The systemic implications of constructive alignment of higher education level learning outcomes and employer or professional body based competency frameworks

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Abstract
The past 50 years has seen the development of schemes in higher education, employment and professional work that either identify what people should know and/or what they should be able to do with what they have learned and experienced. Within higher education this is usually equated with the learning outcomes students are expected to achieve at the end of studying a course, module or qualification and increasingly the teaching, learning and assessment strategies of those courses, modules or qualifications are being designed to align with those learning outcomes. In employment, there has been the emergence of job and role specifications setting out the knowledge and skills required of incumbent and recruits alike. Where professional bodies confer (often statutorily recognised) status in employment sectors they also increasingly set out their expectations of members through competency frameworks. This paper explores the varied relationships between these three means of measuring knowledge and skills within people including the nature of the knowledge and skills being measured as well as the specificity of the knowledge and skills being measured, using the case study of environmental management in the UK. It then argues that there needs to be a more constructive alignment between these three forms of measurement, achieved through a dynamic conversation between all concerned, but also that such alignment needs both to recognise the importance of less tangible 'systems thinking' abilities alongside the more tangible 'technical' and 'managerial' abilities and that some abilities emerge from the trajectories of praxis and cannot readily be specified as an outcome in advance.

Keywords: higher education, higher education institutions, employers, professional bodies, knowledge, skills, competency frameworks, alignment.

1. Introduction

Higher Education has many purposes as seen from the perspective of governments, employers, students, professional bodies, taxpayers and higher education institutions (HEIs) themselves, but increasingly higher education is deemed by most stakeholders to have an important role in providing an educated workforce, and one that meets the specific needs of organisations and different sectors of the economy at local, regional, national and international levels. This trend is seen within Europe both with developments at the European level (e.g. Crosier et al, 2015; Davies, 2017) and with reports at the national state level (e.g. BIS, 2016). Within such documents, academic publications and surrounding policy discourses much is made of improving the employability of graduates, '*including measures supporting students' transitions from higher education into the labour market*' (Crosier et al, 2015), of '*tackling future skills mismatches and promoting excellence in skills development*' (European Commission, 2017), and of defining '*competences*' (Lester, 2014; Davies, 2017).

In response to some of these policy level developments, and through its own innovations, the higher education sector has supported the application of qualification frameworks and qualification specifications (including vocational qualifications) that set out the intended learning outcomes that students taking a qualification would expect to achieve[1]. These learning outcomes variously describe the knowledge and understanding expected of that named subject as well as a variety of subject related and key/core/transversal skills[2] These learning outcomes are themselves influenced by academic research and scholarship within a named subject and the wider application of that named subject within the work and activities of certain individuals and organisations for whom the subject is seen as relevant. Indeed, HEIs have often created work related or work based qualifications where appropriate and where there is a market need or statutory requirement.

In parallel, and also in response to trends in economies and policies, there has been an expansion in the number and range of professional bodies and/or competency frameworks as more professional job roles have arisen or existing job roles have acquired more 'professional' responsibilities and expectations on the part of governments, agencies, employers and the wider public (e.g. Johnson et al, 2013). Equally employers have also been more active in designing and specifying what they require for particular job roles (Oldham and Fried, 2016) or person specifications which are often expressed as both essential and desirable characteristics that in turn vary in the balance between what are seen as role specific characteristics and what are seen as wider employment related characteristics[3]. In some circumstances organisations have developed their own competency frameworks some of which are based upon or draw upon professional body competencies (Vincent, 2016).

Finally, some governments have also been explicit in developing policies, backed by funding incentives, to encourage employers and employer representative organisations to get involved in the defining of standards for vocational qualifications at all levels, but including higher education. This is seen most recently in the UK with the introduction of degree level apprenticeships[4] that are funded through an Apprenticeship Levy (a 0.5 per cent tax on the wage bill of employers whose salary costs are £3 million or more each year)[5]. Thus a group of employers determine the standards expected of the degree apprentice[6] and HEIs are expected to provide qualifications that meet those standards.

This very brief overview of the varying ways in which degree programmes, job roles and professional standards are specified and developed raises questions about whether and how these specifications should

[1] See http://www.qaa.ac.uk/assuring-standards-and-quality/the-quality-code for examples of this from the UK

[2] See https://ec.europa.eu/esco/portal/escopedia/Cross-sector_skills_and_competences and http://www.qaa.ac.uk/assuring-standards-and-quality/skills-for-employability for some brief details on these.

[3] For example these are the requirements of a person specification as noted at https://knowhownonprofit.org/how-to/how-to-write-a-job-description-and-person-specification:

- the technical, organisational, communicative, and creative skills and abilities you expect from an ideal candidate
- any specific qualifications or education required for the role
- the level of experience needed in either similar organisations or equivalent roles
- the kind of personality that would fit in with your team, and with your organisation's ethos
- character traits that are likely to help them to do the job effectively
- any preferred achievements, e.g. Volunteering.

[4] See https://www.ucas.com/ucas/undergraduate/getting-started/apprenticeships-uk/degree-apprenticeships

[5] See https://www.gov.uk/government/publications/apprenticeship-funding-from-may-2017 for more details

[6] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/448905/DEFENCE_Systems_Engineering_Master_Level.pdf for one example

be aligned to improve employability prospects of higher education students and whether these specifications should be narrower or broader in scope to reflect the dynamic nature of employment and job roles. To examine these questions further the paper next outlines the key aspects of systems thinking and then uses these to look in some depth at a UK based case study which exemplifies the complex nature of defining and specifying what is expected of one subject/profession: environmental management (EM). The paper then concludes by arguing for a more constructive alignment between these three forms of measurement, achieved through a dynamic conversation between all concerned, but also that such alignment needs both to recognise the importance of less tangible 'managing' abilities alongside the more tangible 'technical' abilities and that some abilities emerge from the trajectories of praxis and cannot readily be specified as an outcome in advance.

2. Systems thinking in practice and knowing

Complexity and uncertainty can be features of any human activity system but this is more so when considering many larger scale situations (Ison, 2010). The number of facts and factors involved, the number of people with different perspectives and disciplinary expertise, all grow larger and seemingly more intractable. To be able to represent a complex messy situation by showing most of the components and how they are thought to fit and work together is therefore very helpful when understanding, researching, designing and implementing systemic changes that draw upon and integrates the thinking from many disciplines.

Drawing on some basic features of systems thinking, there are three generic elements underpinning systems thinking in practice:

- understanding inter-relationships ('thinking' about the bigger picture)
- engaging with multiple perspectives (the 'practice' of joined-up thinking)
- reflecting on boundary judgements (the praxis of thinking in practice)

In identifying 'systems of interest' in any particular situation it is helpful to appreciate three broad areas in which 'systems' are generally understood and used by people, practitioners and academics alike:

- Natural systems – living organisms or wider biophysical entities like ecosystems or the solar system.
- Engineered (purposive) systems – mechanical equipment, computers, heating systems etc., and
- Human (purposeful) systems – organizations, higher education, employment policies, etc.

Across these three broad areas the first two are usually approached using more systematic and positivist scientific methods and methodologies as the systems are more often seen as ontological realities (this is a system for …) while the third area is more often treated through a systemic lens where the representation of the system of interest is used as an epistemological device and the systemic inquiry framed as constructivist (for the purpose of my inquiry I see this as a system for …) (Checkland, 1999; Blackmore, 2010).

The underlying philosophy of purposeful systems thinking is to be holistic, to look for wholes (a 'system of interest') at the highest appropriate level, rather than to reduce things to ever smaller components (Checkland, 1999; Reynolds and Holwell, 2010). This concept of defining a system of interest as a collection of entities that are seen by someone as interacting together to do something (Morris, 2009) is both simple to state and yet complex to enact because of differing philosophical and practical approaches to the concept of a system, that have arisen from, and give rise to, different trajectories of understanding and action. In this paper I particularly follow the traditions espoused by Russel and Ison (2017) who, among other things, note:

> *'All learning is experiential, and experience arises in the act of making a distinction in relation to oneself (to one's history). In other words, appreciating that without distinction (difference) there is no experience is a key ingredient of institutional and praxis innovation*.' (p 500)

Multiple perspectives feature strongly in the discourses around knowledge, skills and competences and how different terms are defined and enacted:

> '*Notwithstanding its widespread use in the technical and further education field, there is no one common definition of the term "competency". Different disciplines and different contexts generate a variety of understandings. For educators and trainers, competencies typically refer to specified skills, knowledge, attitudes and behaviour that are of central importance to undertaking effectively a given task, activity or career*.' (Linard and Aretz, 2000)

This educational perspective can be compared to this professional perspective from the Chartered Institute of Ecology and Environmental Management (CIEEM) website[7]:

> '*Competencies are the skills, knowledge and behaviours that are required to perform certain activities well and which are critical to success in specific professional roles. Put simply you are competent if you:*
>
> - *know what to do;*
> - *know how to do it;*
> - *know when to do it;*
> - *know why you do it;*
> - *can do it consistently well; and*
> - *know your limits and when to seek help and advice.'*

Both statements align reasonably with the four types of knowledge used within innovation studies (although there are also many different theories on knowledge and knowing):

- know-what: information, knowledge of facts;
- know-why: knowledge of scientific principles;
- know-how: skills or capability to do something; and
- know-who: social skills to access know-how of others (Lundvall and Johnson, 1994)

However, when such factors are set out as a list of learning outcomes, a job specification or a competency framework, they are describing an idealised set of a characteristics (or conceptual model of behaviours) reflecting a point in time, against which people are variously measured and assessed. In the (higher) education sector Biggs and Tang (2011) have promoted the concept of constructive alignment whereby learning activities and assessment tasks should directly address the intended learning outcomes as learners construct meaning from what they do. Equally, competency frameworks attempt to align professional standing/standards and recognition with actual professional practice while job descriptions are set out to help match candidate abilities with the desired capabilities sought by an employer. But how well do each of these means of judging peoples' potential (and actual) behaviours align with each other within and across subject areas?

[7] https://www.cieem.net/competency-framework

3. The systemic and systematic implications of assessing education and employment

To highlight the systemic and systematic elements of assessing education and employment outcomes I begin by systematically describing how both these sectors of the UK economy (through universities, employers and professional bodies) 'view' one subject – environmental management – before attempting to define a system of interest that helps outline possible boundaries and inter-relationships and suggest how constructive alignment between these different models of behaviours might or might not be helpful.

3.1 A case study of outcomes and frameworks: Environmental management in the UK

Environmental management (EM) can be complex and messy. Unsurprisingly systems thinking has been extensively applied to managing environmental situations (e.g. Seiffert and Loch, 2005; Ison, 2010; Gundill et al, 2012). As noted above a systems approach is involves the identification of issues from a context via the perspective of a diversity of actors in that context. One of the founders of the systems approach West Churchman noted: '*A systems approach begins when first you see the world through the eyes of another*'. (Churchman 1968 page 23). What follows is an analysis using three sets of perspectives.

EM as represented by degree titles and benchmark statements (the academic perspective)

EM is but one formulation for describing academic interest in environmental matters. This can be seen in the variety of environmental degree titles just within English HEIs where the search term was EM (Table 1). The snapshot provided in Table 1 is itself partial in that the search using the phrase 'environmental management' provided a list of 133 degree titles rather than the 97 noted there, as many degrees without environment in their title mentioned environmental management as part of the degree course description or in keywords e.g. countryside management. Equally a search using environmental science throws up a similar sized but partly different list. Given the limitations of the search engine and even while 24 of the 97 do specifically have EM in their title it is clear, even without further probing, that the professional or employment sector these degrees are potentially aligned with vary. This variation itself represents diverse subject specific approaches to EM - from business studies to health care, from sustainability to geography; let alone the more conventional, science-based focuses of ecology and environmental science. The range is vast and contrasting, suggesting both single and multi-discipline approaches, and both systematic and more systemic biases among the various degrees. The potential student might be forgiven for considering "environment" to be a multi-purpose word of no-fixed-meaning and EM as a term with limited utility suggesting everything and clarifying nothing.

Table 1. An analysis from the Universities and Colleges Admissions Service (UCAS) website[8] of undergraduate degree courses with environment in their title available from HEIs in England (search of course database conducted 12/2/16 using the phrase environmental management)

Degree Title	Number of degree courses on offer[9]
Environmental Management (EM)	18
Construction and the Built Environment	13
Environmental Science	10
Environmental Resource Management	4
Sustainability and EM	4
EM and Sustainability	4
Countryside and EM	3
Environmental health	3

[8] https://www.ucas.com/

[9] The same HEI might offer degree courses with similar titles but different characteristics e.g. placement years or with a foundation year

Ecological and environmental science with management	2
Geography and EM	2
Business studies with EM	2
32 other title combinations (6 with EM in the title[10])	1

In spite of this diversity, UK HEIs have to align their work by the codes of practice and related documents set out by the Quality Assurance Agency. One of these related documents is a Benchmark statement for undergraduate degrees in Earth Sciences, Environmental Sciences and Environmental Studies, first published in 2000 and then updated in 2014 (QAA, 2014), with the expectation that (undergraduate) 'environmental' degrees will align their learning outcomes as far as possible with this statement. Table 2 sets out what graduates must demonstrate across four skills areas. However the document fails to acknowledge the internal inconsistency of having three subjects in one document which, unlike most other subject benchmarks, does not reflect the external developments in the environmental sector since 2000 when the first benchmark statement was published. Notably, the benchmark has not been extended into Masters Level qualifications, which is surprising given that a search for UK based masters in EM using the findamasters.com website[11] shows numerous entries (277 in a search carried out on 12/2/16).

More specifically there is almost no overlap in the list of subject knowledge and elements for earth sciences with either environmental sciences or environmental studies (in contrast the latter share about half of their knowledge and elements list). Also, while there is greater emphasis placed on sustainability, employability, multi- and inter-disciplinarily and practical skills development in this latest version there is still insufficient coverage given to the socio-economic, political and cultural contexts of all three areas as well as the contributions that each makes to those contexts as well as the environmental one. Most importantly, the past decade has seen substantial growth in the academic and professional field of environmental management and, although this gets some mentions, it by no means reflects the number of jobs or professional bodies with environmental manager/management in their title (as I discuss further below).

Table 2. What graduates of an honours degree in Earth Science, Environmental Science and Environmental Studies must demonstrate

Intellectual skills (knowledge and understanding)	• knowledge and understanding of subject-specific theories, paradigms, concepts and principles • an ability to integrate evidence from a range of sources to test findings and hypotheses • an ability to consider issues from a range of interdisciplinary and multidisciplinary perspectives • an ability to analyse, synthesise, summarise and critically evaluate information • an ability to define complex problems and to develop and evaluate possible solutions • a critical approach to academic literature, data and other sources of information
Practical skills	• conduct fieldwork and laboratory investigations competently (as appropriate) • describe and record observations in the field and laboratory • interpret and evaluate practical results in a logical manner • undertake laboratory and fieldwork ethically and safely • plan, conduct and present an independent project with appropriate guidance • prepare, manipulate and interpret data using appropriate techniques • use appropriate numerical and statistical techniques • use appropriate technologies in addressing problems effectively
Communication skills	• an ability to communicate effectively to a variety of audiences using a range of formats • good interpersonal communication skills to enable effective team working • an ability to argue a case in an effective manner

[10] This includes the BSc (Hons) Environmental management and technology from the Open University UK

[11] http://www.findamasters.com/

Personal and professional skills	• work effectively as a team member • recognise and respect the views of others • demonstrate an awareness of the importance of risk assessment and relevant legislation • develop the skills for autonomous learning • identify and work towards targets for personal, career and academic development • reflect on the process of learning and to evaluate personal strengths and weaknesses • display an appreciation of developing their graduate skills relevant to career pathways

EM as represented by job titles and descriptions (the employers' perspective)

One way to define environmental management and environmental managers is by the jobs they do, the titles given to them, and the descriptions provide for them. Take, for example, the job description for an environmental manager that was provided on the Prospects website[12] that claims to be the UK's official graduate careers website:

> *Environmental managers, increasingly known as sustainability managers, are responsible for overseeing the environmental performance of private, public and voluntary sector organisations. Examining corporate activities, you'll establish where improvements can be made and ensure compliance with environmental legislation across the organisation.*
>
> *You'll also create, implement and monitor environmental strategies to promote sustainable development. Your wide remit means you'll review the whole operation, carrying out environmental audits and assessments, identifying and resolving environmental problems and ensuring necessary changes are implemented.*

As already noted, the academic landscape of EM is confused and confusing, sweeping in a large number of subjects and domains of practice. This diversity is reflected in the tasks which Environmental managers are engaged with. Conventionally, EMs have an extremely varied workload and one that usually entails a range of strategic tasks, such as these from the Prospects website:

- *develop and implement environmental strategies and action plans, to ensure corporate sustainable development*
- *take the lead on sustainable procurement for all goods and services*
- *coordinate all aspects of pollution control, waste management, recycling, environmental health, conservation and renewable energy*
- *lead the implementation of environmental policies and practices*
- *ensure compliance with environmental legislation and keep up to date with UK, European Union and international regulation and legislation*
- *liaise with relevant bodies such as local authorities, public bodies and competent bodies*
- *audit, analyze and report environmental performance to internal and external clients and regulatory bodies*
- *carry out impact assessments to identify, assess and reduce an organization's environmental risks and financial costs*
- *promote and raise awareness, at all levels of an organization, of the impact of emerging environmental issues*
- *implement best practice in areas of corporate, ethical and social responsibility and address any issues arising*
- *develop and implement environmental management systems to continually improve the impact of the organization on the environment*
- *coordinate public hearings and consultations on environmental matters*
- *manage relations with the board of directors, senior management and internal staff*

[12] https://www.prospects.ac.uk/job-profiles/environmental-manager

- *train staff at all levels on environmental issues and responsibilities*
- *participate in environmental education and research*
- *negotiate environmental service agreements and manage associated costs and revenues*
- *write environmental reports, assuming the lead responsibility with the company*
- *set organizational sustainability targets, and develop plans to meet those targets and oversee their delivery*

This task list is largely systematic in tone and areas of analysis (e.g. implementation of practice, assessing compliance with legislation) as well as at times suggesting a potential for a more integrative and systemic approach (for example balancing the requirement for legal conformity whilst engaging with corporate responsibility and dealing with the results of public consultation). Nevertheless the list of transferable (transversal) skills on the website is more promising:

- *understand and utilize systems to carry out problem solving*
- *show initiative, to recognize emerging problems and pro-actively develop solutions using methods such as systems thinking*
- *negotiate and organize*
- *stimulate and manage change*
- *demonstrate strong leadership and influence*
- *display a high level of computer literacy*
- *show commercial awareness and an understanding of business*
- *be self-motivated and able to motivate staff at all levels*
- *communicate effectively, both orally and in writing*
- *manage projects as well as produce and deliver presentations*
- *establish effective networks within the company and with external organizations*

A further look at the website shows that although this career is open to all graduates, it would help to have a degree in one of the following subjects: *bioscience*, *earth sciences*, *ecology*, *energy*, *environmental engineering*, *environmental health*, *environmental sciences or management*, *engineering with a sustainability focus.*

These details reinforce the perceived breadth and depth of EM as a job as well as an academic subject although interestingly the Prospects website only has four job descriptions that include 'environmental' in their title: EM, environmental consultant, environmental education officer and environmental health practitioner. It does not include environmental scientist as such but does include ecologist (see below).

EM as represented by professional bodies

The idea of environmental jobs and related titles is relatively new and dates back 1980s. Although people already did the activities associated with these jobs, the titles have emerged as the environment has become much more to the fore in developed economies. These trends have parallels within a broad range of professional bodies and learned societies and their desire to have a strong independent body to champion and regulate the expertise of today's environmental professionals. Thus the Society for the Environment[13] has, since 2004, held the register through which individual members of licensed professional bodies can obtain professional recognition as a Chartered Environmentalist. Starting with eight licensed members the Society now encompasses 24 licensed bodies (see Table 3) representing between them over 9,000 Chartered Environmentalists working in a wide range of professions (however do not that each professional body has a larger membership of its own and only a small proportion will seek Chartered status).

[13] http://socenv.org.uk/page/AboutUs

Table 3 List of licensed bodies in the United Kingdom through which professionals can be recognised as a Chartered Environmentalist

Arboricultural Association	Institute of Materials, Minerals, and Mining (IOM3)
Chartered Association of Building Engineers (CABE)	Institute of Water (IWater)
Chartered Institute of Architectural Technologists	Institution of Agricultural Engineers (IAgrE)
Chartered Institute of Building (CIOB)	Institution of Chemical Engineers (IChemE)
Chartered Institute of Ecology and Environmental Management (CIEEM)	Institution of Civil Engineers (ICE)
Chartered Institution of Wastes Management (CIWM)	Institution of Engineering Designers (IED)
Chartered Institution of Water and Environmental Management (CIWEM)	Institution of Environmental Sciences (IES)
Energy Institute	Institution of Mechanical Engineers (IMechE)
Institute of Agricultural Management (IAgrM)	Royal Institution of Chartered Surveyors (RICS)
Institute of Chartered Foresters (ICF)	Royal Society of Chemistry (RSC)
Institute of Environmental Management and Assessment (IEMA)	Society of Environmental Engineers
Institute of Fisheries Management (IFM)	Society of Operations Engineers (SOE)

Another interesting development amongst all professional bodies is the way that they are defining membership of their profession, and routes to recognition as a Chartered professional (engineer, environmentalist, scientist, or ecologist) through a Competency Framework that describes the knowledge, skills and attributes of a professional person within the scope they define. The Society of the Environment has one such framework for Chartered Environmentalist (Table 4) but many of the licensed bodies have their own competency frameworks or skills map. Indeed, the three professional bodies that have EM in their names, CIWEM, IEMA and CIEEM all have such frameworks and these provide yet another perspective on how to define environmental management and environmental managers.

Table 4 Chartered Environmentalist Competencies

A. Application of knowledge and understanding of the environment to further the aims of sustainability	A1 Have underpinning knowledge of sustainability principles in the management of the environment A2 Apply environmental knowledge and principles in pursuit of sustainable environmental management in professional practice A3 Analyse and evaluate problems from an environmental perspective, develop practical sustainable solutions and anticipate environmental trends to develop practical solutions
B. Leading Sustainable Management of the Environment	B1 Promote behavioural and cultural change by influencing others in order to secure environmental improvements that go beyond minimum statutory requirements B2 Promote a strategic environmental approach B3 Demonstrate leadership and management skills
C. Effective Communication and Interpersonal Skills	C1 Communicate the environmental case, confidently, clearly, autonomously and competently C2 Ability to liaise with, negotiate with, handle conflict and advise others, in individual and/or group environments (either as a leader or member)
D. Personal commitment to professional standards, recognising obligations to society, the profession and the environment	D1 Encourage others to promote and advance a sustainable and resilient approach by understanding their responsibility for environmental damage and improvement D2 Take responsibility for personal development and work towards and secure change and improvements for a sustainable future D3 Demonstrate an understanding of environmental ethical dilemmas D4 Comply with relevant codes of conduct and practice

The Chartered Institute of Ecology and Environmental Management (CIEEM) was established in 1991 and '*is the leading professional membership body representing and supporting ecologists and environmental managers in the UK, Ireland and abroad*.'[14] Its competency framework[15] identifies 4 levels of increasing professional competence – Basic, Capable, Accomplished and Authoritative. The framework contains 40 competencies or areas of professional activity. There are 25 technical competencies (i.e. specific to being an ecologist or environmental manager) and 15 transferable competencies (i.e. common to most professionals). These competencies are grouped together into 14 themes (Table 5) and are the basis for determining the seven grades of membership (Fellow, Full, Associate, Graduate (CIEEM accredited degree or pathway), Graduate (non-CIEEM accredited degree or pathway), Qualifying, and Student), Continuing Professional Development requirements, and degree accreditation. The framework is presented as a matrix and as spreadsheet where all the detailed descriptors can be found.

Table 5 The main themes in CIEEM's competency framework

Technical Themes	**Transferable Themes**
Surveying Environmental Management Environmental Assessment Policy, Legislation and Standards Scientific Method Education and knowledge exchange	Professional Conduct Health and Safety Communication Formal Facilitation, Stakeholder Engagement and Partnering Organizational Management Project Management Information Management People Management

The Chartered Institute of Water and Environmental Management (CIWEM) has its origin in 1895 and, "*is the leading international [...] professional body dedicated to the water and environment sector.*" Its 14 mandatory competencies mainly relate to 8 grades of membership (Fellow, Chartered, Non-Chartered, Associate, Technician, Graduate, Student, and Apprentice), but also degree accreditation, and are grouped into 5 themes (Table 6). While there are descriptions giving more details of what is required for each of these competencies these are not presented in a spreadsheet as is CIEEM's framework.

Table 6 CIWEM's mandatory competencies

A. EXISTING AND EMERGING FACTORS INFLUENCING ENVIRONMENTAL AND WATER ISSUES	A1. Knowledge of wider environmental issues and trends A2. Ability to develop strategies or plans to address changes in your sector
B. PLANNING, IMPLEMENTATION AND EVALUATION OF WORK	B1. Ability to analyse and evaluate environmental and/or water problems B2. Ability to solve problems by identifying, developing and evaluating options B3. Ability to initiate, implement and manage change B4. Ability to plan and implement solutions and monitor their continuing performance
C. SAFE AND EFFECTIVE WORKING PRACTICES	C1. Ability to manage resources effectively and efficiently C2. Understanding, promotion and application of Health and Safety (H&S) C3. Your contribution to sustainability C4. Understanding, promotion and application of quality enhancement

[14] https://www.cieem.net/about-ieem
[15] https://www.cieem.net/competency-framework

	and Quality assurance (QA)
D. COMMUNICATION AND PROFESSIONAL ETHICS	D1. Ability to communicate in English D2. Work professionally, ethically and comply with relevant codes of conduct
E. PROFESSIONAL DEVELOPMENT	E1. Demonstrate continuing professional development E2. Discuss your commitment to CIWEM

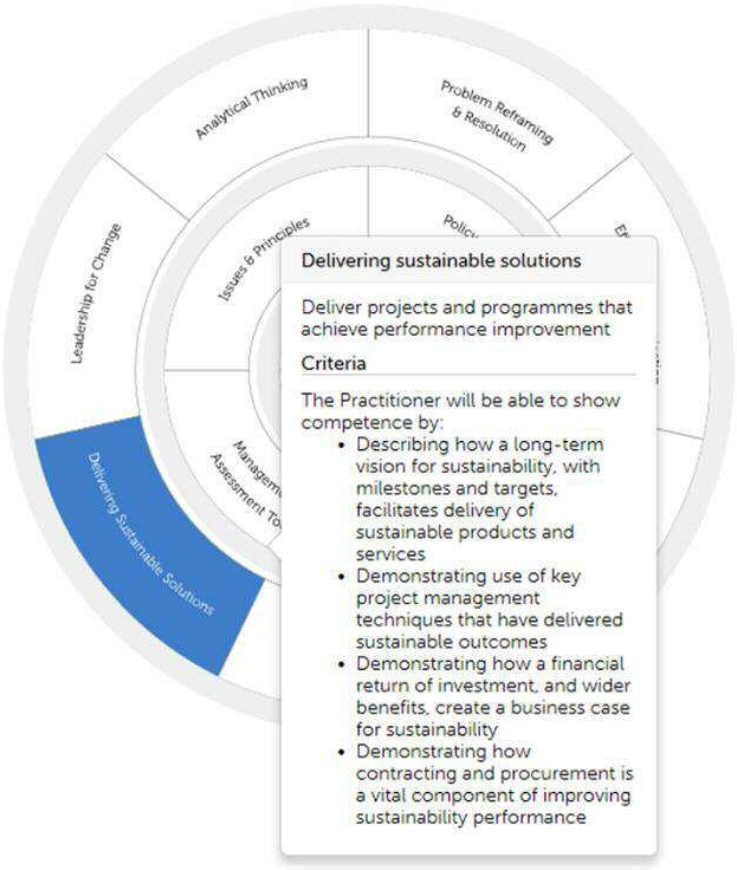
The Institute of Environmental Management and Assessment (IEMA) notes: '*we are the worldwide alliance of environment and sustainability professionals, working to make our businesses and organisations future-proof*.'[16] They have a skills map[17] covering 13 'skills' which once again mainly link to seven grades of membership (Fellow, Full, Practitioner, Associate, Graduate, Affiliate, and Student). This skills map is displayed as an interactive diagram on IEMA's website with the core skills presented as a wheel with different, detailed descriptors shown as pop-up text in each wheel at each level of membership (Figure 1).

Figure 1 A snapshot of (1) the core IEMA skills map and (2) an example of pop-up text describing expectations of that skill at that particular level of membership (practitioner in this example)

(1)

[16] https://www.iema.net/about-us/
[17] https://www.iema.net/skills-map

(2)



4. Environmental management as a complex adaptive learning system to meet both current and future needs

This descriptive account has only begun to touch upon the diversity of expression and coverage of what are the knowledge, skills, competencies, attitudes, behaviours and practices required for environmental management, and while this appears quite complicated, complex even, other subject areas (e.g. engineering and computer science) will also have many different actors and ways of describing what they can or should do. In the UK at least the advent of degree apprenticeships potentially introduces another set of, in this case employer defined standards. Such diversity can instigate different responses. One would be to try to achieve consensus between all concerned to produce one set of common descriptors and set of terms (e.g. see Kassler et al, 2012) or for someone like myself to try and map and match the different elements of each framework to find the precise similarities and differences (Steiner, 2013). However we should heed the cautionary note of Russell and Ison (2017) describing their experiences with agricultural research and extension in Australia:

> *Over time we came to understand that consensus was a lowest-common-denominator position in which the only carry through action was from those who held the consensus position from the start; the process robbed the other pastoralists of their enthusiasm for action.* p491

They also note:

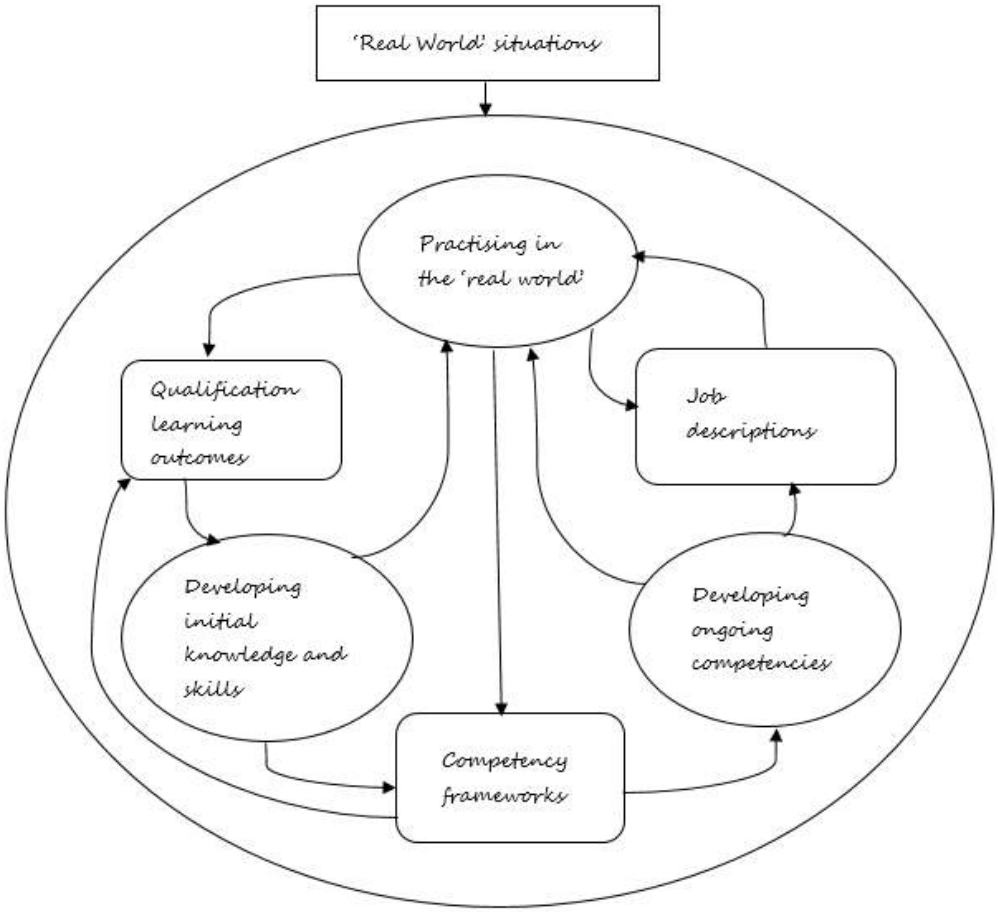
> *If innovation as well as social and personal change could be achieved by "effective" communication and the ready availability of knowledge, the world operating under the current mindset would be a*

> *great place to live. There would be ready at hand the vehicle, the wherewithal, to deliver on sound planning and intervention for the achievement of positive change. The desire for change and the belief in getting the communication "right," in order to achieve the nominated change, is pervasive in our society*. p486

They go on to suggest that it is better to think of promoting a relational dynamic where actors are constantly explaining what they are trying to achieve to other actors and through those conversations are able to reach dynamic agreement on the similarities and differences and purposes of what they do and why they do it. Figure 2 is my attempt to show this dynamic visually in an influence diagram, where constructive alignment, where possible and desirable, is achieved through the conversations between the actors and in light of developments in real world situations that may throw up new challenges that all involved have to adapt to. However this highlights another issue of how willing, how able and in what spaces the actors undertake those conversations if some of those conversations appear to challenge their own positions of power and traditions of practice.

An example of this challenge can be seen in the systematic and systemic views of EM I have outlined here. It is my view that both the QAA benchmark statement and the professional body competency frameworks tend to be systematic in nature (although not exclusively) with partitioned elements of EM emphasising isolated blocks of skills – be they technical or social. The focus is on what EM needs to 'do to' the world and there is a notable lack of discussion of what EM is/needs to 'be' or 'be with' in the world if it is to be effective. I would also argue that the competency frameworks tend to focus on the contemporary existing market in established specialisms and expertise in professional practice, rather than providing a clear imperative for co-creativity, innovation and imaginative responses to current and future needs. There appears to be no clear way in which integration and interactions between different elements of competency frameworks and the QAA benchmarks can be handled in the overtly systematic approach currently in evidence.

Figure 2 An adaptive learning system for training and developing a workforce to meet both current and future needs showing the influences and flow of information and meaning between qualification learning outcomes, competency frameworks and job descriptions as mediated by the activities of practising and defining initial and ongoing knowledge skills, competencies and behaviours.



Based on my own and my colleagues' previous research and teaching experience, I believe that both learning and practice needs to reflect the complexity of real-world problems faced by environmental managers (and many other professions) and that these challenges cannot be resolved by the singular efforts of specialists in any particular field. EM students and professionals need the ability to see 'the bigger picture' - the wider context within which environmental management dilemmas are situated, including the uncertainties involved, the different needs and understandings of the stakeholders involved, and the often rapidly changing social, economic and biophysical dynamics. The linearity and/or silos associated with conventional EM mind-sets are not adequate to cope with the complexity of rapidly evolving environmental situations. While the QAA and the EM Institutes are doing their best to manage professional competency frameworks and qualification specifications against a moving background the focus remains directed at traditional and 'boxed' outcomes and competencies. The complexity and integrative nature of environmental issues suggests that Environmental Managers now require skills sets and understanding of the systemic aspects of EM which takes the individual beyond the observation and application of systematic 'fact'. Facts are contested and such 'facts', if they are to be useful in EM policy and practice need to be cross-referenced with value systems, multiple perspectives and the combinatorial or 'wicked' problems which EM faces. Equally, all complex adaptive systems will exhibit emergent properties and behaviours, which is why specifications and frameworks need to be seen as 'living' documents subject to change and interpretation.

5. Conclusions

In this paper I have tried to highlight that there are multiple ways in which an educational subject can relate to professional employment and vice versa and that different actors can specify the knowledge,

understanding, skills and competencies, attitudes and behaviours that can be associated with that subject and profession. I used the case of environmental management in the UK to explore this dynamic, where the nature of environmental education and employment has evolved over the years leading to many different developments. Studying for, and working in, environmental subjects is both diverse and specialised and the way in which students and employees are expected to demonstrate their knowledge, understanding and skills/competences varies as to whether it is Universities, professional bodies or employers that set out the criteria, although there are many areas of overlap, particularly on 'transversal skills'

This diversity is both a strength and a weakness as it is able to encompass a wide range of possibilities and perspectives as the subject evolves over time but equally there are significant transaction costs for individuals and organisations to understand and match themselves and their activities against different frameworks. This might suggest that it would be better to try and create a single overarching framework but I have argued that such consensus may lead to an impoverished framework and lack of trust between the different actors. Instead I have argued that the constructive alignment of such frameworks can best be achieved through constant and ongoing conversations between the actors so as to resolve any unnecessary differences but to enable requisite diversity to meet the many complexities of the real world and I have provided a diagrammatic representation of the boundaries, relationships and conversations that could be involved. But I also acknowledge that there are no simple mechanisms for creating and maintaining those relationships and conversations.

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