.214	-0.028	-0.022	0.203
Emotional Intelligence	0.331	0.169	-0.091	0.140	0.528	0.016	-0.031	-0.025
Initiative	0.650	0.006	0.038	0.191	0.170	0.219	0.115	-0.013
Open-Minded	0.187	0.043	0.059	0.151	0.307	0.531	0.006	-0.086
Passion for Subject	0.164	0.260	0.114	-0.296	0.040	0.508	0.198	0.100
Personable	0.283	0.136	-0.048	-0.062	0.491	0.050	0.036	0.095
Personal Responsibility	0.551	0.089	0.028	0.080	-0.035	0.008	0.385	-0.165
Positive Attitude	0.549	0.072	0.048	-0.055	0.310	0.020	0.278	-0.036
Professionalism	0.317	0.147	0.267	-0.027	0.249	0.166	0.494	0.004
Questioning Approach	0.113	0.135	0.261	0.310	0.047	0.373	0.112	-0.405
Reliability	0.328	0.089	0.085	0.077	0.265	-0.062	0.524	-0.166
Resilience	0.559	0.183	0.146	0.347	0.033	0.083	0.171	0.039
Self-Motivated	0.597	0.126	0.169	0.031	0.004	0.093	0.076	-0.004
English Proficiency	-0.038	-0.206	0.357	0.007	0.457	0.123	0.154	-0.126
Listening	0.208	0.135	0.263	-0.039	0.591	-0.089	0.111	0.078
Verbal Communication	0.247	0.032	0.394	0.085	0.559	-0.030	-0.046	0.032
Written Communication	0.083	0.030	0.579	0.075	0.284	0.125	0.212	-0.229
Entrepreneurship	0.111	0.352	-0.084	-0.009	0.101	0.641	-0.098	0.250
Innovation	0.045	0.101	0.104	0.157	-0.061	0.726	-0.065	0.222
Application of IT	0.039	0.055	0.714	-0.033	-0.041	-0.026	-0.022	0.032
Digital Literacy	0.126	0.278	0.542	-0.085	0.131	0.016	0.057	0.059
Handling Data	0.078	0.061	0.633	0.139	-0.002	-0.026	0.061	0.008
Critical Thinking	0.013	0.208	0.213	0.626	0.003	0.188	0.003	-0.266
Decision Making	0.075	0.134	-0.010	0.718	0.047	0.017	0.083	0.060
Environment and Sustainability	0.120	0.739	0.034	0.061	-0.084	0.217	-0.026	0.115
Values and Credibility	0.133	0.701	0.049	0.106	0.028	0.162	0.100	-0.123
Academic Expertise	0.111	-0.094	0.568	0.141	-0.100	0.394	0.129	0.080
Specific Technical Aspects	0.098	-0.024	0.588	0.253	-0.021	0.081	0.314	0.065
Work Experience	0.054	0.089	0.155	0.126	0.125	0.135	0.499	0.261
Commercial Awareness	0.041	0.246	0.081	0.144	0.117	0.269	0.124	0.711
The Mechanics of Business	0.110	0.352	0.020	0.087	0.138	0.249	0.093	0.685
Independence	0.274	0.015	0.084	0.543	0.057	-0.052	0.173	0.027
Planning and Organising	-0.018	-0.105	0.193	0.504	0.168	-0.050	0.435	0.042
Resourcefulness	0.265	0.060	0.156	0.512	0.161	0.196	0.255	0.117
Self-Awareness	0.079	0.260	-0.014	0.345	0.463	0.057	0.248	0.006
Self-Development	0.084	0.299	0.036	0.093	0.192	0.372	0.306	0.059
Thoroughness and Attention to Detail	0.069	0.001	0.213	0.037	0.018	-0.073	0.685	-0.059
Working Under Pressure	0.206	0.067	-0.072	0.225	0.133	0.048	0.573	0.200
Collaboration	-0.066	-0.114	-0.020	0.096	0.523	0.360	0.275	-0.066
Leadership	0.139	0.101	-0.056	0.451	0.364	0.040	0.106	0.168
Negotiation and Influencing	0.094	0.033	-0.009	0.411	0.577	-0.081	0.179	0.203
Networking and Relationship Building	-0.056	0.143	0.235	0.318	0.477	0.293	-0.064	0.116
Teamworking	0.036	0.049	-0.148	0.120	0.615	0.251	0.236	0.112
Cultural Sensitivity	0.032	0.631	-0.047	0.109	0.402	-0.093	-0.004	0.153
Global Supply Chain	0.046	0.580	0.106	0.236	0.090	0.060	0.026	0.439
Multicultural Workplace	0.018	0.585	0.197	0.041	0.152	0.118	0.133	0.177

Appendix XI - Study of factor scores (eight rotations) with colour shading to identify desirable themes for each graduate role

Auditor (not based in a single factory)

	Theme/Comparison	factor score
D1	Positivity	0.160
D2	Appreciation of the Wider World	-0.480
D3	Data, Numbers and Communications	-0.049
D4	Getting the Job Done and Tackling Problems	0.870
D5	Working Well with Others	0.574
D6	Innovation and Creativity (and academia?)	-1.058
D7	Dependability and Experience	0.047
D8	The Business World	-0.470

Customer Support Technologist

	Theme/Comparison	factor score
D1	Positivity	0.419
D2	Appreciation of the Wider World	-0.187
D3	Data, Numbers and Communications	0.606
D4	Getting the Job Done and Tackling Problems	0.394
D5	Working Well with Others	0.611
D6	Innovation and Creativity (and academia?)	-0.809
D7	Dependability and Experience	0.070
D8	The Business World	1.033

Factory Based Technologist

	Theme/Comparison	factor score
D1	Positivity	-0.169
D2	Appreciation of the Wider World	-0.255
D3	Data, Numbers and Communications	-0.316
D4	Getting the Job Done and Tackling Problems	0.752
D5	Working Well with Others	0.004
D6	Innovation and Creativity (and academia?)	-0.322
D7	Dependability and Experience	0.373
D8	The Business World	-0.168

Company 'Graduate Scheme' Role

	Theme/Comparison	factor score
D1	Positivity	0.142
D2	Appreciation of the Wider World	0.198
D3	Data, Numbers and Communications	-0.369
D4	Getting the Job Done and Tackling Problems	-0.046
D5	Working Well with Others	0.072
D6	Innovation and Creativity (and academia?)	0.122
D7	Dependability and Experience	-0.363
D8	The Business World	0.061

Laboratory Technician/Technologist

	Theme/Comparison	factor score
D1	Positivity	0.067
D2	Appreciation of the Wider World	-0.215
D3	Data, Numbers and Communications	-0.375
D4	Getting the Job Done and Tackling Problems	-0.857
D5	Working Well with Others	-0.292
D6	Innovation and Creativity (and academia?)	-0.615
D7	Dependability and Experience	0.898
D8	The Business World	-0.293

Law and Regulatory New Graduate Role

	Theme/Comparison	factor score
D1	Positivity	0.360
D2	Appreciation of the Wider World	0.162
D3	Data, Numbers and Communications	0.280
D4	Getting the Job Done and Tackling Problems	0.002
D5	Working Well with Others	0.162
D6	Innovation and Creativity (and academia?)	-0.333
D7	Dependability and Experience	0.771
D8	The Business World	-1.061

NPD, Development or Process Role

	Theme/Comparison	factor score
D1	Positivity	-0.120
D2	Appreciation of the Wider World	-0.101
D3	Data, Numbers and Communications	-0.157
D4	Getting the Job Done and Tackling Problems	-0.176
D5	Working Well with Others	0.021
D6	Innovation and Creativity (and academia?)	0.646
D7	Dependability and Experience	-0.009
D8	The Business World	0.404

Nutritional Graduate Role

	Theme/Comparison	factor score
D1	Positivity	-0.308
D2	Appreciation of the Wider World	0.285
D3	Data, Numbers and Communications	0.457
D4	Getting the Job Done and Tackling Problems	-0.734
D5	Working Well with Others	0.701
D6	Innovation and Creativity (and academia?)	-0.047
D7	Dependability and Experience	0.378
D8	The Business World	-0.082

PhD or other Postgraduate Research Role

	Theme/Comparison	factor score
D1	Positivity	0.456
D2	Appreciation of the Wider World	-0.091
D3	Data, Numbers and Communications	0.857
D4	Getting the Job Done and Tackling Problems	0.462
D5	Working Well with Others	-0.879
D6	Innovation and Creativity (and academia?)	0.646
D7	Dependability and Experience	-0.604
D8	The Business World	-0.689

Research / Materials Technician/Technologist

	Theme/Comparison	factor score
D1	Positivity	-0.081
D2	Appreciation of the Wider World	-0.394
D3	Data, Numbers and Communications	0.563
D4	Getting the Job Done and Tackling Problems	-0.020
D5	Working Well with Others	0.126
D6	Innovation and Creativity (and academia?)	0.395
D7	Dependability and Experience	0.000
D8	The Business World	0.035

Retail Technologist

	Theme/Comparison	factor score
D1	Positivity	0.145
D2	Appreciation of the Wider World	0.882
D3	Data, Numbers and Communications	-0.290
D4	Getting the Job Done and Tackling Problems	0.340
D5	Working Well with Others	-0.169
D6	Innovation and Creativity (and academia?)	0.088
D7	Dependability and Experience	0.063
D8	The Business World	0.315

Sensory Technologist Graduate Role

	Theme/Comparison	factor score
D1	Positivity	-0.520
D2	Appreciation of the Wider World	-0.260
D3	Data, Numbers and Communications	0.095
D4	Getting the Job Done and Tackling Problems	-0.109
D5	Working Well with Others	0.608
D6	Innovation and Creativity (and academia?)	-0.796
D7	Dependability and Experience	-0.434
D8	The Business World	0.189

Specifications / Quality Systems Technologist

	Theme/Comparison	factor score
D1	Positivity	-0.082
D2	Appreciation of the Wider World	0.044
D3	Data, Numbers and Communications	0.601
D4	Getting the Job Done and Tackling Problems	-0.230
D5	Working Well with Others	-0.137
D6	Innovation and Creativity (and academia?)	-0.872
D7	Dependability and Experience	0.238
D8	The Business World	-0.215

Sustain, Env, Ethical & Threat Management Role

	Theme/Comparison	factor score
D1	Positivity	0.450
D2	Appreciation of the Wider World	1.621
D3	Data, Numbers and Communications	0.752
D4	Getting the Job Done and Tackling Problems	0.188
D5	Working Well with Others	0.597
D6	Innovation and Creativity (and academia?)	0.249
D7	Dependability and Experience	-1.341
D8	The Business World	-0.698

Key

original strong - grading <-0.4

original strong + grading >+0.4

Refined comparative desirability

against the 'theme' (using factor scores)

>0.5	Much more desirable than most other roles
-0.2 to +0.5	
-0.2 to +0.2	
<-0.2 to -0.5	Less desirable than most other roles
<-0.5	

Appendix XII - Copy of the CFGC page on IFST website

Institute of Food Science + Technology

Published on *IFST* (https://www.ifst.org)

Home > Knowledge Centre > Other knowledge > Competencies for Food Graduate Careers

Competencies for Food Graduate Careers [1]

New framework to outline key competencies for food sciences graduates

Following the publication of the Wakeham Review [2] in May 2016, the ability of higher education institutions to produce employable graduates for the agri-food sector has been brought into focus. The report highlighted that higher education institutions and businesses need to ensure graduates entering work have the right skills for the future.

Responding to the challenge, Emma Weston, Associate Professor, Division of Food Sciences, University of Nottingham initiated a research project to explore what makes a 'great graduate for the food industry' and how educational providers can optimise the curricula to facilitate this.

Material found when clicking this link found later in this appendix section

'Competencies for Food Graduate Careers' [3], developed in collaboration with IFST and representatives from SMEs, retailers, manufacturers, research and development, higher education Institutions, aims to disseminate a competency framework tailored to typical technical careers pathways for graduates entering the food industry.

The core document comprises of a list of 48 elements that provide a consistent and relevant set of behaviours, knowledge and skills that may be desirable in a food science graduate. A list of 14 role types and associated definitions were then reviewed and ratified by the industry stakeholder group. They are illustrated below:

Each link reveals the role infographic

- Auditor Roles (not a single factory) [4]
- Company Graduate Scheme [5]
- Nutritional Roles [6]
- Law and Regulatory Roles [7]
- Sustainability, Environmental, Ethical, and Threat Management [8]
- Sensory Technologist [9]
- Retail Technologist [10]
- Customer Support Technologist [11]
- Specifications or Systems Technologist [12]
- Factory Based Technologist [13]
- Research or Materials Technician/Technologist [14]

- Laboratory Technician/Technologist [15]
- NPD, Development or Process Roles [16]
- PhD or other Postgraduate Research [17]

The online interactive tool will be openly accessible in the New Year so it can be used by students to help them identify and pursue careers suited to their strengths; employers to help with recruitment and selection; and educators to help ensure courses reflect the needs of the food sector.

Key stakeholders involved in the project included: Campden BRI, Fresh Cut Foods, Greencore, MorePeople, PepsiCo, Sainsbury's, Warburtons, University of Nottingham as well as Cardiff Metropolitan University and Queens University Belfast. In addition, over 200 responses were obtained from the wider food and drink industry in a bespoke survey.

Emma Weston commented: "At University of Nottingham we are really passionate about developing the highest quality food sciences graduates to enter the UK food and drink industry. This means more than just delivering excellent scientific education; students also need to have developed a wider set of competencies to enable them to be successful in their first graduate job. The support from industry has been superb and provided material that is as true to life as possible. Of course at Nottingham we are integrating the project results into our teaching this academic year. However the 'Competencies for Food Graduate Careers' is aimed to be of practical value to all students in personal development and securing their first role in the industry. Further opportunities for use are also being explored for employers and educators."

Andrew Gardner, Operations Director, IFST added: "IFST is keen to support roll-out and promote adoption of the 'competencies' as they have an immediate relevance and should impact positively on the sector in terms of how universities shape food science degree programmes to meet the needs of the sector."

Food and drink is the largest manufacturing sector in the UK employing around 400,000 people. It is estimated that 140,000 recruits will be needed by 2024 to meet the growing demand.

The white paper (see pdf below) includes links to descriptors of each of the 14 typical food graduate roles and associated competences. An interactive tool will be available next year on the University of Nottingham website. For more information about the project or to obtain a copy of the Competencies for Food Graduate Careers, please contact Emma Weston, the Project Leader emma.weston@nottingham.ac.uk [18].

Industry White Paper August 2017.pdf [3]
CFGC Themes Poster Sept 2017.pdf [19]

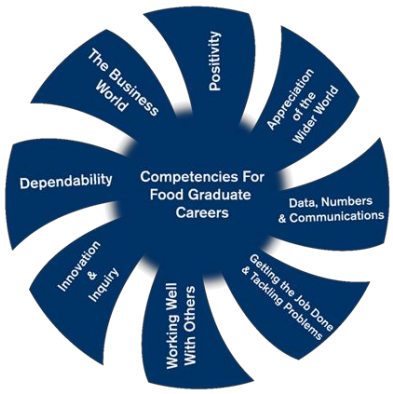
Subject Interest Area:

- Education [20]

- News
- My IFST
- Policies
- Contact

Source URL: https://www.ifst.org/knowledge-centre-other-knowledge/competencies-food-graduate-careers

Links:
[1] https://www.ifst.org/knowledge-centre-other-knowledge/competencies-food-graduate-careers
[2] https://www.gov.uk/government/publications/stem-degree-provision-and-graduate-employability-wakeham-review
[3] https://www.ifst.org/sites/default/files/Industry%20White%20Paper%20August%202017.pdf



Competencies for Food Graduate Careers

Food and drink is the largest manufacturing sector in the UK (accounting for 19% of the total manufacturing sector) turning over £95.5bn per annum and employing around 400,000 people. 140,000 new recruits are needed by 2024 to meet growing demand. (FDF, 2017) and a significant proportion are needed within the technical field coming from food science or technology based courses). To meet this demand, 33 degree programmes (BSc and MSc), accredited by Institute of Food Science and Technology (2017) are available from 16 providers across the UK and there are many more related degree courses on offer in the country.

To ensure job-readiness Food Sciences degree providers need to ensure that course content reaches beyond the science and technology of the subject matter and also encourages development of the associated personal competencies that make a great graduate for the industry across the range of initial roles they could choose as a graduate.

This project seeks to develop, test and disseminate a competency framework tailored to typical technical careers pathways for graduates entering the food industry. This framework aims to:

- Inform students intending to join the food industry as a technical graduate as a key objective.
- Support recruiters and employers in providing consistent, accurate advertisement and selection criteria.
- Optimize food science degree courses to reflect the needs of the industry

Institute of Food Science and Technology is fully aligned and supportive of the aims to develop greater clarity and support to talent entering the UK Food Industry.

A core group of stakeholders has been engaged during the project activity, representing employers, recruiters and recent graduates in the food industry. The breadth of the group aimed to cover representation from different sectors in manufacturing, retail, research and development, academic and technical services.

Developing Consistent Terms; 'A Common Language'

The importance of consistency of word use in the project was identified. Stakeholders supported a qualitative process of developing a 'common language'. The process included semi-structured interviews, thematic analysis and on on-line focus group.

The *Competencies for Food Graduate Careers* comprises of a list of 48 elements. They provide a tailored, consistent and relevant set of behaviours, knowledge and skills or 'elements' that may be desirable in a food sciences graduate. The tool informs all future stages of the project and aims to support students in gaining clarity in what elements they may need to develop in themselves or articulate in interviews for a particular role.



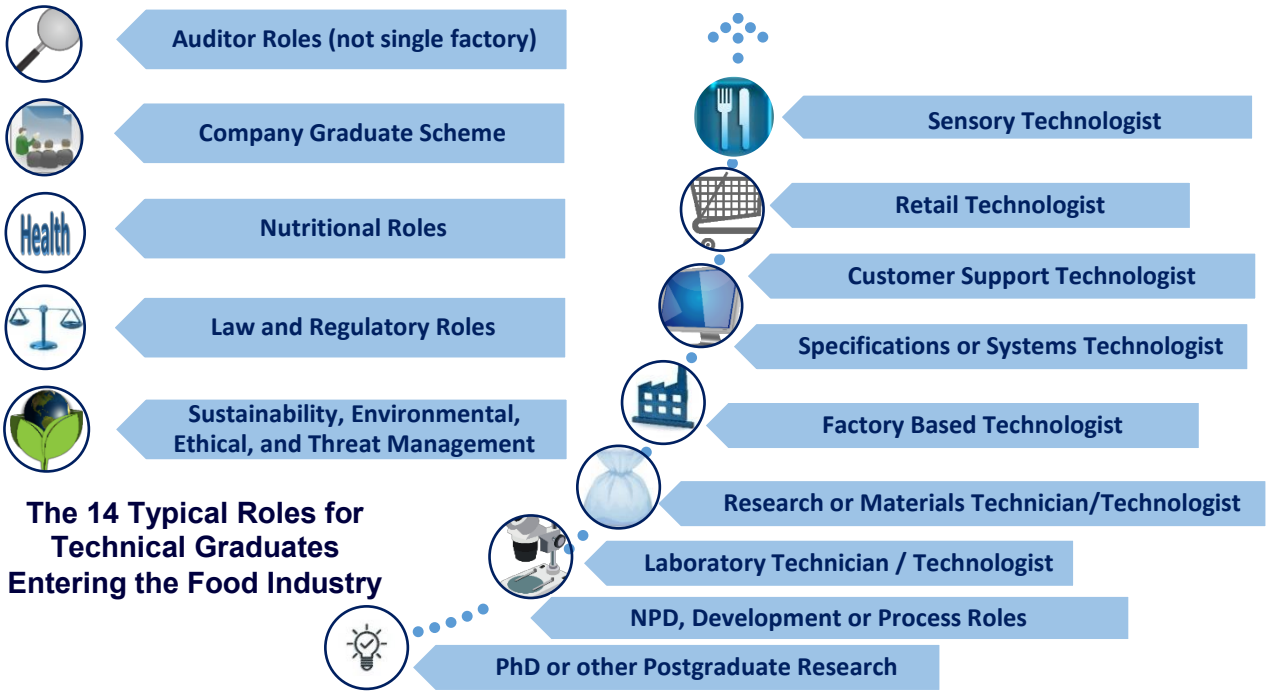
References [both accessed Sept 2017]:
FDF, 2017 *https://www.fdf.org.uk/statsataglance.aspx*
IFST, 2017 *https://www.ifst.org/accreditation-accreditation-degree-courses/ifst-accredited-programmescourses*

Establishing the Graduate Roles

The list of typical initial destinations for Food Sciences graduates was established.
A review was undertaken encompassing:

- Current job market and advertisements
- Websites providing food industry careers advice
- Employment data of recent University of Nottingham Food Sciences alumni

A list of **14 role types** and associated definitions were then reviewed and ratified by the industry stakeholder group. They are illustrated below:



The 14 Typical Roles for Technical Graduates Entering the Food Industry

Surveying the Wider Industry

An online survey was issued in early 2017. Recruiters, employers and recent graduates were asked to rate each of the 48 elements in the *Competencies for Food Graduate Careers* for desirability in a specific graduate role of their choice using an adaptation of a 5 point Likert scale.

226 responses were gathered across the 14 roles from participants in the food and drink industry across the UK and Republic of Ireland. The amount of data gathered varied between the roles (data sets of 3 to 55) and in general appears to mirror the prevalence of the number roles usually on offer in the UK. The roles with lower sample sets are highlighted where required, mindful that the data has limitations for robust statistical analysis, but have been included. It was important to ensure full representation of the job market.

Data was analysed with two approaches:

- Multivariate analysis of the survey data to explore themes
- Analysing the descriptive data for more detailed conclusions

Looking at the detailed descriptive data for each individual role, a number of key elements can be extracted, as either rated essential or highly desirable or being more desired than average data from the survey.

In addition it could be found that eight 'themes' were generated, indicative of general proficiency groups valued in a technical graduate for the food industry. The diagram adjacent outlines these themes and their agreed characterisation.

The each theme contains up to 12 of the 48 elements established. Some elements can be found within 2 themes but in each case with a logical argument (for example, verbal communication can be found in D3 and D5).

	Theme	What the Theme Encompasses
D1	**Positivity**	Having the behaviours that drive success and wellbeing in the workplace
D2	**Appreciation of the Wider World**	Engaging and embracing values, processes and ways of working in the industry with a diverse perspective.
D3	**Data, Numbers & Communications**	The ability to embrace information of all types, then use it and disseminate to best advantage.
D4	**Getting the Job Done & Tackling Problems**	Identifying and overcoming challenges to find solutions and reach your goals.
D5	**Working Well with Others**	Using a variety of styles for effectiveness and synergy in your relationships and activities with others.
D6	**Innovation & Inquiry**	Creativity in mind, approach and method to find new opportunities and enable results.
D7	**Dependability**	Harnessing your experiences and skills to establish trust in your ability to deliver.
D8	**The Business World**	Appreciation of systems and drivers that produce successful operational performance and profit.

8 Themes of Desirable Competencies Generated from Survey Material

We can compare the *relative* importance of each theme between the 14 roles included in the study. Below illustrates for each role the relative importance or desirability indicated for each theme (the darker the blue shading, the higher the relative importance). It can be suggested some roles require high levels of specific themes and some much less so; other roles require a more balanced skills set.

Auditor (not based in a single factory)	Company Graduate Scheme	Customer Support Technologist	Factory Based Technologist	Laboratory Technician/Technologist	Law and Regulatory New Graduate Role	NPD, Development or Process Role	Nutritional Graduate Role	PhD or other Postgraduate Research Role	Research or Materials Technician/Technologist	Retail Technologist	Sensory Technologist Graduate Role	Specifications or Quality Systems Technologist	Sustain, Env, Ethical or Threat Management Roles
D4	D2	D8	D4	D7	D7	D6	D5	D3	D3	D2	D5	D3	D2
D5	D1	D5	D7	D1	D1	D8	D3	D6	D6	D4	D8	D7	D3
D1	D6	D3	D5	D2	D3	D5	D7	D4	D5	D8	D3	D2	D5
D7	D5	D1	D8	D5	D2	D7	D2	D1	D8	D1	D4	D1	D1
D3	D8	D4	D1	D8	D5	D2	D6	D2	D7	D6	D2	D5	D6
D8	D4	D7	D2	D3	D4	D1	D8	D7	D4	D7	D7	D8	D4
D2	D7	D2	D3	D6	D6	D3	D1	D8	D1	D5	D1	D4	D8
D6	D3	D6	D6	D4	D8	D4	D4	D5	D2	D3	D6	D6	D7

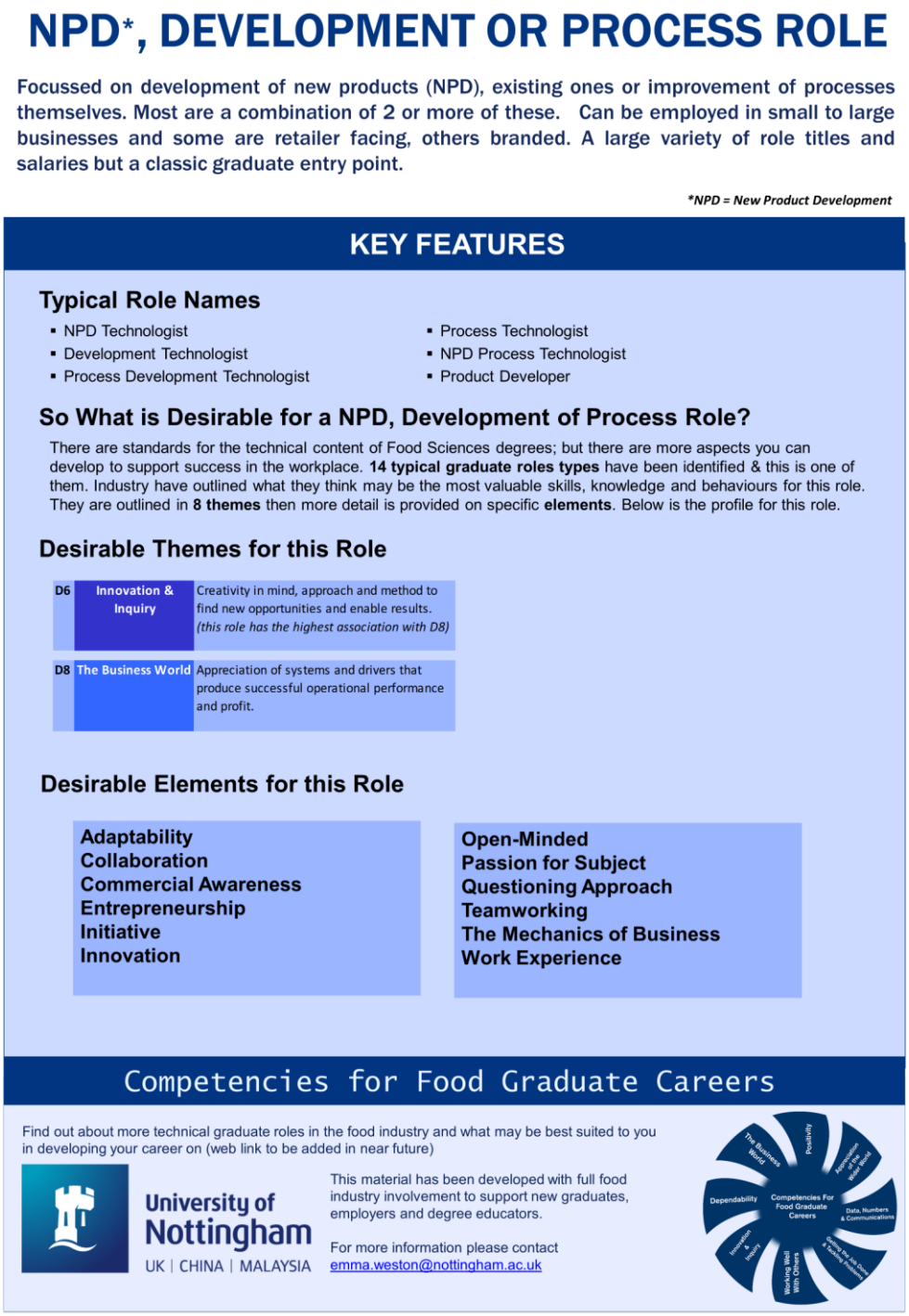
Relative Importance of Each Theme for Each Graduate Role

(grey shaded roles have sample sizes of <10)

Producing Useful Material

Next the level of importance of each of the 48 individual elements for a particular role was also established. Lists of the most desirable elements were then compiled for each of the 14 roles.

Using all the results gathered in the study to date a profile for each role can be drawn aiming to demonstrate the key differences between each typical point of graduate entry in to the Food Industry. An example of such as profile can be seen here using the NPD (New Product Development), Development role.



NPD*, DEVELOPMENT OR PROCESS ROLE

Focussed on development of new products (NPD), existing ones or improvement of processes themselves. Most are a combination of 2 or more of these. Can be employed in small to large businesses and some are retailer facing, others branded. A large variety of role titles and salaries but a classic graduate entry point.

**NPD = New Product Development*

KEY FEATURES

Typical Role Names

- NPD Technologist
- Development Technologist
- Process Development Technologist
- Process Technologist
- NPD Process Technologist
- Product Developer

So What is Desirable for a NPD, Development of Process Role?

There are standards for the technical content of Food Sciences degrees; but there are more aspects you can develop to support success in the workplace. **14 typical graduate roles types** have been identified & this is one of them. Industry have outlined what they think may be the most valuable skills, knowledge and behaviours for this role. They are outlined in **8 themes** then more detail is provided on specific **elements**. Below is the profile for this role.

Desirable Themes for this Role

D6	Innovation & Inquiry	Creativity in mind, approach and method to find new opportunities and enable results. *(this role has the highest association with D8)*
D8	The Business World	Appreciation of systems and drivers that produce successful operational performance and profit.

Desirable Elements for this Role

Adaptability
Collaboration
Commercial Awareness
Entrepreneurship
Initiative
Innovation
Open-Minded
Passion for Subject
Questioning Approach
Teamworking
The Mechanics of Business
Work Experience

Competencies for Food Graduate Careers

Find out about more technical graduate roles in the food industry and what may be best suited to you in developing your career on (web link to be added in near future)

University of Nottingham
UK | CHINA | MALAYSIA

This material has been developed with full food industry involvement to support new graduates, employers and degree educators.

For more information please contact
emma.weston@nottingham.ac.uk

Possibilities for Students and Industry

The Student:

The *Competencies for Food Graduate Careers* will be openly accessible as an online tool. A student shall be able to review the profile for a particular role, compare roles or choose which elements they feel they possess or exhibit successfully and find out which roles may be ideal for them.





In finding out more about a particular graduate job, the tool is hoped to be of real use to undergraduates when building personalised career plans and choices reflecting on their own strengths and interests. It should also help them prepare for success in graduate selection processes.

The Employer or Recruiter:

There could be significant value in *Competencies for Food Graduate Careers* for employers in refining their selection and recruitment processes, namely:

- writing clear job specifications
- building role profiles
- developing targeted criteria for all stages of interviews and selection.





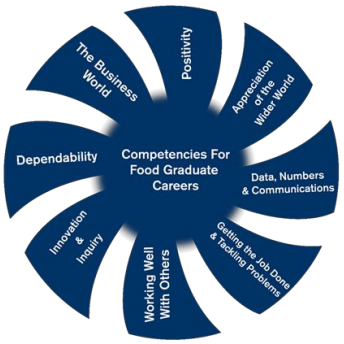
The Educator:

Finally the *Competencies for Food Graduate Careers* can also inform and direct educationalists and degree providers into providing a targeted content within their food science based degree courses to match the needs of the UK food industry.

Future:

All detailed material will be made available in the near future (2018) on the University of Nottingham website alongside the interactive online tool.

To obtain a copy of the *Competencies for Food Graduate Careers,* for more information about graduate roles or any other queries please contact Emma Weston - Project Leader, emma.weston@nottingham.ac.uk



Food Sciences Degrees Alumni 2017 Course Skills Review - Spring

This appendix includes only key pages of a total of 47 in the pdf

Welcome



This short University of Nottingham survey is for graduates of BSc Food Sciences or BSc Nutrition & Food Sciences in 2017 (including those moving to the new MSci year).

Completion of this survey is a valuable part of current research and will have an impact on future students. Thank you in advance for taking the time to complete it.

Survey Focus

We will ask you to review a list of competencies and confirm their level of inclusion in your degree studies.

When answering the questions please consider the education you received whilst studying BSc Food Sciences or BSc Nutrition & Food Sciences with us at Nottingham. Please do not include your experience on an industrial placement/extra year or other development opportunities you have had outside of degree studies.

Basic Information:

- The survey is completely anonymous (unless you choose to enter your name and even then your identity will not be shared or published)
- Likely to take approximately **15 minutes** to complete
- Please follow the instructions in each section and ensure you finish the survey completely to ensure the data is captured correctly.

We appreciate this takes time out of your busy day but we hope the results will be really valuable for us in developing our degrees for future students.

Do contact me if you have any questions, thank you

Emma Weston
Assistant Professor, Division of Food Sciences, The University of Nottingham
Contact details *emma.weston@nottingham.ac.uk , 0115 951 6214,* or School of Biosciences, Division of Food Sciences, Sutton Bonington Campus, Loughborough, LE12 5RD
Alternative contact sbztjf@nottingham.ac.uk. *School of Biosciences Associated with School of Sociology and Social Policy* Approval Code: SSP 01 - SB1516/06.

Survey Information and Confirmation to Proceed

In order to begin the survey can you please read the survey information by and clicking on **'More info'** below.

Please then click ‘Yes’ to confirm you understand and agree with the process of the study.

What if I have further Questions at this stage?
Please do not hesitate to contact the primary researcher (Emma Weston)
emma.weston@nottingham.ac.uk

Agreement:
I understand the purpose, scope of the survey and the planned use of the data gathered and am happy to participate in the project ✱ *Required*

More info

- Yes
- No

Rating the Course

What to Expect
You will see a number of competency 'zones' presented in alphabetically over *14 pages.* Each zone has a number of elements outlined in it with definitions provided for you to help you understand the term.

The survey asks you simply to review each element and consider it's inclusion in the degree course you studied.

Then there are a final few short questions about your employment since graduation.

A couple of things...can you please read this before starting:

1. The focus of this sruvey is whether each of the elements were included in your degree course, not how important each of the elements of the framework are.

2. When answering the questions please try to consider only the education you received whilst studying BSc Food Sciences or BSc Nutrition & Food Sciences with us at Nottingham. So **do not** include:

- your experience on an industrial placement year or abroad
- extra activities you were engaged with whilst studying e.g. NAA

This might seem a but tough but think about the modular and course teaching, thanks! *Do complete this survey even if you are moving to the newMSci course as you have completed the 3 year degree part completely.*

3. You will be asked to reflect on the level of its inclusion in your degree programme. Examples of ‘inclusion’ could be:

- The content or delivery of the modules / course.
- The types of assessment you were given.
- A general opportunity to develop your competency in an element during the course in activities or other experiences within your degree studies.

4. Please use the free text boxes to enter any additional comments or examples you may have after each section e.g. what modules provided a certain skill..

5. You will be given guidance on how to complete the scale for the assessments on each page.

Course Studied

You are graduating with a BSc in 2017. Can you confirm if:

- This is the completion of your degree
- You are taking the additional year for an MSci degree.

Which course did you study?

- Food Science
- Food Science (with placement year)
- Food Science (with certificate in European studies)
- Nutrition & Food Science
- Nutrition & Food Science (with placement year)
- Nutrition & Food Science (with certificate in European studies)

Behaviours Zone (part 1) - page 1 of 14

This first section starts to look at the **Behaviours** zone which centres on the types of qualities that are more personal but can still be developed. Can you please consider if there was opportunity for you to develop these elements in your degree studies using the scale provided:

Explanation for using the scale in each section (use 'More info' tab in all subsequent pages)**:**

- **Excellent:** there was a high level of opportunity to develop this element in my course.
- **Good:** there was a significant opportunity to develop this element in my course.
- **Minimal:** there was a low opportunity to develop this element in my course
- **None:** My course did not include any development opportunities in this element at all.
- **Don't Know:** I am not sure how to answer this specific question or do not understand the element described.

Acceptance of Abiguity: Appreciation that there may be different ways of achieving a result or more than one positive outcome. ✱ *Required*

- ○ Excellent
- ○ Good
- ○ Minimal
- ○ None
- ○ Don't Know

Adaptability: A constructive approach to handling change. ✱ *Required*

- ○ Excellent
- ○ Good
- ○ Minimal

- None
- Don't Know

Confidence: Having the self-assurance to process information and situations and then undertake the required actions. ✱ *Required*

- Excellent
- Good
- Minimal
- None
- Don't Know

Emotional Intelligence: Understanding yourself, others and the situation then adapting how you work for best results. ✱ *Required*

- Excellent
- Good
- Minimal
- None
- Don't Know

Initiative: Taking active steps when you see it's needed, without prompting. ✱ *Required*

- Excellent
- Good
- Minimal
- None

- Don't Know

Do you have any examples of where any of these elements may have been included in your course/modules?

Do you have any other comments about these elements; for example if you chose 'Don't Know' at any point above?

The survey continues including the other elements of CFGC.
Then demographic questions follow, and the survey ends.

Appendix XIV - Example of data collated to review an imbalanced element

v2 3rd May 2018

Working Under Pressure	D7 - Dependability
Definition	**Establishing your personal approach to balancing demands and challenges in working life**

Summary below: HIGH frequency of desirability in graduate roles by employers. However student perception is s 'MEDIUM' inclusion and inclusion in course is 'LOW'.

With 3.0 scoring, To move to medium inclusion needs to be over 10% nominal inclusion, about 6.3/6.6, (high is >30%, 18.9/19.8)

Assessed Inclusion in Course Curriculum (FS/N&FS) <10% of total nominal inclusion **LOW**	6.4/6.2
Count - number of times element included in course in some form	10 / 10
5 times included as desirable in 14 roles Score given of 4.0	5 HIGH
Student Perception of Inclusion: High, Medium or Low >70% chose 1+2, 'medium inclusion'	1 MEDIUM

Food Science/Nutrition & Food Science Core Modules Detail

Module	Inclusion Score	Where
D21BF1 - Food Materials and Ingredients	0.2	I (L)
D223F0 - Manufacture of Food	0.2	I (L)
D224F0 - Food Products Case Studies	2.2	T, L, I (AS)
D224FB - Food Safety and Legislation	0.2	I (L, AS)
D235F8 - Personal and Professional Development for FS	1	L
D23BF2 - Food Factory Operations	1.2	L, I(AS)
D23PRO - Research Project	0.2	I (L)

Employers Detail

Matrix of Highly Desirable or Essential Elements for Each Role														low sample size
(Where the element is distinctly is most highly desired it is shaded in purple)														
	Auditor (not based in a single factory)	Company Graduate Scheme	Customer Support Technologist	Factory Based Technologist	Laboratory Technician or Technologist	Law and Regulatory New Graduate Role	NPD, Development or Process Role	Nutritional Graduate Role	PhD or other Postgraduate Research Role	Research or Materials Technician/Technologist	Retail Technologist	Sensory Technologist Graduate Role	Specifications or Quality Systems Technologist	Sustain, Environmental, Ethical or Threat Management Roles
Working Under Pressure														

Typical Quotes

".And we have to teach them how to deal with the stress in their everyday lives and how to manage it so that it doesn't affect them."
"So if something isn't possible, isn't feasible, or they're struggling with how they would do that, they need to be able to discuss that with somebody."
"...effectively the food industry is a very, very pressurised environment, its twenty four seven, its three hundred and sixty four or five days, depending on which industry you're working in ."
"It's recognising when you've just got to ramp up the pace, but managing that quality at the same time."
"What you understand, you control. What you don't understand, controls you."

Alumni Detail *(mean (not used) 1.5). strong inclusion was choice '1', weakest mark 2.8*

Competencies (proportion chose the options below)- MEDIUM	Working Under Pressure
1+2	0.861
1	0.444

Open Comments from Alumni
Overall Comments (7 Alumni Comments)

D224F0 - FPCS and D23BF2 - FFO (NPD)

(i) Working under pressure; NPD and food product case studies particularly developed this skill

Final Year

(i) Final year was a good test for working under pressure

General course/study

(i) Again working under pressure with many deadlines/exams at once - university is, by nature, a stressful environment and encourages you to thrive under pressure

(ii) I think a good amount of pressure is applied throughout the course. There is a nice balance between coursework and exams and placement helped me to understand 'real world' pressures.
(iii) Having short deadlines (restricted in the time you can spend on something) was uncomfortable and therefore helped develop this a lot.
(iv) All of the modules
(v) Generally throughout the course no specific examples but the targets are hit in full force for preparing "oven-ready students"

Opportunities

Review of currently included modules

D21BF1 - Food Materials and Ingredients 0.2 - L - INFORMAL **BOTH**
L - Some pressure to complete practical work within timetabled slots. INFORMAL
Propose no change

D223F0 - Manufacture of Food 0.2 - L - INFORMAL **BOTH**
L - Yes, there is lots of complete and a mix of it INFORMAL
Propose no change

D224F0 - Food Products Case Studies 2.5 – T, L, – FORMAL, AS – INFORMAL **BOTH**
T - lectures outline the importance of working well under pressure. L - given tight timeframes for group delivery of items in weekly structures (end of day, ind report, gp pres). Viva is also a pressured environment and good development/practice for this (LO5 - "Interact positively with team members in a time limited environment") A - INFORMAL 15 min max for group report, over time - stopped
Propose no change unless weighting for green

D224FB - Food Safety and Legislation 0.2 – L, AS- INFORMAL **BOTH**
NEW L - limited work for the day preparing for & presenting the formulation task (group) INFORMAL. A - INFORMAL **NEW** assessment/summative/group Product formulation exercise will be assessed (50%of module mark). Presentation will be pressured for some students on the second day
Action: Agreed L (and AS perhaps) should be formalised & included in module spec, docs for poster group work
Opportunity 0.2 move to 1.2 or 2.0 +1.0 or 1.8

D235F8 - Personal and Professional Development for FS 1.0 - L - FORMAL **BOTH**
L - Some find the careers launchpad, group assessment centre trial or mock interview pressured. TBC Presentation Karaoke - see if works/used in future after 2017/8. On reflection was a challenge.
Action: Student views - Jan 2018?
Propose no change

D23BF2 - Food Factory Operations 1.2 – L– FORMAL, AS – INFORMAL **BOTH**
L - Traditionally time pressured in prep for the NPD showcase and timetable structured that way FORMAL. Some may find showcase itself pressured personally. A - INFORMAL - Summative NPD (50%) Some may find the presenting for the assessed NPD showcase pressured and may

impact on marks.

Action: Consider formalising planning and organising in the portfolio or showcase but how do you quantify this?

Opportunity UNLIKELY 0.2 move to 1.0 +0.8

D23PRO - Research Project (40) L - INFORMAL (0.2) **BOTH**

L - INFORMAL but likely there will be points of working under pressure during actual activity/writing up

Action: Perhaps formalise L and make green?

Opportunity 0.2 move to 1.0 Plus green +0.8

Needs to increase by 2.2 each for Medium

Likely and increase of 1.8 so getting close

May be able to take Working under Pressure into High inclusion with current modules

Make the green areas stronger perhaps and overall course pressure as per alumni comms?

Review of Typical Optional Modules

Module	Inclusion Score	Where
N13214 - Exploring Perspectives in Entrepreneurship	1	L
N11119 Introduction to Finance	??	??
D236F6 - Microbial Fermentation	0.2	I (L)
D23XXX - Ecotrophelia	1	L

N13214 - Exploring Perspectives in Entrepreneurship L & AS – FORMAL **open to BOTH**

L - FORMAL included in LO's for tranferable skills. Only inclusion is the prep for the tutorials 1 and 2 so quite weak *Propose no change*

N11119 Introduction to Finance

Action: get this mapped formally

D23XXX – Ecotrophelia (External) **open to BOTH**

L – A selection of deadlines to meet and need to do this within final semester of degree course

Propose no change

Extra Inclusions and Thoughts (variable means not core to BSc courses)

1. Formalise some existing L's in modules and take a bit further?
2. Make the green stronger areas heavier weighting?
3. Can the degree overall provide some contribution, see alumni comments?
4. Shall we market the final year project as a comparatively significant opportunity to develop and this increase RP weighting (and not mfr of foods)?
5. Can the experience in the industrial placement be quantified? *Variable*

6. Encourage applicants for Ecotrophelia if someone wants to develop this element as extra in final year? *Variable*

7. Will the MSci give more opportunity for development, if so, how? *Variable*

8. Can experiences outside of course (or within) can add to this (examples gathered thus far) *Variable*

- Handling stressful meeting situations with a calm and confident manner.
- Standing your ground with operations or dispatch colleagues when stock is on hold and cannot leave the site when the order is urgent.
- During a food safety issue balancing the work required for the investigation processes with regular communications to managers and customers
- Managing not to pass on stress to those around you.
- Being able to continue with day to day tasks whilst waiting for a vital piece of personal information or communication.
- Gaining understanding of how you react to pressure and knowing the best way to manage situations for best effect.
- Being able to copy with pressure over a period or days or weeks and re-energise and re-focus yourself as required.
- Meeting an incredibly challenging deadline and coping with the stress and judging the optimum quality of output in the time you have.

<u>Other Thoughts</u>

- Are we assuming pressure is normal for all modules and not mapping as such, a bit like 'lecture' and exams' with listening and written comms
- Students are nearly scoring at High so it is perhaps about formalising and taking the whole course experience on board and coursework deadlines meeting etc..

<u>Teaching ideas</u>

Sainsbury boss Mike Coupe (you tube) about focussing on what you can influence, not what you can't

http://www.bbc.co.uk/news/av/business-38497797/what-used-to-stress-sainsbury-s-boss

Appendix: Summary from Original Language Development in 2016

Working Under Pressure	D7 - Dependability
Definition	**Establishing your personal approach to balancing demands and challenges in working life**
Some examples of this element	• Handling stressful meeting situations with a calm and confident manner. • Standing your ground with operations or dispatch colleagues when stock is on hold and cannot leave the site when the order is urgent. • During a food safety issue balancing the work required for the investigation processes with regular communications to managers and customers • Managing not to pass on stress to those around you. • Being able to continue with day to day tasks whilst waiting for a vital piece of personal information or communication. • Gaining understanding of how you react to pressure and knowing the best way to manage situations for best effect. • Being able to copy with pressure over a period or days or weeks and re-energise and re-focus yourself as required. • Meeting an incredibly challenging deadline and coping with the stress and judging the optimum quality of output in the time you have.
Relevant quotations	".And we have to teach them how to deal with the stress in their everyday lives and how to manage it so that it doesn't affect them." "So if something isn't possible, isn't feasible, or they're struggling with how they would do that, they need to be able to discuss that with somebody." "...effectively the food industry is a very, very pressurised environment, its twenty four seven, its three hundred and sixty four or five days, depending on which industry you're working in." "It's recognising when you've just got to ramp up the pace, but managing that quality at the same time." "What you understand, you control. What you don't understand, controls you."

Appendix XV – Suggested actions following curriculum mapping.

Examples of minor amendments to core modules and documentation

Module Details	Examples of elements for adjustment
D211F4 - Food Commodities and Primary Processing	*positive attitude, verbal communication*
D21BF1 - Food Materials and Ingredients	*teamworking, planning & organising*
D223NA - Nutrition, Regulation and Endocrinology	*questioning approach*
D224F0 - Food Products Case Studies	*negotiation & influencing, open-minded*
D224FA - Microbial Mechanisms of Foodbourne Disease	*reliability, teamworking*
D224FB - Food Safety and Legislation	*working under pressure, cultural sensitivity*
D235F8 - Personal & Professional Development for F. S.	*self-motivation, resilience*
D235F1 - Microbial Methods and Isolation	*reliability, teamworking*
D235F9 - Food Flavour and Physiology of Perception	*teamworking*
D23BF2 - Food Factory Operations	*negotiation & influencing, resilience*
D23PRO - Research Project	*working under pressure, open-minded*

Examples of longer term suggestions for module refinements

Inclusions in year 1 and year 2 outside of specific modules	*resilience, cultural sensitivity*
D211F4 - Food Commodities and Primary Processing	*teamworking*
D224FB - Food Safety and Legislation	*positive attitude, cultural sensitivity*
D224F0 - Food Products Case Studies	*leadership*
D23BF2 - Food Factory Operations	*leadership*
D23PRO - Research Project	*planning and organising*

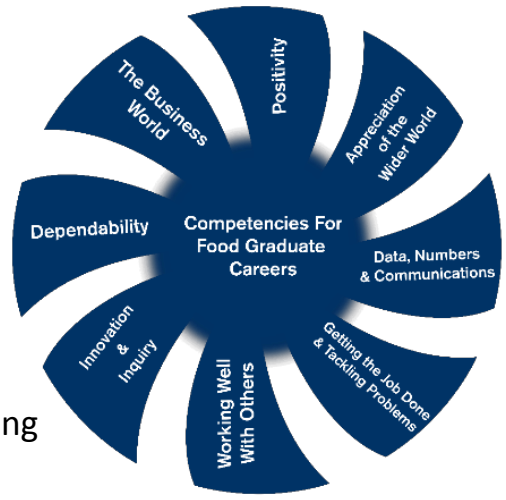
Examples make opportunities more explicit in nature to students

D212A2 - Contemporary Agricultural Systems	*commercial awareness*
D23BF2 - Food Factory Operations	*commercial awareness*
D23BF2 - Food Factory Operations	*entrepreneurship*
A number of modules, course overall	*verbal communication*
A number of modules, course overall	*handling data*
A number of modules, course overall	*written communication*

Signpost Students to optional modules or wider experiences

commercial awareness
leadership
negotiation and influencing
self-motivated
the mechanics of business

University of Nottingham
UK | CHINA | MALAYSIA



Competencies for Food Graduate Careers

Information on Themes & Roles for Our Student Teaching

Autumn 2017

Associated Documentation to support this:

- UoN/IFST White Paper outlining the project and displaying the 14 typical graduate roles (https://www.ifst.org/knowledge-centre-other-knowledge/competencies-food-graduate-careers)
- List of Elements, their Definitions and which are **Desirable** in these 14 Typical Roles
- Infographic Posters for each of 14 typical graduate roles

8 Themes of Desirable Competencies Generated from Survey Material

	Theme	What the Theme Encompasses
D1	**Positivity**	Having the behaviours that drive success and wellbeing in the workplace
D2	**Appreciation of the Wider World**	Engaging and embracing values, processes and ways of working in the industry with a diverse perspective.
D3	**Data, Numbers & Communications**	The ability to embrace information of all types, then use it and disseminate to best advantage.
D4	**Getting the Job Done & Tackling Problems**	Identifying and overcoming challenges to find solutions and reach your goals.
D5	**Working Well with Others**	Using a variety of styles for effectiveness and synergy in your relationships and activities with others.
D6	**Innovation & Inquiry**	Creativity in mind, approach and method to find new opportunities and enable results.
D7	**Dependability**	Harnessing your experiences and skills to establish trust in your ability to deliver.
D8	**The Business World**	Appreciation of systems and drivers that produce successful operational performance and profit.

What are in Each of the 8 Themes?

D1

Positivity

Adaptability
Confidence
Initiative
Personal Responsibility
Positive Attitude
Resilience
Self-Motivated

D2

Appreciation of the Wider World

Cultural Sensitivity
Entrepreneurship
Environment & Sustainability
Global Supply Chain
Multicultural Workplace
The Mechanics of Business
Values and Credibility

D3

Data, Numbers and Communications

Academic Expertise
Application of IT
Digital Capability
English Proficiency
Handling Data
Specific Technical Aspects
Verbal Communication
Written Communication

D4

Getting the Job Done and Tackling Problems

Acceptance of Ambiguity
Critical Thinking
Decision Making
Independence
Leadership
Negotiation & Influencing
Planning & Organising
Resourcefulness

D5

Working Well with Others

Collaboration
Cultural Sensitivity
Emotional Intelligence
English Proficiency
Leadership
Listening
Negotiation & Influencing
Networking & Relationship Building
Personable
Self-Awareness
Teamworking
Verbal Communication

D6

Innovation and Inquiry

Academic Expertise
Collaboration
Entrepreneurship
Innovation
Open-Minded
Passion for Subject
Questioning Approach
Self-Development

D7

Dependability

Personal Responsibility
Planning & Organising
Professionalism
Reliability
Thoroughness & Attention to Detail
Work Experience
Working Under Pressure

D8

The Business World

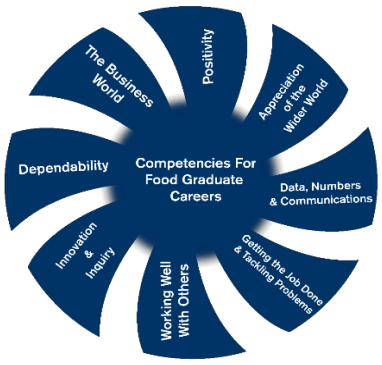
Commercial Awareness
Global Supply Chain
The Mechanics of Business

NB: some elements sit under 2 themes

Relative Importance of Each Theme for Each Graduate Role

(grey shaded roles have sample sizes of <10)

Auditor (not based in a single factory)	Company Graduate Scheme	Customer Support Technologist	Factory Based Technologist	Laboratory Technician/Technologist	Law and Regulatory New Graduate Role	NPD, Development or Process Role	Nutritional Graduate Role	PhD or other Postgraduate Research Role	Research or Materials Technician/Technologist	Retail Technologist	Sensory Technologist Graduate Role	Specifications or Quality Systems Technologist	Sustain, Env, Ethical or Threat Management Roles
D4	D2	D8	D4	D7	D7	D6	D5	D3	D3	D2	D5	D3	D2
D5	D1	D5	D7	D1	D1	D8	D3	D6	D6	D4	D8	D7	D3
D1	D6	D3	D5	D2	D3	D5	D7	D4	D5	D8	D3	D2	D5
D7	D5	D1	D8	D5	D2	D7	D2	D1	D8	D1	D4	D1	D1
D3	D8	D4	D1	D8	D5	D2	D6	D2	D7	D6	D2	D5	D6
D8	D4	D7	D2	D3	D4	D1	D8	D7	D4	D7	D7	D8	D4
D2	D7	D2	D3	D6	D6	D3	D1	D8	D1	D5	D1	D4	D8
D6	D3	D6	D6	D4	D8	D4	D4	D5	D2	D3	D6	D6	D7



Oct-17

Competencies for Food Graduate Careers

Alphabetical list of **Elements** and their associated definitions

Academic Expertise Evidence of the required level of academic ability whether by degree calibre, further study or specific competencies such as research, evaluation, speaking or writing.
Acceptance of Ambiguity Appreciation that there may be different ways of achieving a result or more than one positive outcome.
Adaptability A constructive approach to handling change.
Application of IT The ability to work confidently with spreadsheets and other computer packages and have additional skills with other software, databases or systems as the role requires.
Collaboration Working with others for mutual benefit.
Commercial Awareness The required skills to develop a competitive business in terms of supply chain efficiency, market performance, product development & costings.
Confidence Having the self-assurance to process information and situations and then undertake the required actions.
Critical Thinking Objectively analysing the facts and situations of an issue to form an evaluated judgement.

Cultural Sensitivity Appreciation of different cultures and practices that impact on ways of working and customer needs such as religious and dietary requirements.
Decision Making Making a considered response to an issue. Taking direct action or escalating as appropriate to gain traction on the matter.
Digital Capability The ability to work effectively and communicate using all available technology for maximum impact.
Emotional Intelligence Understanding yourself, others and the situation then adapting how you work for best results.
English Proficiency Possessing the required level of English understanding to give effective communication of all types.
Entrepreneurship To see an opportunity and exploit it for beneficial effect.
Environment and Sustainability Feeding the world, looking after the planet.
Global Supply Chain Appreciation of how to operate a successful food business across nations, commercially, in light of current issues and most importantly ensuring robust transparency.
Handling Data The ability to understand, manipulate and present data with confidence (this may include handling large and complex data sets).
Independence Capacity for self-directed operation.

Initiative Taking active steps when you see it's needed, without prompting.
Innovation Generating an idea or item that's better or original.
Leadership The ability to gain the respect, trust and confidence of others,Â which realises the best in people to deliver success in the workplace.
Listening Providing the correct environment to allow for engaging discourse and ensuring the required comprehension has been gained.
Multicultural Workplace Ability to embrace and maximise the benefits of working with colleagues and associates from all over the world.
Negotiation and Influencing Getting the best outcomes for all parties by being persuasive in your approach when working towards an objective.
Networking and Relationship Building Positive approach to establishing suitable internal and external contacts and then nurturing these links to allow for optimum working connections.
Open-Minded Willing to consider new ideas or the points of view of others.
Passion for Subject Finding the Food Industry fascinating.
Personable Social qualities that are likeable to others in a variety of contexts.
Personal Responsibility Being fully aware of what you are accountable for and owning all outcomes, good or bad.

Planning and Organising Remaining in control of activities under your responsibility and completing tasks to agreed deadlines.
Positive Attitude Proactive and constructive in communications and tasks.
Professionalism Having personal presentation and behaviours appropriate for your business.
Questioning Approach Taking genuine interest in finding out the answer or challenging the status quo.
Reliability Trustworthy, consistent in meeting objectives and never letting you down.
Resilience Responding positively to adverse situations and persevering.
Resourcefulness Finding a way to achieve your goals and overcome problems.
Self-Awareness Understanding what you can do well and how you may be perceived by others and then developing your contributions and behaviours positively.
Self-Development Owning your own future development in your current role and beyond.
Self-Motivated Delivering energy and just getting on with it!

Specific Technical Aspects Demonstration of experience or knowledge in your field or a particular scientific area the employer deems essential or desirable to fulfil the role.
Teamworking Valuing the contributions of others and being committed to getting the best out of working together towards a common goal.
The Mechanics of Business Appreciation of generic commercial aspects of handling money such as types of costs, profits, reports & risk.
Thoroughness and Attention to Detail Meticulous, careful and accurate.
Values and Credibility Understanding and respect for ethical and social considerations pertinent to the larger food industry and your specific sector; this includes authenticity matters.
Verbal Communication Consciously choosing the content and style of your delivery to suit the target audience whatever the size and context. Checking your message has been understood.
Work Experience Proven record of relevant employment, to demonstrate understanding of workplace expectations (this may be stipulated as food industry based).
Working Under Pressure Establishing your personal approach to balancing demands and challenges in working life.
Written Communication Producing clear structured work in a precise way that can be clearly followed by the intended audience.

Matrix of Highly Desirable or Essential Elements for Each Role

(Where the element is distinctly the most highly desired it is shaded in purple)

	Auditor (not based in a single factory)	Company Graduate Scheme	Customer Support Technologist	Factory Based Technologist	Laboratory Technician or Technologist	Law and Regulatory New Graduate Role	NPD, Development or Process Role	Nutritional Graduate Role	PhD or other Postgraduate Research Role	Research or Materials Technician/Technologist	Retail Technologist	Sensory Technologist Graduate Role	Specifications or Quality Systems Technologist	Sustain, Environmental, Ethical or Threat Management Roles
Academic Expertise														
Acceptance of Ambiguity														
Adaptability														
Application of IT														
Collaboration														
Commercial Awareness														
Confidence														
Critical Thinking														
Cultural Sensitivity														
Decision Making														
Digital Capability														
Emotional Intelligence														
English Proficiency														
Entrepreneurship														
Environment and Sustainability														
Global Supply Chain														
Handling Data														
Independence														
Initiative														
Innovation														
Leadership														
Listening														
Multicultural Workplace														
Negotiation and Influencing														
Networking and Relationship Building														
Open-Minded														
Passion for Subject														
Personable														
Personal Responsibility														
Planning and Organising														
Positive Attitude														
Professionalism														
Questioning Approach														
Reliability														
Resilience														
Resourcefulness														
Self-Awareness														
Self-Development														
Self-Motivated														
Specific Technical Aspects														
Teamworking														
The Mechanics of Business														
Thoroughness and Attention to Detail														
Values and Credibility														
Verbal Communication														
Work Experience														
Working Under Pressure														
Written Communication														

low sample size

Information for Field Group Interview

P1. Agreed positive outcomes

Scoring positive for the questions/statements below (mode of '2' and or mean of <2) and associated supporting open comments

Like the content and found it useful for module tasks

Included Questions

- I am confident from explanation given of the research undertaken, that the CFGC reflects food industry requirements for graduate competency.
- The terms and language used in the material is understandable to me.
- Having 14 different roles outlined for graduates entering the food industry has been useful
- I found using one of the roles for starting build examples and evidence for specific competencies useful.
- I found using one of the roles as a basis for preparing for my mock interview helpful.

Layout/Presentation

"Easy to follow and understand what job roles are available in the industry."
"I liked how it can be accessed online so can access it outside of the University site."

Usefulness in Module

"Helped us work through CV and personal statement, also mock interview"
"It was very useful for mock interview."
"It was well integrated into the module"

Useful for the Future

Included Questions

- Overall the CFGC has been a useful inclusion to teaching with regard to supporting my future career planning and job applications.

"Having a list of elements that are required for a specific role is practical when preparing for a job application"
"Thought it was very helpful & will continue to help me in coming years, thank you ☺"
"It is important for us to know what competencies we need to be equipped with and prepare for the future career."
"Helped me to see which roles weren't right for me and where to focus on improving before applying to jobs. Helped me to tailor my CV for job applications."

P2. Questions Indicating Possible Areas of Refinement

Where anyone scored 5 'disagree' to the statement, any supporting open comments gathered. They were then grouped into themes below for ease of discussion

Included Questions

- I have found the information on what is desirable for each of the roles useful in considering what the most appropriate first graduate roles are for me.
- I found using one of the roles for developing a tailored CV during the autumn simple to do.

With regard to the detailed information on Moodle noting suggestions on provide examples for an 'element':

- I have found this useful for my future personal development plans.

Areas of aside from today's discussion but worth explaining

Online Tool
Comment – Comments were gathered and sent to the computer science student project group to support their work.

Broader Focus
"Maybe more 'general' jobs"
"Although some competencies are more important for some roles than others, I think all should be considered throughout."
"rather than picking one role, may be beneficial to consider others too."
Comment - It is hard to add any new more general roles for graduate as ……Which ones, We then need to survey each area etc..?
Action: Will ensure signposting to careers advice given within the session

International Context
One comment that useful for International role but also conversely:
"Can also include some roles which targeted for international students or like in a separate class for students who are interested finding jobs overseas."
Comment - Mix in the focus group is not really suitable for this discussion. Will be mindful and communicate to students what is relevant worldwide as pertinent in future

P3. Some focus for today's discussion based on comments made in questionnaire.

Initial Information or Roles Explanation

"Maybe have a short session each role to understand each better. Most of the sessions have been about generic graduate schemes."

"Create more discussion at the start about each of the roles so they're fully understood by everyone and [able] give them proper thought."

"More inclusion at the beginning of the module."

Definitions for the Elements

"Some of the desirability's could have further explanation e.g. cultural sensitivity."

"Would be good to understand what the competencies mean for each role. For examples retail technologists - questioning approach for auditing etc.."

Linking Roles to Real Job Specs

"Include an example of a real life job description for the particular role."

"It was an easier to develop CVs and interviews required as part of the module for a very well described job role. - not so easy with actual job specs."

"The industry speakers who are in can use this for describing about their companies."

Personal Tailoring

"Better analysis into what strengths/weakness one had, particularly with module inclusion."