The differing profiles of the human-computer interaction professional: perceptions of practice, cognitive preferences and the impact on HCI education

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Abstract

At a time when there is increasing demand for Human-Computer Interaction (HCI) skills, it becomes increasingly important that the curriculum is effective and relevant. This research aims to provide a better understanding of the professionals who work in the field of HCI. It extends previous studies by examining the different roles of HCI professionals in order to identify differences regarding cognitive preferences, background, what is valued, concerns and issues, and the potential impact of these upon curriculum design and delivery within the Higher Education sector. This study also extends technological frames theory by applying the framework to HCI practice.

The literature review covers the history of HCI, the position of HCI within the software development lifecycle, HCI academic research and its relationship to practice, HCI practice and HCI education. It then discusses cognitive style research and the Cognitive Styles Index (CSI) and the Object-Spatial Imagery and Verbal Questionnaire (OSIVQ), concluding with the social construction of technology and technological frames.

This study follows a mixed methods approach adopting a pragmatic epistemological stance, collecting data by means of a survey which gathered demographic data and cognitive profiles. These were complemented by interviews which were analysed using the Template Analysis approach.

Both the quantitative and the qualitative data highlight a number of differences between the roles of the professionals, and in particular between those who educate and those who are involved in practice. The interview findings also highlight inconsistences in what is valued, and indicate that HCI is not well understood outside of the HCI community.

It appears that a dominant technological frame has not yet been achieved in the field of HCI, with particular incongruences noted between academia and practice. In particular, the interviews confirm the findings of the literature that the curriculum may not be meeting the needs of practice, and that there still exists a lack of consensus regarding terminology and processes. The discussion moves on to consider the implications for the curriculum discussing the need for more input from practice when designing the curriculum, the advantages of embedding HCI skills within the curriculum in order to address graduate attributes, and the need to be aware of role differences in order to offer appropriate academic advice to students.

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1 Introduction

The aim of this research is to provide a better understanding of the professionals who work in the field of Human-Computer Interaction (HCI) by examining the different roles in order to identify the differences between them, and the potential impact upon curriculum design and delivery. This is achieved by comparing the cognitive profiles and the perspectives of different roles of HCI professional, and identifying where there is consensus or variance.

A better understanding of the differences between HCI professionals and the potential impact upon practice and curriculum design and delivery will serve both to support the educational experience of the students and to strengthen the HCI curriculum, thereby producing graduates who are better equipped to practice in the field.

1.1 Background

The acronym HCI translates literally to Human-Computer Interaction. The study of HCI first emerged in the late 1970s when it was often referred to as Human Factors, and whilst it was originally a specialism within the computer science field, it has now evolved to involve many different areas, including engineering, information management, psychology and design, as well as information technology subjects (Carroll, 2013; Myers, 1998).

HCI is studied in university courses both at undergraduate and postgraduate level in order to explore, understand and aid in improving the usability and user experience of interactive systems and products; it is now a well-established and important subject in computing, technology and design courses throughout the world. However, the multidisciplinary nature of HCI and its rapid growth against the constantly changing backdrop of technology presents educators with a number of challenges, particularly when considering curriculum design. Other challenges derive from the background of the educator, from pressures associated with the Higher Education landscape, and from the criticism that education is not meeting the demands of practice (e.g. Churchill, Bowser, & Preece, 2013a).

Whilst there have been several studies examining the differences between the HCI or usability professional and other professional roles within the field of software development, little research has been conducted to compare the roles of professionals within the field of HCI. Additionally, little is known of how individual differences of the professional, whether Practitioner or Educator, can influence the content and approach to both teaching and practice. The tools and techniques used in the field do not take into account the different cognitive styles of either the Educators or Practitioners, and it is not known whether the cognitive preferences of the Educator influence the content and delivery of the curriculum. This research intends to address this gap by examining the profile of both the HCI Practitioner and the HCI Educator and identifying the differences between them.

1.2 The profile of the professional

In the context of this thesis, a profile is defined as those characteristics that are common to a particular role. The profiles that are considered in this study are the profiles of the HCI Educator, the HCI Practitioner, and those who are involved in both education and practice, who are referred to as 'Both'. The role of the HCI Educator is defined as a professional who specialises in education and is not involved in practice. The role of the Practitioner is defined as a professional who is specialises in practice and is not involved in education. As the roles within HCI practice are diverse, the role of Practitioner has been further differentiated to consider profiles of the following job functions: Designer, User Researcher, User Experience (UX) Architect, and to a lesser extent, Software Developer.

This study contributes to the HCI Education and Culture project led by the University of West London's Sociotechnical Centre for Innovation and User Experience. This has explored cultural differences and the cognitive styles of students in order to inform the curriculum taught in universities and is described in more detail on page 45.

1.3 Challenges facing the field of HCI

The field of HCI is relatively young and made up of practitioners from diverse backgrounds. HCI faces challenges due to its multidisciplinary nature and to the fast changing face of technology (Rogers, 2004). Additionally, HCI is not well understood by those outside the field (Collazos & Merchan, 2015), and it suffers from the lack of a clear identity.

Whilst the acronym HCI may refer to human-computer interaction, many people who use the social networking features of a smart phone or devices such as the ticket machine at a railway station would not consider themselves to be 'computer' users. As a result, the term HCI is used less in practice, and the meaning has been extended to refer to interaction with other devices such as mobile phones, and other 'smart' devices. Very often the term User Experience (UX) is used instead, and at times the terms are used interchangeably, although there are differences between the two terms. HCI is generally considered to be focused on the tasks and the goals of the user, whereas UX extends this definition to include an emotional response, affected by the characteristics of the system and the context of use (Hassenzahl & Tractinsky, 2006).

Whether or not HCI is understood, and whether it is referred to as HCI or UX, the discipline is valued by industry, and specialist websites such as www.itjobswatch.co.uk reflect many job vacancies for the various roles of HCI professional. To support this demand, there are some specialist HCI degree courses within the Higher Education sector, but more often HCI is integrated within an existing programme of study.

1.4 Challenges facing HCI education

As mentioned above, there is increasing demand for UX professionals in the field. At a time when there is increasing demand for HCI skills, and yet universities are cutting back on contact hours in an attempt to become more efficient, it becomes increasingly important to make the curriculum effective and relevant. It appears, however, that this is not always being achieved: HCI may be included within the curriculum but there are also well documented concerns that the HCI curriculum does not reflect practice (e.g. Churchill et al., 2013a).

Inclusion of HCI within the curriculum is often a condition of course validation. However, there is a danger that as universities are under increased pressure to become more efficient, general computer science courses may include HCI as a learning outcome within another module (such as a programming module), rather than being delivered as a specific module with an HCI focus. This is not necessarily a problem as it is often possible to naturally include HCI within the wider curriculum, particularly when the delivering computer science team include HCI specialists; however, often this is not the case and delivery of specialist HCI content by non-specialists can be problematical (Read, Sim, & McManus, 2009). For example, HCI may be an option within a computer science course, or even be embedded within another module, and delivered by an Educator who is a specialist in another area but teaches HCI alongside a range of other computing subjects.

It is natural for the Educator to want to slant the curriculum in the direction in which they have a particular interest, and assuming that the Educator values HCI this is unlikely to result in delivery that is in any way unsatisfactory. Indeed, this often leads to a richer learning experience for the students, for example when the Educator relates curriculum content to their own research areas. However, it may be that the non-specialist Educator does not value HCI, and this may be reflected negatively in the curriculum emphasis.

This risk extends to curriculum design as well as delivery. For example, tensions have been noted between HCI as a design subject and as an engineering subject (Abdelnour-Nocera, Austin, Modi, & Oyugi, 2013) which may further lead to the subject being marginalised during the course design process. As courses are rationalised and streamlined, HCI topics may be subsumed into other modules. The concern is that educators who are not HCI specialists will naturally be influenced by their own preferences and interests and may slant the curriculum to reflect these (Austin & Abdelnour-Nocera, 2014), thereby exacerbating the problem that the HCI curriculum does not meet the needs of practice.

Finally, and of particular interest to this thesis, little is known of how individual differences of the professional, whether Practitioner or Educator, can influence the content and approach to both teaching and practice. Some HCI Educators, including those who specialise in HCI research, may have progressed directly from Higher Education to an academic post, and as a result may have no experience of working in practice. Again, this is not to say that this will result in an unsatisfactory educational experience for the students, but merely that the natural aptitudes, perceptions and values of the Educator delivering HCI topics may be very different to that of the HCI Practitioner.

1.5 Contributions of this study

As can be seen from the discussion above, the field of HCI, and HCI Education in particular faces a number of challenges. Some of these relate to practice and derive from the relative newness of the field, and some derive from the design and delivery of the curriculum.

There have been many studies that survey the practice of the HCI professional (Boivie, Gulliksen, & Göransson, 2006; Clemmensen, 2005; Gulliksen, Boivie, & Göransson, 2006; Gulliksen, Boivie, Persson, Hektor, & Herulf, 2004; Rogers, 2004) and likewise, there have been a few studies comparing the differences in attitudes and perspectives between HCI professionals and other professionals within the field of software development (e.g. Lárusdóttir, Cajander, & Gulliksen, 2014; Putnam & Kolko, 2012). However, there has been little focus on the differing profiles of the HCI professional, and little research into cognitive differences.

This research intends to bridge this gap by examining the profile of the different roles of professionals within the field of HCI, including their cognitive preferences. Whereas previous studies have tended to concentrate on methods and the application of those methods, the emphasis of this study is somewhat different; the purpose is not to investigate the practice of the professionals, but rather their perceptions of that practice. Of course, it is not possible to investigate perceptions of practice without some discussion of the tools and techniques that are adopted but these are not the central focus of this study.

The profiles of the professional will include those who practice, and those who educate. Previous research into HCI education has concentrated mainly on the curriculum, pedagogy and the gap between education and practice (Churchill et al., 2013a; Douglas, Tremaine, Leventhal, Wills, & Manaris, 2002; Hewett et al., 1992). This research extends the earlier studies of Churchill et al (2013a) who surveyed both those in practice and those in education regarding the practices and underpinning philosophies of both education and practice in order to identify a global curriculum. Churchill and colleagues report that what the Practitioner and the Educator value are not always the same but they do not specifically differentiate between those who both practice and educate and those who specialise in either area. This study, in contrast, considers the differences between the Educator, the Practitioner and those who both educate and practice, referred to as 'Both' in this thesis, and the profiles which result from this study will be of particular value to those who are responsible for curriculum design and delivery.

It is important to HCI education that differences in the profile of the professional are recognised. Provided that Educators understand the Practitioner, and equally that they also understand themselves and how they are different from the Practitioner, they will be able to design courses and provide an HCI education which satisfies the needs of the market. This requires that the differences between the roles of HCI Educator and HCI Practitioner are consciously acknowledged by the Educator. If not, there is a danger that the curriculum will reflect the bias of the Educator without consideration of the natural aptitudes, perceptions and values of the HCI Practitioner. As a result, the Educator needs an awareness both of what is valued by the HCI Practitioner, and the personal attributes of the HCI Practitioner; these may be very different to what is valued by the HCI Educator, and the personal attributes of the HCI Educator. That is not to say that either one is superior or more desirable, only that the differences need to be recognised, accepted and accommodated by the Educator when planning and delivering the curriculum in order to highlight what is important to the HCI

Practitioner, and which personal skills and attributes may lend themselves to a successful career in the field of HCI. If the Educator is aware and accepting of the differences, they will be able to tailor their delivery to explicitly address the requisite attributes of the HCI Practitioner.

It is not only differences between Educators and Practitioners that are pertinent, but also differences between the various roles of the Practitioner. If Educators can also recognise the differences in profile of the professional roles both within the wider field of software development and within the field of HCI, they will be better able to advise students towards appropriate module and course choices. This is particularly important as some of the necessary 'soft skills' required to work in the field of HCI may not come naturally to those studying computer science.

In summary, this study extends previous research into HCI practice and education firstly by including the perspective of those who are involved in both education and practice as well as those who educate and those who practice, and secondly by considering the cognitive profile of the professionals.

1.6 Research questions

As the purpose of this research is to have a better understanding of the profile of the HCI professional and the field of HCI rather than to offer any final or conclusive findings, an investigative approach has been adopted for this thesis, and research questions rather than hypotheses have to been used to explore these issues further. These evolved as the project progressed (Creswell, 2013, p.

141). This has resulted in the following central research questions which have been designed to investigate how the profile of the HCI professional differs according to their role, and the impact of these differences upon practice, curriculum design and delivery.

RQ1: What are the differences in the cognitive profile of the HCI Practitioner, the HCI Educator and the general population?

RQ1 has been broken down into the following sub-questions and will incorporate findings from the survey data:

- RQ1a: How does the cognitive profile of the HCI professional differ from that of the general population?

- RQ1b: What are the differences between the Educator, the Practitioner and 'Both' in terms of their analytical/intuitive preferences, and their Visual Object, Visual Spatial and Verbal abilities?

RQ2: Does the profile of the HCI professional vary from role to role in respect of their background, what is valued, and their concerns and issues?

This will incorporate findings from the interviews with professionals and will be discussed in the context of technological frames of reference.

RQ3: What are the implications for the HCI curriculum?

This will be discussed with reference to all of the above.

1.7 Theoretical background

1.7.1 Research design

This study takes a mixed methods approach adopting the triangulation convergence model, which makes use of both quantitative and qualitative data (Creswell & Plano Clark, 2007). A correlational survey design using self-report measures to capture cognitive style was adopted for the quantitative phase of data collection. This was complemented by a number of interviews which provided the qualitative data. The epistemological approach is that of a pragmatist with a postpositive epistemological stance when considering the quantitative data, and a constructionist stance when considering the qualitative data.

1.7.2 Cognition and HCI

HCI practitioners act as an interface between the developer and the users during the development of a computer application or website. As such, they need analytical skills to understand the functionality of the website or application, but at the same time, they need to be able to see the 'whole picture' and put themselves in the shoes of the user. Some HCI evaluation techniques such as heuristic evaluations require an analytical approach. Others, such as the production of a persona need a more intuitive approach. In addition, whilst the developer may be more concerned with the functionality of the application, the HCI practitioner also needs to balance the need for the interface to be user friendly, and the layout, appearance and aesthetics of the interface will contribute to this.

The first phase of this project used a survey to gather data relating to cognitive style. Within the field of cognitive style research, there is a diverse range of theoretical backgrounds and domains of application (Cassidy, 2004; Coffield, Moseley, Hall, & Ecclestone, 2004b; Kozhevnikov, 2007). However, when selecting a tool to measure the relationship between cognitive style and human-computer interaction, the range of candidate theories is constrained by the characteristics of the technology in question.

The Cognitive Style Index - CSI - (Allinson & Hayes, 1996) was considered appropriate as it investigates the intuitive/holistic – analytical spectrum, which correlates to the approach taken when evaluating systems for usability; the Object-Spatial Imagery and Verbal Questionnaire - OSIVQ - (Blazhenkova & Kozhevnikov, 2008) was selected as it investigates the visualiser - verbaliser spectrums which correspond to the medium being investigated.

Whilst these constructs contribute towards a profile that matches the skills required to work within the field of HCI, they only provide a partial profile, and a fuller profile is developed by means of a thematic analysis of the interview data adopting the Template Analysis approach (King, 1998). The analysis of the interview data was supported by the application of technological frames of reference.

1.7.3 Technological frames of reference

A technological frame is a cognitive device that helps an individual to make sense of technology or to describe practice by structuring their previous experience and knowledge in the context of their current experience. Technological frames can provide a framework with which to systematically analyse the perceptions of members of a particular social group, and compare them with the perceptions of another social group (Bijker, 1987; Lin & Silva, 2005; Orlikowski & Gash, 1994). In the context of this study, the application of the technological frames framework facilitated the identification of differences between the groups of professional.

1.8 Overview of the thesis

This thesis has seven chapters which are summarised below.

Chapter 1 has provided an introduction to this study detailing the background of the challenges faced by the field of HCI and in particular the challenges faced by those involved in HCI education. It presents the research questions and introduces the concept of cognition and technological frames. The chapter concludes with a definition of the terms used in this thesis.

Chapter 2 presents a review of the literature. It provides a brief history of HCI and the position of HCI within the software development lifecycle. It moves on to discuss academic research into HCI and the relationship of academic research and practice before moving on to examine both HCI practice and HCI education. This is followed by a brief review of cognitive style research and the particular style instruments which have been selected for use in the study, namely the CSI and the OSIVQ and concludes with an account of the social construction of technology and technological frames.

Chapter 3 presents the research design which is a mixed methods approach adopting a pragmatic epistemological stance. The data was collected by means of a survey which provided some demographic data and the results of the two cognitive style instruments; these were subjected to a number of statistical tests. A series of interviews were conducted and the use of the Template Analysis approach and qualitative data analysis software is described.

Chapter 4 presents the survey results which addresses the cognitive differences between the profiles of the professional. This considers the professional roles of Educator, Practitioner and those who both educate and practice (‘Both). The results highlight a number of differences, particularly between those who educate and those who are involved in practice.

Chapter 5 presents the interview findings which addresses differences between the background, what is valued and the concerns and issues of the professionals. This considers the professional roles of Designer, User Researcher, UX Architect and Educator. Again, differences were noted between the roles and these were particularly apparent between the Educator and those who both educate and practice, resulting in different curriculum emphasis. Differences were also noted between the Designer and the other roles of Practitioner. The interview findings also highlight concerns regarding the relevance of academic research, and the lack of standardisation and clear identity which is seen to be damaging to the profession.

Chapter 6 firstly presents the key findings of chapters 4 and 5 before discussing the results in the context of the research questions. The theoretical area of technological frames is revisited to support the discussion of the differences noted in chapter 5 and to discuss the maturity of HCI in the context of the technology lifecycle. It appears that a dominant technological frame has not yet been achieved in the field of HCI, with particular incongruences noted between academia and practice. In particular, the interviews confirm the findings of the literature that the curriculum may not be meeting the needs of practice, and that there still exists a lack of consensus regarding terminology and processes. The chapter moves on to consider the implications for the curriculum discussing the need for more input from practice when designing the curriculum, the advantages of embedding HCI skills within the curriculum in order to address graduate attributes, and the need to be aware of role differences in order to offer appropriate academic advice to students.

Chapter 7 concludes this thesis by reviewing the aims of this study and discussing the contribution to knowledge which include contributions to both the study of HCI education and to the study of technological frames. It discusses the limitations of the study and identifies a number of areas for further research which include further research into the profile of teaching academics and students of computing and engineering.

Definition of Terms

In order to guide the reader through this thesis, a number of key terms are defined below.

Table 1-1: Definition of terms

Term	**Definition**
Educator	Interviewees who classified themselves as Educators and deliver HCI education
ACM	Association for Computing Machinery
All-Ed	All those involved in education
All-Pract	All those involved in practice
'Both'	Those who both practice and educate
CHI	The top conference for Human Computer Interaction
CSI	Cognitive Style Index (Allinson & Hayes, 1996)
Educator	Those who educate but do not practice
HCI professional	All those who work in the field of HCI
OSIVQ	Object-Spatial Imagery and Verbal Questionnaire (Blazhenkova & Kozhevnikov, 2008)
Practitioner	Those who practice but do not educate
SCOT	Social Construction of Technology
SIGCHI	Special Interest Group on Computer Human Interaction
Technological frame	A cognitive device that allows an individual to make sense of technology in a particular context by structuring their previous experiences and knowledge
Trainer	Interviewees who classified themselves as Educators and deliver HCI training
UXPA	User Experience Professionals' Association

2 Literature review

As discussed earlier in this thesis, there is increasing demand for skilled UX professionals in the field at a time when the curriculum is being squeezed, with less contact time being allocated to students. It is therefore increasingly important that what is delivered as part of the HCI curriculum prepares students to address these gaps in the job market (Dunford, 2016).

If students are to develop attributes that prepare them for employment within the field of HCI, it is not sufficient for the educator to consider only the topics that are to be included in the curriculum; these can be derived from the recommended texts, and indeed, the requisite skills and methods are well represented within the HCI literature. What is not so clearly represented within the literature is the profile of the HCI professional, and how this differs both according to the HCI role and also from that of other professionals.

This chapter commences with a general discussion of human-computer interaction, followed by a review of HCI research, HCI practice, and HCI education. This is followed by a review of cognitive styles research, and finally a discussion of technological frames. Each of these areas would merit extensive coverage but an exhaustive review of the literature is beyond the scope of this work. The aim of this chapter is to rather to address the research questions through selective reference to the literature.

2.1 Human-computer interaction

This section will first of all consider HCI as a discipline. This is followed by a brief history of HCI, consideration of what is meant by the terms usability and the user experience, and how roles, users and practice have changed over time.

Human-Computer Interaction, as the name suggests is the study of how humans interact with computers and other technologies. It has a close relationship with the fields of design and psychology, with one of the key focuses of HCI being usability. It is now routinely considered in the development of interactive systems, and where possible, is integrated in the system development lifecycle (Lindgaard et al., 2006). The methods employed are adopted from the fields of design and psychology, and the lifecycle of an HCI project is similar to that of the system lifecycle which originated in the field of engineering, and has been adapted for use in software development projects. The lifecycle of an HCI project incorporates requirements analysis, design, some sort of development or implementation, such as a prototype, and evaluation or testing, implemented in an iterative manner (Mayhew, 1999).

Methodologically, however, the fields of design, psychology and engineering are not alike, and this combined with the fast changing face of technology and different methods of interacting with technology such as remote access, touch screen and voice interaction has resulted in the rapid development of new methods and tools within the field of HCI. These two factors have contributed to variances in practice and inconsistent use of methods and terminology, which in turn have produced uncertainties for those within practice, and challenges for those delivering the HCI curriculum; practice is evolving at the required speed to meet the needs of the business and the new methods of interaction, but education tends to evolve more slowly, resulting in the curriculum not matching practice. This situation is further complicated by disagreement amongst industry practitioners regarding what should be included in the curriculum, which provides educators with additional challenges (Dunford, 2016).

2.1.1 HCI as a discipline

There have been attempts to define what is meant by the discipline of HCI, although these are not without debate. Long and Dowell's (1989) alternate conceptions of the discipline of HCI as a craft, an applied science and engineering practice are considered by Carroll (2010) to be problematic when considered as competitive paradigms; he argues rather that the craft element is the origin of innovation in practice, that this innovation is explained by the applied science, and that this in turn provides the foundation for engineering models; in other words, the three paradigms need to be linked together rather than considered as distinct disciplines. There is some debate as to whether HCI should in fact be considered to be a discipline, with Carroll (2010) regarding HCI as a meta-discipline centred on the concept of usability, Clemmensen (2005) describing a specialist HCI group in Denmark as a community of interest rather than sharing a 'special discipline', and Blackwell (2015) arguing that HCI is not a scientific discipline, but rather an 'inter-discipline', with the community producing innovation. Churchill, Bowser and Preece (2013a, p. 18) take this even further, questioning whether HCI is even a field, or *"simply a sensibility that is HCI, where* *the three elements, human-computer-interaction are all considered to be equally important".*

Another area for debate is whether HCI is multidisciplinary, interdisciplinary or even cross-disciplinary. This depends on whether you are considering HCI from the perspective of practice or research. Van den Besselaar and Heimeriks (2001) describe multidisciplinary research as using different disciplinary perspectives, and different disciplinary perspectives are evident in practice. Dray (2009) refers to practice as 'cross-disciplinary'; the HCI practitioner is one role in a larger development team which also includes, for example, design and development roles. The team members each have separate goals, and are working independently on the project, using their own methodologies. Similarly, there is differentiation amongst the HCI specific roles, for example, between the HCI user researcher role, and the interaction designer. An interdisciplinary approach is more often found in research projects where the goal is to produce new knowledge or to generate new theories (Blackwell, 2015); the researchers may be from different disciplines, for example computer science and psychology, but the goals are shared, and there is integration and synthesis of the disciplinary frameworks and methods (Choi & Pak, 2006) leading to innovation.

The focus of this research is HCI practice and education. Whilst a variety of definitions have been presented above, in this thesis the term 'discipline' is used broadly and interchangeably with the term 'field', and refers in general terms to the theory, methods and tools either adopted by practice in the field or delivered as part of the curriculum. Where there are references to the multidisciplinary nature of the field, this will be in the context of both Van den Besselaar and Heimeriks' and Dray's designations above.

2.1.2 The evolution of HCI

In order to understand the issues and challenges faced by the field of HCI, it is necessary to understand how the field has developed. The study of HCI first emerged in the late 1970s. It has its roots in the field of human factors, and whilst it may have originally been a specialism within the computer science field, it is now a multidisciplinary subject, embracing many different areas of expertise, including engineering, information management, psychology and design, as well as computing and programming specialisms, and HCI now encompasses an international research community. The field is characterised by its diversity and the speed with which the discipline has grown, with Rogers (2004, p. 88) describing it as *"a young field in a state of flux".*

It is also worth pointing out at this stage that the brief history outlined above reflects Western practice, with HCI not being considered a priority in developing countries such as India and China until the late 1990s and early part of the 21st century respectively (Smith et al., 2007).

Since the inception of HCI, there have been changes both in practice and in the general roles of the computing professional within the computing industry.

2.1.3 The evolution of the HCI professional

Up until the mid-1950s, there were only three roles in the computer industry, and there was no specific consideration of human computer interaction. The three roles were management and system analysis roles, programmer roles and operator roles (Grudin, 2008). However, with the introduction and commercial application of mainframe computers in the mid-1960s there followed an expansion of these roles. In particular, the developer/programmer role has become increasingly specialised over the years, evolving into roles such as business analyst and user interface designers in the 1980s (Mayhew, 2008). The responsibility for user experience design was further specialised in the 1990s to include graphic designers and information architects, with the theory of HCI providing guidance to design practice, for example, the application of cognitive science theory to the design of interfaces such as visualisations or command line interfaces.

The rapid changes in technology evidenced over the last 20 years have produced new methods of interaction such as touch screen, gesture and voice input/output, with the science both informing and being informed by practice and application (Carroll, 2010; Churchill et al., 2013a; Rogers, 2004). These, in turn, have resulted in new design disciplines emerging from the application of HCI theories, such as interaction design and user experience (UX) design. These changes have led to a diverse job market, and a huge variety of job titles many of which include terms such as 'interaction design' or 'user experience' (UX), indicating that Gulliksen et al.*'s* (2004, p. 271) observation that *"Those performing usability work do not have a professional nomenclature but use a plethora of job titles, and* *have a variety of educational backgrounds and areas of professional activity"* still holds true.

HCI practice is generally viewed as a community expanding around the concept of usability (Carroll, 2010; Clemmensen, 2005). However, the term HCI is rarely used outside the academic arena, and the term UX instead dominates the job market. As an example, searches for HCI related jobs using a popular UK job site resulted in 472 live jobs using the search term 'UX' or 'user experience', 199 using the term 'interface', 20 for 'usability', 18 for 'user researcher' and 4 for the term 'interaction'. The term HCI did not return any results ('IT Jobs Watch, Tracking the IT Job Market', 2016). Depending on the context, both terms are used in this thesis; however, the concept of usability remains central to the discussion throughout.

2.1.4 Usability and the user experience (UX)

Since its inception, the concept of usability has been central to HCI roles, leading to the establishment of the Usability Professionals' Association in 1991 (UXPA, 2013), later renamed to the User Experience Professionals' Association, known as the UXPA.

As illustrated above, the market prefers the term user experience. However, definitions of the term user experience also include the concept of usability. For example, the close association of the two terms is evidenced in Carroll's (2010) definition of usability which incorporates many of the emotional qualities associated with the user experience, such as fun and well-being. Similarly, the

International Standards Organization (ISO) advises that elements of the user experience can be evaluated with usability criteria (ISO-9241-210, 2010, p. 3). Clearly, consideration of usability is central to the work of the HCI professional, and this will be considered alongside any discussion of UX.

The term UX may be commonly used, but the user experience is difficult to define, and following from this, difficult to measure (Bevan, 2009; Hassenzahl & Tractinsky, 2006; Jokela, Iivari, Matero, & Karukka, 2003; Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009; Law, van Schaik, & Roto, 2014) which may go some way to explaining the variances in practice. Additionally there are many formal and less formal definitions of usability (ISO-9241-210, 2010; Nielsen, 2012; Shackel, 1991), with practitioners finding the concept to be 'fuzzy' (Boivie et al., 2006).

The International Standards Organization define usability as the *"extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use"* (ISO-9241-210, 2010). This definition of usability is succinct, with each of the terms apart from satisfaction being unambiguously defined and testable; however, this is not the case with the ISO definition of 'user experience': a *"person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service"*, which is further amplified with three separate notes, reflecting the difficulty of definition noted above.

Law et al.(2009) found that within practice, but not necessarily academia, the terms UX and usability are often used interchangeably. Their survey of professionals differentiates those who work in academia, those who work industry and those who either work in both or between the two (which I categorise in this thesis as ‘Both’). They noted a difference between those in industry, who equate user centred design and UX, and those in academia and ‘Both’ who differentiate them, considering them either as distinct entities, or perhaps perceiving UX as a more recent development. This confirms the findings of Naumann, Wechsung and Schleicher (2009) who surveyed practitioners, academic researchers and ‘Both’ on their practice and their views of usability and user experience; although they did not find significant differences between the three groups, they did note that those who worked in industry were the only group who all showed an interest in both usability and the user experience.

Of course, it is impossible to consider the user experience or usability without also considering the user, who is discussed in the next section.

2.1.5 The modern user of technology

Earlier in this chapter there is an account of changes in the technology, and changes in the roles of the computing professional. However, it is not only the roles of the computing professionals that have changed, but also the profile of the user of technology. The changes in the user profile are reflected by changes in HCI practice commonly referred to as the ‘three waves of HCI’ (Bødker, 2006).

As described above, the first computer users were computer specialists, but as the industry developed, particularly with the introduction of personal computers in the 1980s, computer use became more discretionary with non-computer specialists regarding them as tools to support a workplace task.

Whilst the ‘first wave’ of HCI focused on cognitive science and human factors, the ‘second wave’ in the 1990s focused more on the context of use, workspaces and communities of practice as users became intolerant of systems that were difficult to master. Bannon (1991) describes the use of technology as discretionary, but it should be noted that whilst the use of technology may have been in some cases discretionary, even today this is very often not the case in the workplace, with use of particular software or hardware being mandatory. Although it was described as a ‘personal’ computer the majority of use was within the workplace as these were expensive items. For example, the Compaq Presario 4122 Desktop retailed at £1871 in 1996 (The Centre for Computing History, n.d.), which was approximately 14% of the annual average wage of £13,777 (Clark, 2017).

Whilst the majority of computer use during the ‘second wave’ existed in the workplace and pertained to work related activities, there now exists a new breed of user of technology. The iPhone was launched in 2007, with the first Android phone following in 2008; the iPad was introduced in 2010, and the use of smart phones and tablets is now commonplace, with the products at the lower end of the market being affordable even for those on low incomes; computing is no longer a privilege of the well to do. In 2017, around 0.5% of the average national wage of £26,500 will purchase the Samsung J3 smartphone for less than £150, or a mid-price Dell Inspiron laptop for under £500, less than 2% of the average national wage. The availability of such devices has resulted in technology becoming accessible with specialist knowledge no longer being required, and accordingly, the profile of the user has changed. Devices are now often used for leisure and social activities unconnected with the workplace, with the 'third wave' of HCI providing new contexts of use (Bødker, 2006; Churchill, Bowser, & Preece, 2013b). This has resulted in Long and Dowell's (1989, p. 5) definition of the 'general problem' of the HCI discipline *("humans and computers interacting to perform work effectively"*) becoming too narrow as computers are no longer solely used in organisational settings to perform work tasks (Carroll, 2010).

Not only has the context of use changed, but also the attitude of the user towards technology. Whereas the use of technology may have been mandatory for the early user, particularly in the work environment, it is now very often discretionary. Dix (2010) observed that these changes have resulted in the recipient of the technology considering the product to be a service and that the proliferation of the internet of things and mobile applications, most of which are free of charge, has made the recipient of technology less likely to be tolerant of poor design or usability, particularly when using systems associated with leisure rather than work activities (Hertzum et al., 2011).

2.1.6 Conclusion: HCI

Although now more mature, the literature would suggest that Rogers's description of HCI being a *"young field in a state of flux"* (2004, p. 88) still holds true. The computers referenced by Long and Dowell (1989) and Hewett et al. (1992) bear little relation to the new technologies and new methods of interaction that exist today, and when considering the 'human' element, there is now a new breed of user. As reflected in the jobs market, the focus of HCI is now very much on the user experience and usability. In summary, HCI has evolved from human computer interaction and is now more focussed on users, technology and usability. Consideration of HCI should be an integral part of the system development lifecycle, and usability and the user experience are key considerations for the development team. The multidisciplinary roots of the field of HCI have resulted in diverse methods and approaches being adopted in practice, and a plethora of job titles as the discipline has co-evolved with the emergent technologies. Technology is now more far more accessible and is used in a variety of contexts, including leisure. This has resulted in the use of technology very often being discretionary , and in turn, modern users have become more discerning, and less tolerant of a poor user experience (Dix, 2010; Hertzum et al., 2011).

The next four sections will consider how the HCI professional reports practice, how the professional perceives the differing roles of an HCI professional, the values, priorities, concerns and issues of the HCI professional, and the relationship between academic research, practice, and education.

2.2 HCI academic research

Although the focus of this thesis is HCI practice and HCI education, it is also pertinent to consider HCI academic research and its relationship with both practice and education. Later in this thesis, reference is made to the role of the user researcher; this is considered to be a practitioner role, and separate and distinct from the role of the HCI academic researcher who is not specifically considered in this thesis. However, it is acknowledged that academic research is integral to the role of an academic educator, and therefore it will impact upon HCI education.

2.2.1 HCI special interest groups

As stated above, academic research is fundamental to the role of the academic, but it should also be noted that not all academic research is conducted in universities; for example Facebook[1], Google [2] and Microsoft [3] all conduct academic research into HCI and regularly present at academic conferences.

The Association of Computer Machinery (ACM) Special Interest Group on Computer Human Interaction (SIGCHI)[4] was founded in 1982; its membership consists of practitioners, academic researchers and educators, and students. SIGCHI sponsors or co-sponsors many international conferences, including the Human Factors in Computing Systems, commonly known as CHI, where academic research is presented by both academia and practice; CHI is widely regarded as the most prestigious international HCI conference ('Welcome - SIGCHI', 2016). The first European special interest group, The British HCI Group, was formed two years later in 1984. Now renamed Interaction[5], this is a specialist HCI group of the British Computer Society (BCS), also known as The

[1] https://research.facebook.com/userexperience
[2] https://research.google.com/pubs/Human-ComputerInteractionandVisualization.html
[3] https://www.microsoft.com/en-us/research/research-area/human-centered-computing
[4] http://www.sigchi.org
[5] http://www.bcs.org/category/14296

Chartered Institute for IT, and the largest national HCI group in Europe. Annual conferences are organised by Interaction in conjunction with the UK chapter of the professional group, the UXPA.

2.2.2 Criticisms of academic research

Whilst the multidisciplinary nature of the subject has contributed to its richness, the diversity of the research areas has equally led to criticisms that the field lacks identity, with a lack of mainstream 'motor themes' resulting in multiple research areas competing for attention within the research field (Kostakos, 2015; Liu et al., 2014). Another criticism is that much HCI academic research has no immediate relevance to practice as HCI research is often concerned with new and emerging technologies or the development of theoretical frameworks, and as a result, the research does not necessarily reflect practice in the field. For example, although Liu et al.*'s* (2014) survey of CHI submissions highlights the diversity of research topics, it also draws attention to the gap between research and practice, and in particular the paucity of research into the human aspects which are central to HCI practice (Padilla & Chantler, 2015). As Liu et al. observe, although attitudes and roles may have changed over the years as a result of the changes in technology, the changes in the human element of Human Computer Interaction are less dramatic, underlining the value of research into the psychology of HCI; however, trends in HCI research do not indicate this to be a growth area (Liu et al., 2014).

Whilst the CHI conference provides the primary forum to present academic research, practice is not well represented at this conference. One of the reasons that the UPA, now the UXPA, was formed was to better represent the views of the practitioners (Dray, 2009). Dray highlights the differences and the tensions between academic research and practice, recommending a closer alliance between academic research and practice. Dix (2010) in contrast, finds that the relationship between research and practice is close, with conferences such as CHI offering opportunities for debate. This is valid in as far as that attendees are likely to engage in debate, but it overlooks the fact that the majority of practitioners do not attend conferences. Whilst this gap between research and practice is not unique to the field of HCI, it is generally agreed that it needs to be addressed (Buie et al., 2010; Dray, 2009).

2.2.3 Academic research and practice

That is not to say that all HCI practitioners are uninterested in the underpinning theory generated by prior research. Clemmensen (2005) investigates the use and interpretation of theory in practice, and the role of theory in the development of community knowledge of usability specialists based in Denmark. Theory is perceived by the professionals to be of value in providing direction for the development of both methods and interfaces, and also provides a foundation for the communication of concepts, with the methods themselves providing a common framework with the potential to support the task, always assuming that a flexible approach is adopted, rather than rigid application of the methods. This is in contrast to the findings of Rogers (2004) who also investigates the roles of the theory and the methods employed in practice; she found that although practitioners were familiar with the theory, they rarely used it for their work, although in common with the findings of Clemmensen (2005), theoretical concepts were used to support communication with others.

2.2.4 Conclusion: HCI academic research

In summary, the literature reflects a diverse range of research topics emanating from both industry and academia. However, this very diversity has led to accusations that HCI research lacks identity due to a lack of clear motor themes. There are also criticisms regarding the relevance of research topics to current practice. Within practice, practitioners are aware of the underpinning theory generated by prior research, and this is used as a basis for communication. However, whether or not practitioners make direct use of this theory within their practice is inconclusive.

2.3 HCI practice

This next section focuses on how the HCI professional reports practice, how professionals themselves perceive the different roles of professional and the values, priorities, concerns and issues of the HCI professional. It is primarily concerned with the HCI practice: academia is discussed in section 2.4 on page 38.

It should be noted, however, that this research is interested in the perspective and attitude of the professional towards practice rather than the detail of actual practice. Of particular interest are the varying reports of practice, the skills required, and the attitudes toward practice, particularly when different perspectives are presented. Discussion of particular tools and methods will be included only in the context of the above, and it is not the intention to provide detailed coverage of these, but rather to focus on the profile of the professional, their attitudes, their values, and differences between the roles.

As discussed in the introduction to this chapter, previous research has compared HCI roles with other professional roles, but there has been little work comparing the different roles within HCI practice; additionally, it highlighted the centrality of usability and the user experience to the field of HCI. The next section will look at the background and demographics of HCI professionals, and differences in perspectives between professional roles.

2.3.1 Snapshots of practice

Around twelve years ago, there were a number of surveys of practitioners, particularly within the Nordic region, and these provide useful snapshots of practice at that time (Boivie et al., 2006; Clemmensen, 2005; Gulliksen et al., 2006, 2004; Rogers, 2004). For example, Gulliksen et al.*'s* (2004) profile of the professional – this included those working in industry and in academia – indicated that at that time, only around half of the professionals had formally studied HCI with the rest being either self-taught, or benefiting from on-the-job training; many of his respondents had transitioned to HCI from other roles, such as developer. Churchill, Bowser and Preece's (2013a) survey presents similar findings, with 68% being educated in a related field, and 47% having formal HCI education. These earlier surveys provide accounts of usability practice within the system development lifecycle, success factors, obstacles to usability practice and the personal skills required of a usability professional (Boivie et al., 2006; Gulliksen et al., 2004). Desirable qualities of the professional were perceived to be communication skills, the ability to work as part of team, networking skills, being both analytical and creative, and having the necessary technical skills and knowledge (Boivie et al., 2006; Clemmensen, 2005).

2.3.2 Perspectives of the professional

As previously mentioned, HCI is a multidisciplinary field; the HCI professional works with other disciplines within the system development lifecycle, and multidisciplinarity is also evident within the field of HCI itself. For example, methods used may be grounded in psychology, engineering or design practice, with different roles preferring different methods, dependent on their work goals. It follows, then, that just as there are differences between the HCI practitioner and other members of the system development team, there are likely to be role differences within HCI practice. These roles have different disciplinary backgrounds, different contexts of practice, and different goals, yet little is known of how they perceive the discipline of HCI, or how they perceive the other stakeholders that they work with. For example, whilst Gulliksen, Boivie and Göransson (2006) discuss the profile of the usability professional in the context of their roles and skills and whilst they do provide some discussion of the attitudes of the professionals, for the most part, this is generalised within the context of system development, and the difficulties in effecting the necessary changes in attitude of all stakeholders in the process to bring about the required changes in practice; the exception is the reporting of the attitude of usability professionals to the developers, who are described in disparaging language such as ‘geeks’. Likewise when Clemmensen (2005) discusses Danish usability specialists’ interest in theory and use of methods, he does not differentiate between the different roles of HCI professional.

One exception to this is the work of Putnam and Kolko (2012) who evaluated the requirement of HCI professionals to be able to ‘walk in the end-user’s shoes’, measuring the empathy and attitudes of UX centric and design centric roles towards the end user; they found designers to be more empathetic, but UX centric professionals more likely to refer to user centred design principles.

Most other research has examined differences in perceptions and attitudes between HCI professionals and other members of a development team. For example, in a later study Putnam et al. (2016) explore human-centred design from the perspective of the different roles of professional involved in the system development lifecycle (researchers, designers, developers and end users), and in particular how they describe their individual roles in relation to a user centred approach. They find that those with researcher roles have the highest human centred approach, and are likely to be involved with the user earlier in the product lifecycle. Similarly, Lárusdóttir, Cajander and Gulliksen (2014) noted variations between different roles of IT professional (scrum managers, team members, usability specialists and business specialists) when conducting user centred evaluations, finding that the business specialists tend to depend on asking users for their opinions, whereas the other roles used a wider variety of approaches to evaluation. In both of the above studies, however, the researchers do not take into account that the job roles, and therefore the work goals of the professionals are very different. For example, the user researcher by very definition of the role, requires early access to the user, and will necessarily adopt a number of approaches in order to carry out their function, whereas a business analyst, whilst also interested in the views of the user, will direct fewer resources towards this activity as it is less central to the primary function of their role.

As discussed above, the concept of usability is central to the practice of HCI. Hertzum and Clemmensen (2012) analysed what usability professionals understand by the term usability, finding that they are focused more on goal achievement (efficiency and effectiveness) than on the satisfaction (experiential) element of the ISO definition. This was followed by an analysis of the differing perspectives of usability from three separate viewpoints: that of usability professionals (referred to in this thesis as Practitioners), of system developers, and of users (Clemmensen, Hertzum, Yang, & Chen, 2013). This study identified some differences between the usability professional and the other groups. The usability professional was found to concentrate less on context-related UX than the user group. However, as discussed above, this is unsurprising and can be explained by the goals of their functional role; the users have a role related task to complete so will naturally be more focused on the context-related UX. This study found that the usability professional focuses more on user-relatedness and subjective UX than either the developers or the users; this is in contrast to the findings of Hertzum and Clemmensen's 2012 study which identified less of an experiential focus on the part of the usability professional. However, it is noted that the first sample size (n=24) was significantly smaller than the second (n=72) and it would be interesting to see the first study replicated with a larger sample size.

2.3.3 Conclusion: HCI practice

The primary emphasis of this section has been on HCI practice. It appears that the number of professionals benefitting from specialised education has not changed over the years with around half having formally studied HCI. Multidisciplinarity is very much in evidence, with evidence of collaboration between other members of the development teams being core, and usability and a user centred approach seen as fundamental to the HCI function. The emphasis of this varies, however, dependant on the role of the practitioner and the goals of their tasks. What is valued, unsurprisingly, is what is required to support the role: communication, team working and networking skills, the ability to be both analytical and creative, and having appropriate technical skills and knowledge. Although the literature does highlight differences between the roles, for the most part it focuses on the differences between the HCI practitioner and other members of the software development team rather than differences between the HCI roles.

In summary, the studies discussed above provide valuable snapshots of practice reflecting the tools and methods adopted and the background of HCI professionals. To some extent, they provide a comparison of the attitudes and perspectives of the roles of the HCI professional with other professional roles, particularly regarding perceptions of usability, and perception of the differing roles. However, there has been little research to date that concentrates specifically on the roles within the field of HCI; this thesis intends to address that gap.

2.4 HCI education

The previous section focused on HCI practice. This section concentrates on academia and commences with an overview of the position of computing in the UK school system before moving on to HCI education at higher level; although HCI is taught in a variety of programmes, in the UK it is most often found within the computing curriculum where HCI is only one area of study within a computer science course. Although not directly relevant to the research questions, prior to discussing the position of HCI within the Higher Education curriculum, it is necessary to understand a little bit about the position of computing within the UK education system and the poor reputation suffered by what was then referred to as Information and Communication Technology (ICT) courses (Brown, Sentance, Crick, & Humphreys, 2014).

This section then moves on to consider the findings of the previous section from the perspective of academia and delivering the curriculum.

2.4.1 The position of computing within the UK school curriculum

There has been a resurgence in the interest of computing within the UK school curriculum in recent years, but prior to that computing had become marginalised, with emphasis instead being placed on the use of applications such as word processing and spreadsheets. This resulted in a dilution of standards and a poor learning experience for students, many of whom were not challenged by the subject, and many students mistakenly believed that ICT and computer science were one and the same thing, which further damaged the reputation of the subject. As a result, computer science began to disappear from the curriculum (Brown et al., 2014).

Brown et al. provide a detailed account of the reintroduction of computer science into the curriculum, but in summary, in 2008 the Computing at School[6] group (CAS) was formed to promote the cause of computing and reverse this downward trend. In 2011 and 2012 a number of high profile organisations and individuals such e-skills UK (now known as the Tech Partnership[7]) which is the UKs sector skills council for the IT industry, the Confederation of British Industry (CBI[8]) which lobbies policymakers, and Google's executive chairman Eric Schmidt highlighted the deficiencies of the UK computing curriculum, and mainstream media started to report the stories. The Royal Society[9], the independent scientific academy of the UK and the Commonwealth, produced a report in January 2012 making recommendations that computer science should be reintroduced into schools. Recognising the transferrable skills such as problem solving and computational thinking afforded by the study of computer science, this was effected by the UK Department for Education; from September 2014, the English national curriculum requires that computing be delivered in English schools to all students from the age of 5 to 16.

Whilst the resurgence in the interest in computer science is welcome, it appears that HCI is marginalised in the school curriculum with only a brief mention at Key

[6] https://www.computingatschool.org.uk
[7] https://www.thetechpartnership.com
[8] http://www.cbi.org.uk
[9] https://royalsociety.org

Stage 3[10] (11 to 14 year olds) and no specific mention at Key Stage 4 (14 to 16 years olds), which incorporates the years of GCSE study (Department for Education, 2013). There is a little reference to HCI in the A level specification; for example, the OCR A level specification (OCR, 2014) makes several references to usability testing and evaluation but does not specifically mention HCI or UX principles or theory; however, within the AQA specification there is less emphasis (AQA, 2016). HCI has a better presence in the vocational equivalent of A levels: it is a core module in two of BTEC's Specialist Computing Diplomas and an option in several of the other offerings (Pearson, n.d.).

2.4.2 The higher education (HE) HCI curriculum

Clearly, HCI is also a subject for higher level study at both Masters' and PhD level (Dix, 2010; Dunford, 2016; Hornbaek, Oulasvirta, Reeves, & Bødker, 2015). In this thesis, references to education and the curriculum will refer to the taught element of Human Computer Interaction prescribed in the curriculum at both undergraduate and graduate level rather than areas for study via a research project.

In the UK, HCI is credited with more importance at higher level study than in the school curriculum, with some institutions including it as a specialism within their undergraduate programmes. For example, the University of Manchester offers BSc Computer Science (Human Computer Interaction) for 2017 entry, and there

[10]
- undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users
- create, reuse, revise and repurpose digital artefacts for a given audience, with attention to trustworthiness, design and usability

are similar offerings from Newcastle University, Brunel University London and The University of Dundee. The Quality Assurance Agency for Higher Education (the QAA) recommend that the latest curricula design of the ACM and IEEE should inform curriculum design for undergraduate computer science degrees (QAA, 2016, p. 11); within the 2013 Computer Science Curricula HCI is presented as both as a Core Tier-1 and Tier-2 subject, indicating that some HCI provision should be core in a computer science course (Association for Computing Machinery & Institute of Electrical and Electronics Engineers, 2013, p. 40). Beyond this, in the UK HCI is delivered as an option in many computing courses, and elements of human computer interaction are considered required for some courses accredited by professional bodies, for example, the Tech Partnership (2015) make specific reference to user centred design in documentation for their IT Management for Business degree programme.

However, it is noted that globally, just as HCI was not considered a priority in practice in developing countries (Smith et al., 2007), the importance warranted to HCI in the curriculum reflects the priority it is given by practice; for example, Sari and Wadhwa (2015) report that it is given less priority in developing countries such as Indonesia than in developed countries such as Australia.

2.4.3 The currency of the HCI curriculum

Just as practice modifies the tools and methods used to reflect current technology, so the curriculum changes to reflect both vicissitudes in practice and the most recent research. However, practice is generally time constrained and will move fast, creating and adapting tools as necessary to meet current needs;

curriculum development, in contrast, moves at a much slower pace, particularly if it is standardised at a national or regional level. For example, work on the Computer Science Curricula began in the autumn of 2010 and was published in December 2013 (Association for Computing Machinery & Institute of Electrical and Electronics Engineers, 2013).

There have been a number of initiatives to review the undergraduate HCI curriculum since the publication of the ACM SIGCHI Curricula for Human-Computer Interaction (Hewett et al., 1992), both in isolation and in the wider context of computing science, for example, the joint ACM and IEEE Computer Science Curricula mentioned above.

Literature discussing HCI education covers diverse areas including proposals for curriculum content, for example the work of Gulliksen, Boivie and Göransson (2006), as well as delivery approaches, for example Faiola's proposed application of the Design Enterprise Model (2007), and the benefits of collaboration between academia and practice, for example the collaboration of SwissCHI with Swiss universities (Mueller, 2007).

Characteristics of HCI practice are reflected in HCI education. For example, the inclusion of problem based learning pedagogy within a physical and a virtual HCI design studio (Koutsabasis & Vosinakis, 2012) reflects the close relationship of HCI and design, and Faiola's (2007) proposed application of the Design Enterprise Model to the HCI curriculum acknowledges the multidisciplinary approaches adopted in HCI practice, integrating elements of the social sciences (in particular elements of psychology and sociology), interaction and interface design, business awareness (in particular market awareness), and computing theory to support the conceptualisation, implementation and testing of interactive solutions.

However, by its very nature, HCI education is necessarily broader than HCI practice; in Dix's discussion of the academic discipline of HCI (i.e., academic research), he reflects on the dichotomy of the HCI curriculum, differentiating between HCI as a design discipline – employed by practitioners using *"skills, knowledge and processes in the production of devices, software and other artefacts"* – and HCI as an academic discipline focused on gaining understanding – *"how it **goes about** doing **what it is about**"* (Dix, 2010, p. 15). The very breadth of the field presents difficulties as to what should be included in the curriculum, and to what depth. For example, Gulliksen, Boivie and Göransson (2006) identify a number of items that ought to be included in an HCI curriculum to incorporate general IT practice knowledge, specific HCI topics, and a range of HCI practice specific skills, and whilst it is difficult to argue with any of the items on the list, as mentioned above, HCI is a only a part of many programmes of study, not the main focus of most programmes, and very often delivered by non-specialists (Read et al., 2009); if the list were to be included in its entirety, the delivery would be superficial (Grandhi, 2015). The charge of lack of relevance to practice levelled against academic research (see page 30 above) applies to HCI education as well as to academic research; the SIGCHI HCI Education project found that students and, to a lesser extent, academics are concerned that educators are familiar with the academic research side of HCI, but have had little or no exposure to practice, and subsequently do not provide students with an appropriate skillset so that they are prepared for a career in both practice and academia (Churchill et al., 2013a).

This has resulted in tensions that affect the both delivery of HCI education, and its perception by all roles of professional (Dunford, 2016; Grandhi, 2015). These, to some extent, arise from the multidisciplinary nature of the field; whilst the multidisciplinary nature of the field is seen as a positive, it is not possible to cover all areas in depth, resulting in course specialisation in some areas and a broader coverage of topics in another. However, equally the expectation exists that graduates will be prepared for employment with the requisite skills and knowledge, which may not be the case with a broad curriculum (Churchill et al., 2013a). Gulliksen, Boivie and Göransson (2006) note that a number of skills identified as contributing to success in practice are transferable skills resulting from academic research; however, university education alone is no substitute for hands on experience. Whilst it is important to address the skills and knowledge that graduates should possess when entering the job market (Buie et al., 2010), specific pedagogical or curriculum delivery approaches, for example project based learning or use of design studios are beyond the scope of this thesis and discussion of these will only be in general terms.

HCI may be recognised as important but the methods and theory taught as part of the HCI curriculum are not necessarily well understood in the wider field of software development (Collazos & Merchan, 2015), leading to mismatches between the application in practice within software development projects, and what is delivered in the HCI curriculum. One solution to this is greater collaboration between academia and practice, and there is evidence of successful collaboration between practitioners and education to develop educational programmes that meet the need of the market (Herbert et al., 2013; Mueller, 2007), and in particular, of the HCI community. Still closer collaboration between practice and education is recommended to ensure that what is taught meets the needs of practice, but also to ensure that practice is aware of current research (Collazos & Merchan, 2015).

As well as conference and journal publications, workshops targeting HCI education provide opportunities for national and international discussion, collaboration and debate. In recent years there have been events such as the long running series of HCI Educators international workshops and conferences which are often hosted at events such as the British HCI conference (the most recent being held in 2016 hosted by the Advanced Visual Interfaces conference in Italy), the Developing a Living HCI Curriculum to Support a Global Community workshop hosted by CHI in 2014, OzCHI 2014's HCI Education in Asia-Pacific and the Teaching HCI: A Living Curriculum hosted by AfriCHI in 2016. Similarly, the disciplinary commons in HCI Education created in the UK during academic year 2007/8 allowed academics to share practice and to reflect on their own teaching ('A Disciplinary Commons in Computing', 2007).

Other research into HCI education includes the output of the University of West London's Sociotechnical Centre for Innovation and User Experience; our HCI Education and Culture project has explored cultural differences and the cognitive styles of students in order to inform the curriculum taught in universities finding both cultural and cognitive differences between HCI students at universities in the UK, India, Namibia, Mexico and China who were engaged in a similar design and evaluation set of tasks. These differences were particularly apparent between HCI students from a design school and HCI students from engineering faculties when entrants to the courses were filtered by means of an entrance examination (Abdelnour-Nocera et al., 2013). The HCI Education and Culture project has also been informed by the initial findings from this current study observing differences in the cognitive profile of educators and practitioners. A number of publications have resulted from this project (Abdelnour-Nocera et al., 2013; Abdelnour-Nocera, Michaelides, Austin, & Modi, 2012; Austin & Abdelnour-Nocera, 2013, 2015; Austin, Abdelnour-Nocera, Michaelides, & Modi, 2012) as well as contributions to HCI Education workshops (Austin & Abdelnour-Nocera, 2014; Austin, Michaelides, Abdelnour-Nocera, & Modi, 2012).

The most significant research into HCI Education in recent years has been the ACM SIGCHI HCI Education project which will be discussed in more detail below.

2.4.4 The ACM SIGCHI HCI Education project

The SIGCHI Education project was conducted between 2011 and 2014, with the aim of investigating the underpinning philosophies and practices of HCI education. This was in response to requests from both HCI educators to assist curriculum planning, and from industry to ensure that practice is kept abreast of technological advances by informing staff development (Churchill et al., 2013b). The project has culminated in the creation of a HCI education community committed to the creation of a *“vibrant and content-focused living curriculum”* (Churchill, Bowser, & Preece, 2016, p. 73), and has generated global interest, most recently from the African HCI community (Peters et al., 2016) who identify three key qualities required by the HCI professional: creativity, curiosity and empathy.

The SIGCHI Education project had five main goals: (1) to identify which of the areas identified for inclusion in the 1992 ACM Curricula for Human-Computer Interaction (Hewett et al., 1992) were still relevant, which were no longer core topics, and which new areas should be considered for inclusion; (2) to gain a solid understanding of the content and structure of HCI education and training; (3) to understand how HCI education is experienced globally*, “especially by elucidating the differences between three key perspectives: students, academics, and practitioners”* (Churchill, Preece, & Bowser, 2015, p. 2); goals (4) and (5) were to understand how SIGCHI can support stakeholders in HCI education by providing key tools and resources via a community-led repository of educational resources. Of these, the third goal is of particular interest to this study.

It is not the intention of this thesis to replicate this research but rather to complement it. Whilst there is some overlap in the areas of investigation, and some commonality in the findings, the emphasis of this thesis is understanding the professional, rather than understanding the position of HCI education and the requirements of the curriculum.

Whereas this thesis is focused on educators, practitioners and those who both practice and educate ('Both'), Churchill , Preece and Bowser (2015) include students as well as educators (professors or academics) and practitioners (industry professionals) as primary stakeholders in the future of HCI education. Their respondents were asked to classify themselves as student, academic and/or industry professional, and respondents were permitted to select more than one category if appropriate. This potentially identifies my category of 'Both', and includes also part time students who are either educating or practicing. However, Churchill, Preece and Bowser's findings are reported only for each of the perspectives of student, academic or industry professional, with no differentiation or consideration of those who selected more than one role. Additionally it is noted that some respondents have been 'double counted' in the analysis of the data as the breakdown of roles (54% academics, 25% students and 34% industry professionals) results in more than 100%; the distribution of those who selected more than one category is not clear from the data provided. This is, none the less, the most significant project into HCI education in recent years, and a number of interesting findings have emerged of particular interest to this study, particularly with regards to what is valued.

Generally, design and empirical research methods were highly valued by all groups surveyed, with qualitative research regarded as supplementing quantitative research (Churchill et al., 2013a). There were, however, differences noted between the groups regarding what is valued in HCI teaching; in 2013 it was noted that industry practitioners value topics with more immediate application and relevance such as change management and product development, and do not value topics such as health informatics or ubiquitous computing. Conversely, the academics rated ubiquitous computing highly and change management low, perhaps reflecting the relative research opportunities associated with the topics (Churchill et al., 2013b). The latest report at time of writing (Churchill et al., 2016) notes further differences between what students, academics and industry professionals value, with the student valuing topics closely associated with more traditional computer science such as robotics and machine learning, the academics valuing discount usability techniques, along with more generalised topics such as statistics and computer supported collaborative work which support research activities, and the industry professionals valuing topics directly related to practice such as communication and business, alongside more HCI specific topics such as wire-framing and information architecture.

Despite the limitations of this study noted above, this is the most significant project into HCI education in recent years, and a number of interesting findings have emerged of particular interest to this study, particularly with regards to what is valued.

2.4.5 Conclusion: HCI education

The primary emphasis of this section has been academia and HCI education. Whilst the previous section discussed the literature in relation to reporting practice, differences between the roles, and values, priorities, concerns and issues (see section 2.3, page 32), this section has discussed the literature in the context of the implications of the above to the HCI curriculum.

As detailed in sections 2.4.1 and 2.4.2, there has been a resurgence of interest in computer science in the UK school curriculum, but this is not extended to include HCI which exists mainly as a topic of study at the higher level. The literature reflects that although academia moves slower than practice, there have been several initiatives to ensure the currency of the curriculum, and these do tend to reflect practice. The major problem experienced by academia results from one of strengths of the field: its multidisciplinary nature has resulted in a broad range of candidate items to include in the curriculum, and the competing tension of lack of time and resources may result in superficial coverage of some areas. Greater collaboration between practice and academia is recommended so that what is taught is relevant to practice and well understood by all in the software development arena.

There have been a number of initiatives to address these issues, most notably the SIGCHI Education project which has provided a stepping stone for further discussion in this area. These initiatives have resulted in an HCI Education community which is committed to developing a curriculum that meet the needs of practice, academia and students. The SIGCHI Education project reports that what is valued within HCI education varies according to the role of the stakeholder, with practitioners valuing what has immediate application to practice and academics valuing those topics which provide research opportunities. This thesis extends the SIGCHI Education project by including the values and priorities of those who combine education and practice as well those professionals who are specialists in those roles.

So far this chapter has focused on human-computer interaction. The remainder of this chapter will discuss theories of cognitive style and technological frames.

2.5 Cognitive style

As detailed above, a number of studies have focused on differing perceptions of practice amongst the roles (Clemmensen, 2005; Lárusdóttir et al., 2014; Putnam et al., 2016; Putnam & Kolko, 2012). However, there has been less research into understanding the cognitive profile of the HCI professional, and, in particular, how the profile of the HCI professional differs from that of other roles. In order to explore this further, the next section will consider how theories of cognitive style can support research in this area.

Styles research is an umbrella term that covers several different foci. Acknowledging this, Zhang and Sternberg (2005) propose the term 'intellectual style' which encompasses various types of style research to include the range of style constructs, for example, cognitive style, learning style and problem solving style; they refer to intellectual style as the individual's preferred method of processing information and handling tasks, considering it in varying degrees to be cognitive, affective, physiological, psychological and sociological. In this thesis, I refer to the cognitive profile of the individuals, which although it incorporates many elements of Zhang and Sternberg's definition of intellectual style is focussed on Analytical/Intuitive preferences and Visual Object, Visual Spatial and Verbal abilities.

There have been differences noted between the intellectual styles of members of different professions, for example, when processing information, scientists (for example, computer scientists or engineers) are found to be more context independent, whereas visual artists (for example, designers), although more generally context dependent, are able to consciously adopt either context dependent or independent approaches dependent on the requirements of the task in hand (Blazhenkova, Kozhevnikov, Zhang, Sternberg, & Rayner, 2012).

Style research also indicates that there are differences between roles of professionals within a particular field, and that these are particularly notable when comparing those with an academic background with those in the field. For example the work of Curry (1991) identifies differences in the learning style of university and community based medical specialists, as well as differences between surgeons, paediatricians and family physicians.

Within the literature, the terms most commonly used are ‘learning style’ and ‘cognitive style’. These terms are often used interchangeably, and even within the community of specialist style researchers there is debate regarding which is the broader and more encompassing term (Peterson, Rayner, & Armstrong, 2009). This thesis refers to the cognitive profile of the HCI professional, which is considered to be broadly equivalent to the Zhang and Sternberg definition of intellectual style above, particularly when considered within the context of technological frames theory which is covered in section 2.6 below. Drawing upon this broad definition, this section intends to probe this area further by providing an overview of style research before moving on to consider those elements of style theory that are particularly relevant to HCI.

2.5.1 Challenges of style research

Style research is not without its critics. It has been criticised as being conceptually unclear and reviews of the literature demonstrate varied theoretical backgrounds and domains of application (Cassidy, 2004; Coffield et al., 2004b; Kozhevnikov, 2007). Proponents of styles research themselves acknowledge this as problematical (Peterson et al., 2009; Rayner & Cools, 2011) incorporating as it does a wide range of differing and conflicting theoretical and methodological style models from various fields, including psychology, education and management. This, combined with little differentiation between styles, personality and ability (Zhang, Sternberg, & Rayner, 2012), has led to criticisms of fragmentation across the disciplines and domains, and a lack of research rigour and a lack of relevance, with many psychology researchers now consciously avoiding the term due its negative connotations, preferring instead to refer to affordances or dispositions (Kozhevnikov, Evans, & Kosslyn, 2014).

One of the most cited and critical reviews of learning styles is that of Coffield et al. (2004a) which was one of two studies into learning styles models commissioned by the Learning and Skill Research Centre (LSRC). The LSRC was supported by the Department for Education and Skills and the Learning Skills Council to focus solely on post-16 learning and as a result, most of the findings of this study were related to post-16 education and training, with particular emphasis on schools and FE institutions in the UK. The study consisted of a systematic and critical review of 71 models of learning styles, which were categorised into 13 major models. Each of these models was evaluated using the same framework, considering not just the validity and reliability of each model, but also the pedagogical considerations. The models under consideration included models based on genetic factors, cognitive styles, stable personality types, flexibly stable learning preferences and learning approaches, as well as commercial models such as Honey and Mumford (1992). They conclude that the *"theories and instruments are not equally useful"*, with some models being more appropriate for particular learner profiles, and *"there is no consensus about the recommendations for practice*" (Coffield et al., 2004a, p. 119). Six models were, however, identified as meriting further research, including the Allinson and Hayes Cognitive Style Index (1996) which will be discussed in more detail in section 2.5.4 below.

2.5.2 Application of styles research

The primary domain of application of styles research is that of education and pedagogy (Evans & Cools, 2011; Waring & Evans, 2014) which is outside the scope of this thesis. However, the application of styles research extends beyond education to both business and management. It can be of benefit to both the individual and the organisation, for example, supporting career management, or work performance. Assuming that intellectual style is malleable rather than fixed (Zhang, 2013) individuals can be trained to develop particular strategies to address individual style weaknesses, and coping strategies to deal with individuals whose style is at variance with their own, thereby increasing their individual career opportunities. Applied at an organisational level, this approach may assist matching individuals with particular roles, with conflict management, with team composition and with planning succession management, resulting in more productive use of human resources (Armstrong, Cools, & Sadler-Smith, 2012; Armstrong, Heijden, & Sadler-Smith, 2012).

2.5.3 Cognitive style and human-computer interaction

As discussed, cognitive, or learning style theory is a complex area and there are many instruments to determine the different perspectives of cognitive style. However, when considering cognitive style in the context of human-computer interaction, some elements of style are more relevant than others. For example, the role of the HCI professional requires excellent communication skills, and often includes elements of design. It follows then, that those instruments that focus on verbal and image processing may be of use when considering a cognitive profile. Additionally, the professional will often adopt an analytical or a holistic approach, so an instrument that measures whether the approach tends towards the analytical or the intuitive may be of value.

Many of the instruments do in fact purport to measure these dimensions. Riding and Cheema's (1991) analysis of the labels used in style research resulted in two categories of cognitive style family, the wholist-analytical and the verbalizer-imager, and these two dimensions of style form the basis of Riding's commercially licensed computer test, the Cognitive Styles Analysis (CSA). Although the CSA has been used in studies involving design students (Lawler, 1996; Pektas, 2010), critics of the CSA judge this instrument to have poor test-retest reliability, (Coffield et al., 2004a; Parkinson, Mullally, & Redmond, 2004;

Peterson, Deary, & Austin, 2003), and as a result, this instrument was not considered for this study. Instead, the Cognitive Styles Index (Allinson & Hayes, 1996) and the Object-Spatial Imagery and Verbal Questionnaire (Blazhenkova & Kozhevnikov, 2008) were identified as appropriate instruments, and were adopted for use both in this study and the wider HCI Education and Culture project led by the University of West London's Sociotechnical Centre for Innovation and User Experience (see page 45 above).

2.5.4 The Cognitive Styles Index

One of the most frequently used instruments in styles research is the Cognitive Styles Index or CSI (Allinson & Hayes, 1996). This originated from prior research where Hayes and Allinson tested the hypothesis that culture would account for differences in learning style in a study involving managers from East Africa, India and the United Kingdom. Using Hofstede's (1984) four dimensions of Power Distance, Uncertainty Avoidance, Individualism-Collectivism and Masculinity-Femininity, and the Theorist and Pragmatist scores of Honey and Mumford's (1992) Learning Style Questionnaire, they identified two dimensions of learning style, Analysis and Action (Hayes & Allinson, 1988). Further work in this area resulted in the CSI which is designed to test whether individuals tend more towards an intuitivist or analyst approach.

The CSI was developed with the aim of producing a compact but psychometrically sound instrument, easy to administer and appropriate for use with large scale organisational studies. A series of 38 questions with a possible response of true-uncertain-false test whether the subject tends more towards an intuitivist or analyst, producing five notional styles of Intuitive, Quasi-Intuitive, Adaptive, Quasi-Analytical and Analytical. Intuitivists are seen to *"be relatively nonconformist, prefer an open-ended approach to problem solving, rely on random methods of exploration, remember spatial images most easily, and work best with ideas requiring overall assessment"* whilst analysts *"tend to be more compliant, favour a structured approach to problem solving, depend on systematic methods of investigation, recall verbal material most readily and are especially comfortable with ideas requiring step by step analysis".* Those who are Adaptive are equally happy with either approach (Allinson and Hayes, 1996).

Application of the CSI suggests that there is a relationship between the cognitive profile of the individual and their occupation. Those in creative industries tend more towards the intuitive end of the spectrum, whilst those in professions that require a more disciplined and systematic approach tend more towards the analytical (Allinson & Hayes, 2012).

Not only is the CSI widely used, but it was also the only instrument of the thirteen selected by Coffield et al. (2004a) which met all four criteria of internal consistency, test-retest reliability, construct validity and predictive validity. It should be noted, however, that Coffield et al. were evaluating the instruments in the context of post-16 learning, and they deemed the use of the CSI to be more relevant in an organisational or business setting than with students.

The original version of the CSI assesses the unitary construct of intuition/analysis. However, there has been open criticism of this approach with

Hodgkinson and Sadler-Smith (2003a) favouring Epstein et al.'s (1996) cognitive-experiential self-theory (CEST) position that the analytic-rational and the intuitive-experiential are separate systems that work both independently and in parallel with each other, and therefore a unitary construct is not appropriate. They posit instead that intuition and analysis should rather be considered as separate unipolar scales, and have produced a modified version of the CSI resulting in the four dimensions of high analytic/high intuitive, high analytic/low intuitive, low analytic/high intuitive and low analytic/low intuitive. This criticism of the original version of the CSI has resulted in vigorous debate within the styles community, with some researchers favouring the modified version of the CSI (Hodgkinson & Sadler-Smith, 2003a, 2003b; Hodgkinson, Sadler-Smith, & Sinclair, 2014), and others defending the position of Hayes and Allinson (Allinson & Hayes, 2012; Armstrong & Qi, 2016; Hayes, Allinson, Hudson, & Keasey, 2003). Kozhevnikov, Evans and Kosslyn (2014) present both viewpoints in their proposed cognitive-style framework, and accept as reasonable the defence of Hayes et al. that acknowledgment of Epstein's CEST does not preclude the existence of a single continuum of intuition-analysis governed by a common set of principles.

In practice, both versions of the instrument are adopted in research studies, with the modified version being preferred within particular domains and research communities. For example, the modified version was selected for its increased utility within the context of teacher training, providing as it does the four dimensions of high analytic/high intuitive, high analytic/low intuitive, low analytic/high intuitive and low analytic/low intuitive (Evans, Graff, Evans, & Waring, 2008; Evans & Waring, 2011) whereas Hammad Farrag's (2011) study of entrepreneurial behaviour supports the original unitary dimension. It should be noted, however, there is less normative data published for the modified version of the CSI; Frampton et al. (2006) in their study of information architects select the original version on the basis of insufficient adoption of the revised version.

Coffield et al. (Coffield et al., 2004a) consider both versions of the instrument to be valid and reliable. As this thesis is concerned with practice rather than pedagogy, the original version of the CSI (Allinson & Hayes, 1996) has been applied rather than the modified version.

2.5.5 The Object-Spatial Imagery and Verbal Questionnaire

The Object-Spatial Imagery and Verbal Questionnaire or OSIVQ (Blazhenkova & Kozhevnikov, 2008) is also a self-report instrument, consisting of 45 statements which are designed to assess Visual Object ability (the ability to construct vivid, concrete and detailed images when using recollection), Visual Spatial ability (the ability to perform complex spatial transformations and to use schematic imagery to represent spatial relations among objects) and Verbal ability (the ability to use verbal-analytical tools when approaching cognitive tasks). 15 statements are associated with each dimension, and each statement is scored from 1 to 5, with 1 indicating that the respondent totally disagrees with the statement and 5 indicating that the respondent totally agrees with the statement. This results in an average score between 1 and 5 for each of the dimensions.

The OSIVQ resulted from Blazhenkova and Kozhevnikov's perceived limitations of previous studies of the visual-verbal cognitive style. Their review of the literature highlights two main approaches to visual/verbal research: firstly, self-report questionnaires which are criticised as having low internal reliability, and secondly, objective measures, such as Riding and Rayner's CSA mentioned above which are criticised as having poor construct validity, potentially assessing an individual's speed of processing rather than a processing preference. These objective studies also found no clear relationship between the visual measures of visual style and the performance when undertaking visual-spatial tasks. Some of these shortcomings are attributed to many of the studies being descriptive and not relating the cognitive styles to cognitive science theories.

Whereas previous studies using self-report questionnaires mostly used a single scale, categorizing individuals as either visual or verbal, Blazhenkova and Kozhevnikov in contrast apply cognitive science findings to the visual-verbal cognitive model. They reject the bipolar model of visual-verbal cognitive style in favour of current neuroscience research that defines visual and verbal systems as being relatively anatomically and functionally independent (Gevins & Smith, 2000; Motes, Malach, & Kozhevnikov, 2008). They also apply neuropsychological research findings that suggest "*an* object imagery system *that processes the visual appearance of objects and scenes in terms of their shape, colour information and texture and a* spatial imagery system *that processes object location, movement, spatial relationships and transformations and other spatial attributes of processing*", and adopting the terms 'object visualizers' and 'spatial visualizers' (Blazhenkova and Kozhevnikov, 2008). This distinction had already resulted in the Object-Spatial Imagery Questionnaire or OSIQ (Blajenkova, Kozhevnikov, & Motes, 2006) which reports significant correlation between performance on the object imagery tasks and the object imagery scale, and the spatial imagery tasks and spatial imagery scale. The purpose of their 2008 study was twofold: to propose a third independent dimension of cognitive style, the verbal dimension, and to design and validate a self-report instrument to assess these three dimensions by extending the OSIQ which differentiates between object imagery and the spatial imagery. The objective was to produce an instrument that would allow them to also assess subjective aspects of imagery in a cost effective and efficient manner and at the same time extend the range of verbal assessment to include problem solving, learning and professional preferences.

Of particular interest to this thesis is that their findings demonstrate a relationship between the three OSIVQ dimensions and an individual's professional specialisation and choice of educational direction. Distinct differences were observed between humanities professionals, visual artists and scientists. For example, the humanities professionals' Verbal ability scores were significantly higher than those of both visual artists and scientists, whilst the object imagery scores of the visual artists was higher than those of both the scientist and the humanities professional, and the spatial imagery scores of the scientists was higher than those of the other two groups. These differences support the suggestion of Hayes and Allinson (2012) that there is a relationship between cognitive style and choice of profession.

Applications of the OSIVQ have included the influence of cognitive style on students' mathematical or artistic ability (Pérez-Fabello, Campos, & Campos-

Juanatey, 2016; Pitta-Pantazi, Sophocleous, & Christou, 2013; Xistouri & Pitta-Pantazi, 2011), the matching instructional mode to cognitive style (Thomas & McKay, 2010) and of particular interest to this thesis, the strategic focus and the commission of errors during team work activities (Aggarwal & Woolley, 2013). Aggarwal and Woolley find that teams which are high in Visual Spatial ability are more process focussed than those that are high in Visual Object ability, and that team members' cognitive style influence both strategic focus and strategic consensus, which in turn influence the commission of errors during team work activities.

2.5.6 Cognitive profiles

As discussed in section 2.5.3 above, when considering cognitive style and human-computer interaction those instruments that that measure whether the approach tends towards the analytical or the intuitive, or focus on verbal and image processing may be of value.

Both the CSI (Allinson & Hayes, 1996) and the OSIVQ (Blazhenkova & Kozhevnikov, 2008) discussed above have been used alongside other instruments to create cognitive profiles. The OSIVQ is the newer tool and has been less widely employed. It has, however, been used to profile psychology students (Campos & Campos-Juanatey, 2014), fine art students (Pérez-Fabello et al., 2016), and primary school teachers (Pitta-Pantazi et al., 2013). The CSI is a well-established instrument and has been used to produce a diverse range of cognitive profiles. For example, Moore, O'Maidin and McElligott (2003) find that computer science students with analytical preferences are more likely to have above average performance scores than those with a preference for intuition, Armstrong and Hird (2009) report that entrepreneurs tend to be more intuitive than the general population and Chaffey, Unsworth, and Fosse (2012) made use of the CSI to create a profile of occupational therapists in mental health practice, finding a difference between novice and experienced practitioners.

Both analytical and visual ability were considered by Frampton et al. (2006) who compared profiles of IBM certified and uncertified IT architects with the assumption that the certified would be more highly skilled than the uncertified. They identified four measurable capabilities of skilled and practicing IT architects, namely analysis, conceptualisation, problem solving and future vision. Analysis was measured using the CSI (Allinson & Hayes, 1996), and conceptualisation, which was defined as the ability to visualise complex structures, was measured using the original version of the Vividness of Visual Imagery Questionnaire – the VVIQ (Marks, 1973); this study was completed prior to the design of the OSIVQ (Blazhenkova & Kozhevnikov, 2008). Although differences were observed between the two groups for problem solving and future vision, these differences were not apparent when comparing the capabilities of analysis and conceptualisation. Frampton et al. speculate that as analysis is intrinsic to the role of IT architect, it may not be a differentiator. As they also suggest that the lack of difference in the VVIQ results could be a limitation of using a verbal questionnaire to evaluate visual ability, it may be that they do not regard the ability to visualise complex structures as intrinsic to that particular role.

2.5.7 Conclusion: cognitive style

The literature suggests that despite criticisms of learning styles research, the most cited being the report by Coffield et al. (2004a), some instruments are of value. In particular, the Cognitive Style Index (CSI) of Allinson and Hayes (1996) was identified by Coffield et al. as being robust, and appropriate for use within an organisational or business setting. The Object-Spatial Imagery and Verbal Questionnaire or OSIVQ (Blazhenkova & Kozhevnikov, 2008), which was developed after the Coffield report was published, has its theoretical roots in cognitive neuropsychological research. Whilst there is a relatively small body of literature that refers to the OSIVQ, it has been employed in a number of studies in the field of mathematical or artistic ability, matching instructional mode to cognitive style and the strategic focus and the commission of errors during team work activities.

Both instruments have been used to produce cognitive profiles for a variety of roles. As discussed above (see page 57 and page 61), the results of studies using both the CSI and the OSIVQ suggest that there is a relationship between cognitive style and professional specialisation, and use of these two instruments may contribute towards the profile of the HCI professional, and may differentiate between the roles of Educator and Practitioner. However, instruments designed to capture cognitive style can only provide a partial profile of the professional, and therefore this study incorporates interviews as well as cognitive style surveys.

The next section will discuss the concept and utility of technological frames.

2.6 Technological frames

A technological frame, sometimes referred to as a technological frame of reference, is a cognitive device that allows an individual to make sense of technology in a particular context by structuring their previous experiences and knowledge (Lin & Silva, 2005). Whilst technological frames do not directly address any of the research questions, they do provide utility by offering a framework with which to systematically analyse the perceptions of members of the same social group, for example, Educators, and compare them with the perceptions of another social group, for example, Practitioners, and to explain the differences between the groups. In situations where various social groups (i.e., different roles of professional) have alternate views of the same technological area (i.e., HCI), a technological frames perspective can support the conceptualisation of these differences. The literature above has highlighted some of the differences between the roles of the professional working in the field of system development as well as some differences between the roles of those working in the associated field of HCI. These differences have resulted in criticisms of both HCI practice and HCI education. Gulliksen et al. (2004) note the variety of job titles and differing areas of professional activity, and this is echoed by Carroll (2010, p. 11) who describes HCI having "*no … specified set of practices*". On a similar theme, Churchill, Bowser and Preece express concern that despite there being a clear demand for the skillsets, the lack of consensus and clarity regarding HCI education limits our ability to state the value proposition of HCI education (Churchill et al., 2013b).

Of particular interest to this thesis are the differences in perception of various roles of professionals when considering their own areas of professional practice or particular aspects of practice. This includes, for example, the different use of the terms ‘usability’ and ‘user experience’ by those who work in academia or industry (Law et al., 2009) and differences in what is valued by students, academics and industry professionals (Churchill et al., 2016).

In order to situate this discussion within the literature, the first section below introduces the concept of technological frames and an overview of its application to research within the IT industry; the next section discusses what it is that constitutes technology, and then the discipline of human-computer interaction is discussed in the context of technology.

2.6.1 The history of technological frames

Technological frames derive from the Social Construction of Technology (SCOT). SCOT describes the development of technology as an interactive process, shaped by social factors and the various social groups with a particular interest in a particular technology; it may result in different social groups interpreting the same technology differently (Pinch & Bijker, 1987). There are differing definitions of technological frames and technology within the literature (Bijker, 1987; Davidson, 2006; Gal & Berente, 2008; Kaplan & Tripsas, 2008; Orlikowski & Gash, 1994; Pinch & Bijker, 1987), and differing applications of the theoretical framework.

2.6.1.1 Bijker

Bijker first introduces the concept of a technological frame when developing his theory of invention, which he defines as being “*composed of, to start with, the concepts and techniques employed by a community in its problem solving”* (Bijker, 1987, p. 168). In his definition of the technological frame he discusses problem solving in the context of what constitutes a problem, the strategies available to solve the problem and the requirements a solution has to meet, including both socio-cognitive and technical aspects; the elements of a technological frame are defined as a combination of current theories, tacit knowledge, engineering practice, specialised testing procedures, goals, and practices of use.

Pinch and Bijker’s (1987) discussion of technology in the context of the Sociology of Technology results in a descriptive model, focusing on the meaning given by different social groups to an artefact, hence the designation ‘Social Construction of Technology’ (SCOT). Their account incorporates both technical and non-technical elements, resulting in a symmetrical account of both successful and failed artefacts. Bijker later extended this model to include the concept of social inclusion within a particular group (Bijker, 1987, 1997, 2001). The following section will discuss Bijker’s definition of a social group, technological frames, and inclusion in relation to this thesis.

Although Bijker is describing technological advances, he considers a technological frame to be a broad concept which can also be applied to non-engineers as well as engineers; he describes it as *“a frame with respect to* *technology, rather than as a technologist's frame"* (Bijker, 1987, p. 172). This is particularly relevant to this thesis as the roles and backgrounds of the HCI professional are diverse; some may work closely with the underpinning technology, but other roles may be very different, requiring 'soft' skills not normally associated with the role of an engineer.

Bijker's definition applies to the interaction of the professionals concerned: *"frames are located* between *actors, not* in *actors, or* above *actors"* (1987, p. 172); that is to say that technological frames are not a characteristic of an individual, a system or an institution. According to the SCOT, members of a particular social group jointly attach the same meaning to an artefact, and this shared meaning structures the interaction between members of a particular social group. Inclusion in a technological frame can be specified by describing the elements of the frame which are detailed above, for example, the goals or problem solving strategies, and the shared meaning is dependent on the degree of inclusion of that actor within that particular technological frame. It should be noted, however, that actors can be members of different social groups, for example they may be both an educator and a practitioner, or an interaction designer and a developer, and as a result, they may have different degrees of inclusion within various technological frames (Bijker, 1987, p. 174).

The meaning attached to an artefact may differ from social group to social group; for example, an artefact may be seen in a positive light by one group, but by another group it may be regarded negatively. This is described as *"interpretative flexibility"* (Bijker, 2001, p. 26). As a result, problems seldom have the same pertinence for all social groups. Where there is no clearly identifiable dominant technological frame, there exists a variety of approaches to problem solving; if however, there is a dominant technological frame, the approaches to problem solving will be influenced by the level of inclusion within that technological frame. Those with high inclusion will be more likely to adopt established problem solving approaches, whereas those with low inclusion are more likely to question the basic assumptions of that particular technological frame and are less likely to draw on the standard problem solving strategies of that technological frame.

It is noted that the involvement of powerful or influential stakeholders and the influence of organisational and intra-organisational culture and politics can influence the interpretative processes and affect the framing and reframing process, and this in turn may influence the formation of a dominant frame, both in terms of content and direction (Davidson, 2006; Lin & Silva, 2005).

2.6.1.2 Orlikowski and Gash

Above I have described how Pinch and Bijker describe technological frames in the context of engineering practice. However, the technological frame concept most widely used when discussing IT systems is that of Orlikowski and Gash (Orlikowski & Gash, 1994); they discuss the concept of shared cognitive frames used to make sense of information technology within organisations, which they also refer to as technological frames. Orlikowksi and Gash discovered significant differences in the technological frames of users and technologists during an implementation of Lotus Notes, concluding that various groups share a particular interpretation of what a technology means. As with the Bijker definition, this interpretation may vary from group to group and it will structure their interaction with that technology, but unlike Bijker, they consider the socio-cognitive and technological aspects of the technological frames to be distinct.

Orlikowksi and Gash's emphasis is on the interaction with technology, which in the context of this thesis is interaction with HCI tools and techniques. They define technological frames as "*that subset of members' organizational frames that concern the assumptions, expectations, and knowledge they use to understand technology in organizations. This includes not only the nature and role of the technology itself, but the specific conditions, applications, and consequences of that technology in particular contexts"* (Orlikowski & Gash, 1994, p. 178). Their framework is often cited in longitudinal studies within a specific organisation to explain aspects of technology such as attitudes towards IT features, organisational application of IT, the incorporation of IT into work processes, or the development of IT applications (Davidson, 2002, 2006; Lin & Silva, 2005; Olesen, 2014; Orlikowski & Gash, 1994).

Different groups may have different perspectives, and the perspective of one group may be different from that of another group, but within the group, for the most part, the perspectives are shared, together with the particular interpretation of what a technology means; this will structure their interaction, application, value and appreciation of that concept. If the practice of HCI is considered to be a technology, then technological frames can be used to explore the *"underlying assumptions, expectations, and knowledge"* of members of a particular social group which result in a shared meaning. As with the Bijker definition, this shared meaning structures their interaction according to their degree of inclusion within that technological frame (Orlikowski & Gash, 1994, p. 194). Understanding people's interpretation of technology is critical to understanding their interaction; as they make sense of the technology they develop assumptions and expectations and further understanding of that technology, much of which is implicit.

2.6.2 Application of technological frames research

As discussed above, the primary application of technological frames research is that of information systems and associated areas, for example, user acceptance, usability and usefulness of systems (Abdelnour-Nocera, Dunckley, & Sharp, 2007; Karsten & Laine, 2007; Shaw, Lee-Partridge, & Ang, 1997).

Lin and Silva's (2005) discussion of the social and political construction of technological frames in the context of the adoption and acceptance of information systems propose that incongruent technical frames should be identified early in the project lifecycle, in order to reframe or influence understandings or expectations.

Although the application of the theoretical lens of technological frames may help understand and explain users' perceptions of information systems, criticisms of the technological frames framework include that its popularity may have led to uncritical use (Davidson, 2006; Gal & Berente, 2008).

Gal and Berente (2008) criticise the use of technological frames in IS implementation studies as being too restrictive. They highlight the risk of mistaking the symptoms of drivers and impediments to IS implementation for the causes, positing that the more holistic theories of social representation can better account for the complexities inherent in the implementation of information systems.

Davidson (2006), on the other hand, acknowledges both the value and the limitations of technological frames research to address the interpretation of IT within organisations and organisational change. In order to address the limitations, she proposes new research strategies to extend the framework and maximise the potential of technological frames research. Orlikowski and Gash (1994) consider the frame structure and the frame content as separate entities. They define the frame structure as having 'common categories' and being constructed from domain knowledge, meaning that it can therefore be abstracted and generalised, as opposed to the frame content, which is defined as 'similar values on the common categories', being constructed from specific knowledge of that particular domain, and therefore context specific. Davidson (2006) suggests that to extend this framework by focussing on the frame structure rather than the frame content would facilitate cross-case comparative analysis.

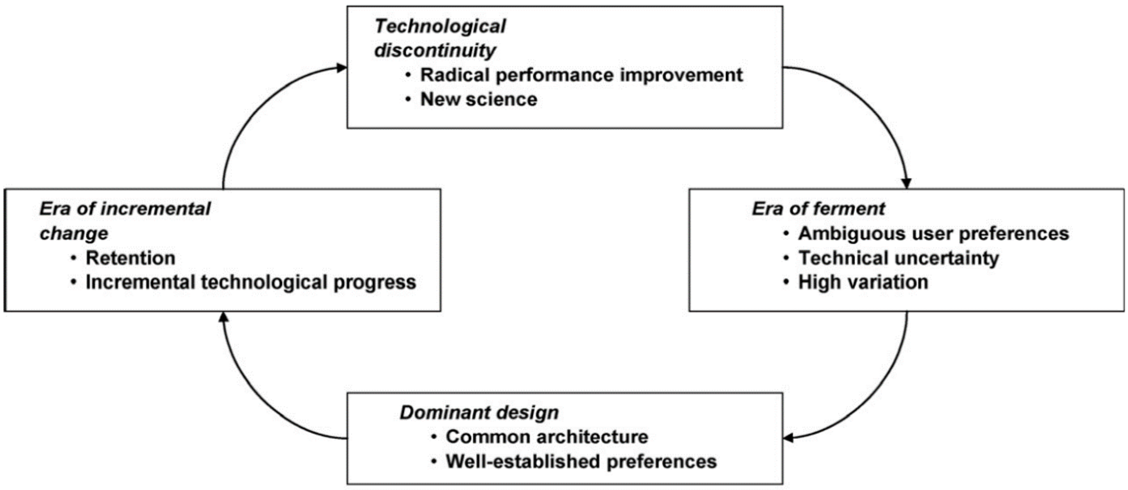
2.6.3 Human-computer interaction as a technology

Much of the technological frames literature reviewed above centres on the implementation of information systems within an organisation. This thesis, however, considers technological frames in a wider context. Whilst the implementation of an information system implies a project, which is a temporary venture with discrete deliverables and a clear start and end, HCI practice is not a project, and in common with other technology practice, such as programming, HCI practice necessarily evolves in order to satisfy the changing needs of the face of technology.

Above, there is reference to HCI practice as a technology. Kaplan and Tripsas (2008) discuss technological frames in the context of evolutionary models of technological change. They use the term ‘technology’ in the context of a particular physical product, such as typewriters, to include the physical manifestation of the knowledge as well as the embodied knowledge. Clearly, there is no physical product in the case of HCI practice, but none the less, there are some parallels which can be drawn if the emphasis is on the tools and methodologies utilised to develop a deliverable, rather than the deliverable itself, which may be either a physical or digital product, or documentation (Clemmensen, 2005, p. 49).

Kaplan and Tripsas identify three key sets of actors whose technological frames of reference are likely to be diverse, namely producers of technology, users of technology, and institutional actors (stakeholders such as government bodies, user groups, standards bodies, and other organisations with influence or regulatory power). They extend the conceptualisation of the actual frame to differentiate between the frame of the competing actors, specifically producers, users and institutional actors, and the collective frame that emerges as a result of the interpretations of those actors. They argue that it is this collective technical frame which affects the direction of technological development; the diversity of the position and the priorities of the different actors may lead to conflicting issues and political machinations to establish predominance in the industry, and competing frames between the actors may impede the development of a dominant collective frame, but unless the conflicting technological frames are resolved, a dominant design may not emerge from the process.

Kaplan and Tripsas (2008) apply a cognitive lens to the standard technology cycle (Anderson & Tushman, 1990; Tushman & Rosenkopf, 2008) to explain changes in technology that cannot be predicted by economic or organisational factors alone, resulting in their technology lifecycle model (Figure 2-1 below).



Adapted from Tushman and Rosenkopf, 1992

Figure 2-1 Kaplan and Tripsas Technology life cycle model (2008)

The first two phases of the technology life cycle model, the era of ferment and the convergence on a dominant design are pertinent to this thesis and are briefly described below.

During the ‘era of ferment’, new technologies emerge. However, actors are having to make sense of these new technologies whilst the new technological frames are still being created. As the technological frames do not yet exist, actors will make sense of the new technologies by referencing similar existing technologies, prior experiences or prior influences, and these technological frames may be diverse. The higher the variety of prior technical frames utilised, the greater the technical variation.

The phase following the ‘era of ferment’ is described as ‘convergence on a dominant design’ – during this phase, the producers often adopt the role of ‘sense makers’ of the technology, and in the process of endorsing the dominant design, thereby consolidate the position of the dominant technical frames. However, prior to the adoption of a dominant design conflicting frames need to be resolved; the SCOT stance that this is influenced by political and organisational issues as well as technological concerns (Anderson & Tushman, 1990) is reflected in the cognitive perspective of Kaplan and Tripsas (2008) who suggest that the dominant design originates from those actors who strategically promote their technological frames as well as their preferred technology.

These two phases are followed by the era of incremental innovation and technological discontinuity. These two phases are outside the scope of this review and will not be discussed.

2.6.4 Conclusion: technological frames

The literature provides a number of different definitions of technological frames which can be used to describe engineering practice or to make sense of IT systems, the best known of which are those provided by Bijker (1987) and Orlikowski and Gash (1994). However, what is common for all definitions is that the interpretation of technology may vary from group to group, with different groups having a different perspective of the same phenomenon, but within a particular group, for the most part, the perspectives and interpretation of technology are shared, structuring their interaction, application, value and appreciation of that concept according to their degree of inclusion within that particular technological frame. As people make sense of technology, their understanding of that technology increases. Kaplan and Tripsas (2008) discuss technological frames in the context of evolutionary models of technological change, identifying three key sets of actors whose technological frames of reference are likely to be diverse, namely producers of technology, users of technology, and institutional actors, and they introduce the concept of a collective frame that emerges as a result of the interaction of these three groups which shapes the direction of technological direction. In the context of this thesis, HCI is considered to be the technology in question.

2.7 Conclusion: literature review

Detailed conclusions resulting from the findings of the literature are discussed at the end of each section above; this final section describes the direction that this study will take to address the gaps which have been identified as a result of the review of the literature.

The research questions outlined in section 1.6 above are designed to explore how the profile of the HCI professional differs according to role, and the impact of this upon practice, curriculum design and delivery. RQ1 is concerned with cognitive differences, and RQ2 probes differences in respect of background, what is valued, and concerns and issues. RQ3 considers the impact of these differences upon the curriculum.

As detailed in section 2.3, the literature does describe some differences in the profile of professionals, but studies have mainly focused on differences in practice, or differences between HCI professionals and other members of the development team (Churchill et al., 2013a; Clemmensen, 2005; Gulliksen et al., 2004; Rogers, 2004). Little research has been done to differentiate between the profiles of HCI professional. Similarly, the review of the literature revealed that very little research has been conducted in the area of cognitive style of the HCI professional, and the majority of the focus on differing perceptions of practice amongst the roles has centred on the difference between the HCI practitioner and other members of the software development team rather than differences between HCI roles. This research intends to address those gaps by differentiating between the roles of the HCI professional, and by including a cognitive profile of the professionals.

As discussed above in section 2.5, the field of styles research is not without its critics (Coffield et al., 2004a; Kozhevnikov, 2007; Peterson et al., 2009; Rayner & Cools, 2011), and not all instruments that purport to measure style are relevant to this thesis. However, the CSI (Allinson & Hayes, 1996), which measures the intuitive/analytical spectrum, and the OSIVQ (Blazhenkova & Kozhevnikov, 2008), which measures object and spatial visual ability and verbal ability have been identified as relevant to the field of HCI, and previous studies using these instruments suggest a relationship between cognitive style and professional specialisation (Allinson & Hayes, 2012; Blazhenkova & Kozhevnikov, 2008). Both tools have been used in conjunction with other instruments to produce profiles of different roles, students (e.g. Campos & Campos-Juanatey, 2014; Moore, O'Maidin, & McElligot, 2003), IT architects (Frampton et al., 2006), entrepreneurs (Armstrong & Hird, 2009) and occupational therapists (Chaffey et al., 2012), and this study will likewise employ those instruments in conjunction with interviews.

RQ3 considers whether differences in the profile of professionals may have implications for the curriculum. The literature indicates that whilst characteristics of HCI practice are reflected in HCI education (e.g. Gulliksen et al., 2006; Koutsabasis & Vosinakis, 2012), the breadth of the field provides challenges to curriculum design (Grandhi, 2015) and what is valued in the curriculum varies according to the role of the stakeholder (Churchill et al., 2013a, 2013b). There has, however, been little research to determine whether what is valued in the curriculum differs according to the role of the HCI professional. This research intends to address that gap, making use of technological frames to support the enquiry. Technological frames offer a framework with which to systematically analyse, compare and explain the perceptions of members of different social groups (Bijker, 1987; Davidson, 2006; Orlikowski & Gash, 1994), particularly when considering HCI in the context of the technology lifecycle (Kaplan &

Tripsas, 2008). The use of technological frames is described in more detail in section 3.7.4 on page 133.

This literature review has addressed a broad range of topics including the history of HCI, HCI education and practice, cognitive styles research, and the concept of technological frames. The next chapter describes the research design and the methods and procedures employed in this study to empirically address the gaps identified above in the review of the literature.

3 Methodology

As detailed in Chapter 1 and explored in the review of the literature in Chapter 2, the aims of this study are to understand better the profile of the HCI professional not only in respect of their background, what is valued and their concerns and issues, but also their cognitive preferences. Of particular interest are the differences between HCI Practitioners and Educators, and how these may impact upon curriculum design and delivery and practice. This will provide a better understanding of the field of HCI, allowing us to support the educational experience of the students and to strengthen the HCI curriculum.

This chapter describes the methodological approach adopted in this study. Section 3.1 revisits the research questions. Section 3.2 covers the research design, including the mixed methods approach adopted; section 3.3 details the ethical considerations and section 3.4 details the recruitment of the sample and data collection methods. Section 3.5 covers the quantitative data analysis approach and the statistical tests adopted, whilst section 3.6 details the interview process. Finally, section 3.7 covers the qualitative data analysis, including the thematic data analysis making use of the Template Analysis method (King, 1998) and qualitative data analysis software.

3.1 Research questions

The research questions are detailed in Chapter 1 and are summarised below.

- RQ1: What are the differences in the cognitive profile of the HCI Practitioner, the HCI Educator and the general population?

    - RQ1a: How does the cognitive profile of the HCI professional differ from that of the general population?
    - RQ1b: What are the differences between the Educator, the Practitioner and 'Both' in terms of their analytical/intuitive preferences, and their Visual Object, Visual Spatial and Verbal abilities?

- RQ2: Does the profile of the HCI professional vary from role to role in respect of their background, what is valued, and their concerns and issues?

- RQ3: What are the implications for the HCI curriculum?

The findings of RQ1 derive from the results of survey data and cognitive style tests; the findings of RQ2 derive from interview data and both contribute to the discussion of RQ3.

3.2 Research design

The research questions detailed above are most naturally satisfied by use of a mixed methods approach. The design adopted is the mixed methods triangulation design, or convergence model, which makes use of both quantitative and qualitative data to *“expand quantitative results with qualitative data”* (Creswell & Plano Clark, 2007, p. 62).

Both quantitative and qualitative data was gathered. A correlational survey design using self-report measures was adopted for the quantitative phase of data collection, making use of an online survey which incorporated the cognitive style surveys. The data provided by the cognitive style surveys does not, however, provide sufficiently rich data to produce anything more than a partial profile, so this was complemented by a number of interviews in order to provide a fuller picture. The mixed methods triangulation convergent design converges the quantitative (survey) data and the qualitative (interview) data; survey data is used to collect some demographic information and some elements of the cognitive profile of the HCI professional, and this is complemented by a number of interviews. Both sets of data are given equal emphasis (QUAN + QUAL), and are collected concurrently and analysed separately prior to being integrated during the discussion phase. The rationale for this approach is that the qualitative data (the interviews and the open questions in the survey) and the quantitative data (the demographic data and the cognitive style of the professionals) each contribute towards the profile of the HCI professional, but address different elements of the research questions addressed in this study; these strands are pulled together in the discussion section of this thesis.

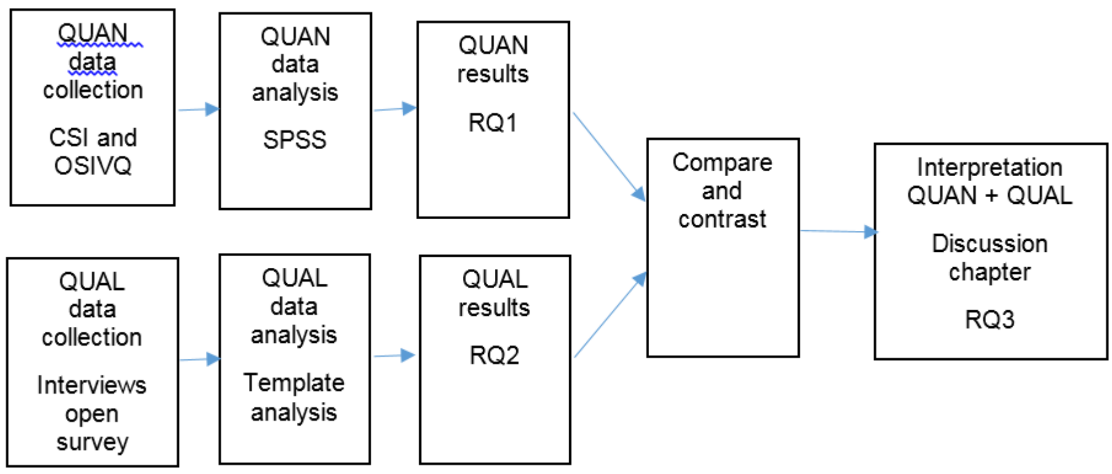


Figure 3-1: Triangulation design - convergence model - adapted from Creswell and Plano Clarke (2009) p63

In summary, the use of a mixed methods approach supports the intent of this study to build a profile of the HCI professional which will include their cognitive preferences. The quantitative data collection in the form of the cognitive style instruments provides only a partial profile of the Professional. The inclusion of qualitative methods provides a more contextual and holistic portrayal of the professional, and an enhanced understanding of their values, priorities, concerns and issues, together with their own perception of the differing roles of the professional. Together the quantitative and qualitative results are complementary in the building of the profile.

3.2.1 Mixed methods

Although the mixed methods approach is relatively young, it is now established as a third methodology, alongside the traditional quantitative and qualitative approaches (Teddlie & Tashakkori, 2003). The mixed methods approach derived from the applied sciences field where qualitative approaches were used alongside the analysis of numerical data to explore complex issues, and it is applied in a number of different domains. For example, between January 2015 and July 2016, the Journal of Mixed Methods Research contained articles from the fields of education, health, athletics, project management, the wine industry, the military, banking, social work and sport management.

Johnson et al (2007) produced a synthesis of definitions offered by leaders in the field of mixed methods research:

> *"Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration" (Johnson, Onwuegbuzie, & Turner, 2007, p. 123).*

Creswell and Clark define a mixed methods study as being based on research questions, with both quantitative and qualitative data collected, analysed, mixed and then the findings presented within a single study (Creswell, 2011; Creswell & Plano Clark, 2007). Mixed methods are presented as a research design, with philosophical assumptions which Creswell and Clark refer to as worldviews, as well as quantitative and qualitative methods of enquiry, in either a single study or a series of studies, and it is this definition of mixed methods that is adopted in this thesis.

> *"Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone" (Creswell and Clark, 2007 p.5).*

3.2.2 Epistemological considerations

One of the challenges of mixed methods research is reconciling the associated paradigms, with quantitative approaches traditionally adopting a positivist or postpositivist stance and making use of deductive methods, and qualitative approaches taking a constructivist (or constructionist) approach, or a participatory approach in the case of advocacy or participatory positions. Guba and Lincoln (2001) describe constructivism as ontologically relativist, epistemologically subjective and methodologically both hermeneutic and dialectic, being interpretive in the discovery phase, and taking a logical approach in the assimilation phase; they do not consider it appropriate to mix paradigms, although they do cautiously agree that methods can be mixed provided that the philosophical stance of the paradigms are commensurable (Lincoln, Lynham, & Guba, 2011, pp. 116–117). Creswell (2011), however, takes the view that mixed methods can incorporate multiple paradigms. Another approach has been to adopt a single paradigm that accommodates both qualitative and quantitative methods; Teddlie and Tashakkori (2009) advocate ‘the use of whatever methodological tools are required to answer the research questions under study’, and propose a pragmatic approach.

> *‘Pragmatists … believe that either method is useful, choosing to use the full array of both QUAL and QUAN methods. Pragmatists believe that decisions regarding the use of either (or both) methods depend on the current statement of the research questions and the ongoing phase of the inductive-deductive research cycle.’ (Teddlie & Tashakkori, 2009, p. 90).*

In this thesis I am adopting a pragmatic approach, taking a postpositive epistemological stance when considering the quantitative data, and a constructionist stance when considering the qualitative data.

3.2.3 Constructivism and constructionism

The literature refers to both constructivism and constructionism, and the often the terms appear to be used interchangeably and inconsistently (Young & Collin, 2004), with research grounded in the field of psychology favouring the term constructivism, and constructionism having its roots in sociological research. Crotty (1998, p. 58) differentiates between the two, describing constructivism as placing more emphasis on the perceptions of the individual, with knowledge derived from the prior experiences of that individual, which he defines as 'the meaning-making activity of the individual mind' whilst he describes constructionism as placing more emphasis on the production of knowledge derived from social processes and a shared understanding: 'the collective generation [and transmission] of meaning', precluding the possibility of one single interpretation of truth. The term 'constructionism' is also applied in the context of constructionist learning and learning theory, but in this thesis the term is not used with Papert and Harel's (1991) definition of 'learning-by-making' but rather in the context of Crotty's (1998) definition of collective meaning-making.

3.3 Ethical considerations

The project was submitted for ethical review to the Faculty Research Scrutiny and Ethics Committee (FRSEC) of the University, and ethical approval granted.

In accordance with the University of West London's Research Ethics Code of Conduct, participants provided informed consent prior to participating in the surveys, and this was confirmed prior to participation in the interview phase. Participant confidentiality was preserved by de-identification of the data and the use of pseudonyms so that individuals cannot be identified. The dataset was stored securely, with both hardware devices and cloud storage being password protected. These processes will be described in more detail below.

3.4 Data collection methods

The aim of this study is to provide a better understanding of how the profile of the HCI professional differs according to their role, and the impact of these differences upon practice, curriculum design and delivery. The profiles of interest are those of the HCI Educator, the HCI Practitioner, and those who are involved in both education and practice, who are referred to as 'Both'. The HCI Educator is defined as a professional who specialises in education and the Practitioner is defined as a professional who specialises in practice. To encompass the diversity within HCI practice, when considering the interview data, the role of Practitioner has been further differentiated to consider the profile of Designer, User Researcher, User Experience (UX) Architect, and to a lesser extent, Software Developer. The role of the 'Both' is also differentiated to distinguish between the Practitioner who educates in a university setting, and the Practitioner who educates within practice as a mentor or trainer.

The research questions consider cognitive differences as well as differences in respect of background, values, priorities, concerns and issues, and the impact of these differences upon the HCI curriculum. In order to measure cognitive preferences, two cognitive styles instruments, the Cognitive Styles Index (Allinson & Hayes, 1996), hereafter referred to as the CSI (see section 2.5.4 on page 56), and the Object-Spatial Imagery and Verbal Questionnaire (Blazhenkova & Kozhevnikov, 2008), hereafter referred to as the OSIVQ (see section 2.5.5, page 59) were administered. These self-report questionnaires were embedded within an online survey that also collected some demographic data, including the role of the respondent: the respondents were asked to identify themselves as either an Educator, a Practitioner or 'Both'. The combination of the demographic data and the cognitive styles instruments combined to provide an initial snapshot of the profile of these three roles of professional. The quantitative data analysis approach is described in section 3.5 below.

In order to investigate differences in respect of background, values, priorities, concerns and issues and the impact of these differences upon the HCI curriculum, a number of Practitioners, Educators and those who both practice and educate ('Both') were recruited from the survey respondents to take part in interviews, the contents of which were analysed using the template analysis approach (King, 1998). The interviews additionally provided the job roles identified above and the application of the technological frames framework (Orlikowski & Gash, 1994; Pinch & Bijker, 1987) facilitated a comparison of the profiles of the HCI professional. The qualitative data analysis approach is described in section 3.7 below.

3.4.1 Recruitment of the population

The target population of this study is the HCI professional who works either as a practitioner in the field, or as an educator, for example, a university lecturer. Participation was invited either directly, for example by canvassing conference attendees, or indirectly via LinkedIn discussions and specialist mailing lists, thereby restricting respondents to those who have an interest in HCI. General requests to participate in my research were posted between November 2012 and May 2014 via the following Linked In groups: SIGCHI, BCS Interaction, the User Experience Network, Usability Matters.Org, User Experience, UX Pro, UXID Foundation, UX/HCI Researchers, UX/UI Designer, and UX Professional. A targeted request aimed specifically at Educators was posted in March 2014 as this particular group was underrepresented in the responses. In addition, emails were sent to a number of mailing lists including the British Computer Society HCI Specialist Interest Group, the London Usability Group, the ACM Computer Human Interaction Special Interest Group and the Usability Professionals' Association.

3.4.2 Survey responses

The requests directed participants towards an online survey which collected some demographic information, and then delivered the OSIVQ (Blazhenkova & Kozhevnikov, 2008) and the CSI (Allinson & Hayes, 1996). The demographic information included their age, gender, role (Practitioner, Educator or 'Both'), the country in which they are based, together with nationality, and nationality at birth, if different, and a brief description of their role. Each request for participation resulted in around 30 responses, and multiple requests for participation were posted over a two year period.

There were 315 responses to the survey between September 2012 and August 2014. However, data entry errors, duplicated responses, and responses from individuals outside the target population of HCI professionals resulted in the following amendments and deletions to the source data, resulting in a sample size of 301.

3.4.2.1 Removal of duplicates

There were a number of requests for participants to complete the survey, and where personal details were provided it was clear that some respondents completed the survey on more than one occasion. Where this was identified from either the name or the email address provided, the first response was preserved, and subsequent responses removed from the data set, reducing the data set by 12. Name and contact details were optional fields, so it is not possible to tell from the data how many of the remaining respondents completed the survey on multiple occasions.

The detail of the duplicates identified can be seen in Table 3-1 on page 93. Although there were some small variations in the results of the cognitive style surveys, these were broadly speaking consistent with the previous attempts, and resulted in different CSI profiles being generated for only 3 out of the 12 respondents. For one of these changed profiles, the respondent had been sitting on a profile boundary, and the score increased by only one. Two respondents had the identical scores for both responses, and the largest variance between attempts showed a difference of 8. One respondent who completed the survey with over a year between attempts did however, have a markedly improved score for the Visual Spatial element of the OSIVQ in the second attempt at the survey. This respondent was one of those selected for interview, and it emerged during the interview that in the period between the two attempts at the survey she had been extensively involved in geographic information systems (GIS). This involves the manipulation and analysis of geographic and spatial data and suggests that her cognitive preferences had changed as a result to exposure and practice in using spatial data, supporting the position of style researchers such as Zhang (2013) that styles are malleable rather than fixed.

Table 3-1: Duplicate survey responses

Duplicate	CSI Score	CSI Category	OSIVQ Object Imager	OSIVQ Spatial Imager	OSIVQ Verbaliser
Duplicate 1a	31	Quasi-Intuitive	2.53	3.53	2.67
Duplicate 1b	31	Quasi-Intuitive	2.20	3.93	3.20
Duplicate 2a	57	Analytical	2.80	3.53	3.40
Duplicate 2b	63	Analytical	2.67	3.20	3.47
Duplicate 3a	38	Quasi-Intuitive	3.67	2.80	3.27
Duplicate 3b	39	Adaptive	3.53	2.60	3.27
Duplicate 4a	37	Quasi-Intuitive	2.73	4.07	3.93
Duplicate 4b	32	Quasi-Intuitive	2.87	4.73	3.07
Duplicate 5a	27	Intuitive	3.93	4.47	2.47
Duplicate 5b	33	Quasi-Intuitive	3.60	4.07	2.20
Duplicate 6a	28	Quasi-Intuitive	2.67	4.33	3.13
Duplicate 6b	25	Quasi-Intuitive	3.27	3.80	3.67
Duplicate 7a	17	Intuitive	4.93	2.80	2.93
Duplicate 7b	19	Intuitive	4.40	3.40	3.00
Duplicate 8a	36	Quasi-Intuitive	3.67	3.47	3.20
Duplicate 8b	38	Quasi-Intuitive	4.00	3.73	3.00
Duplicate 9a	54	Analytical	2.33	3.13	3.07
Duplicate 9b	54	Analytical	2.60	2.60	3.07
Duplicate 10a	59	Analytical	1.67	2.13	3.93
Duplicate 10b	65	Analytical	1.53	2.07	4.27
Duplicate 11a	34	Quasi-Intuitive	3.20	2.20	3.33
Duplicate 11b	26	Intuitive	3.67	1.67	3.13
Duplicate 12a	29	Intuitive	3.80	3.27	3.67
Duplicate 12b	21	Intuitive	3.87	3.20	3.40
Duplicate 12c	25	Intuitive	4.07	3.00	3.33

3.4.2.2 Misclassification of roles

Upon examination of the free text data, some respondents had clearly misclassified themselves, for example, selecting the role of Practitioner, but mentioning only educator positions, or selecting the role of Educator but mentioning practitioner freelance work alongside the teaching role. Where misclassifications were identified, the role was amended to reflect the description of their role.

The classification of ‘Both’ caused particular difficulty. This category was originally conceived to capture those practitioners who also deliver the academic curriculum. However, the free text in the Employment field of the survey and the interview results have uncovered two alternative interpretations of the term ‘Both’: firstly, practice combined with academic delivery, and secondly, practice combined with training or mentoring roles in industry. With hindsight, this categorisation of ‘Both’ should have been extended to differentiate between academic educators and training roles.

Some of these misclassifications became apparent upon analysis of the free text in the Employment field, and others emerged as the interviews progressed. As only a subset of the survey respondents was interviewed, it is not known how many other of the respondents who have classified themselves as ‘Both’ are not involved in academia, and conversely, how many of those who have classified themselves as Practitioners are involved in training and mentoring, but this has not been captured in their classification.

Similarly, it appears that some academic researchers have classified their role as ‘Both’ but it is not clear from the data available whether the reason for this classification is that they are actually involved with both educating and practice, or whether the classification of ‘Both’ fitted their profile better than Educator or Practitioner. For example, one respondent commented that an *“academic postdoctoral researcher … is neither educator or (sic) practitioner”.* With hindsight, an additional role of Academic Researcher should have been included.

It may be that there were other respondents who selected the category of ‘Both’ because they did not feel that they could be described as either Practitioner or Educator, and ‘Both’ was the remaining option. However, insufficient detail of their situation has been collected in the Employment field to determine the extent or the impact of this ambiguity. Where errors in the classification were identified, changes were made. For example, one participant who classified himself as a Practitioner indicated in the free text that he was in fact a part time practitioner and a part time lecturer. His classification was amended to ‘Both’.

Not all apparent discrepancies, however, were errors. For example, one particular respondent who classified herself as ‘Both’ was primarily a practitioner. However, she confirmed during interview that ‘Both’ was an intentional classification as she also had a mentoring and training role, and occasionally was a visiting speaker at a university. This was not the only occasion when the definition of ‘Both’ was taken more loosely by the respondents; a few other respondents who classified themselves as ‘Both’ were also practitioners involved in delivering in house training or one to one mentoring. It was decided that the original classification of the respondents should be preserved for the survey, and where the respondent also submitted to interview, the identifier was tailored to distinguish whether ‘Both’ reflected a training or academic educator role.

It is worth noting at this point one particular respondent categorised herself as an Educator but the free text response revealed an extremely long career, with the first half having been in practice and the second half in academia. The classification of this respondent was not changed in the survey data as the industry experience was not current and the most recent focus had been on the Educator role. However, when this respondent was subsequently interviewed, she discussed at some length both practice and education, and for the purpose of the interviews only was classified as 'Both'.

Job roles were extracted from the Employment field but the design of this field was somewhat problematical. Brief details of their role were requested, giving as an example 'UX designer and part time lecturer'. However, the free text format resulted in inconsistent responses; some of the information provided was clearly communicated, elsewhere it was rambling. In all cases, it was difficult to analyse and quantify which made it difficult to extract the job titles from the data.   Whilst the inclusion of this field would not have been a problem if there had been additional fields to capture role information, in practice it meant that it was difficult to establish the split between user experience designers, interaction designers, researchers, information architects, and other roles, such as lecturer and academic researcher. It would have been better to supplement this question with a checklist that allowed respondents to identify their role/s, or add free text if the role were not covered in the predefined choices. This would have allowed further analysis of the cognitive styles to determine whether there are cognitive differences between specific job roles.

In summary, although there were 315 responses to the survey, obvious errors in the data and classification were identified and corrected, resulting in a data set of 301.

3.4.3 Design of the survey

The primary purpose the survey was to act as vehicle to measure the cognitive preferences of the professionals. The two instruments used were the Cognitive Style Index – the CSI – which consists of 38 multiple choice questions (Allinson & Hayes, 1996) and the Object-Spatial Imagery and Verbal Questionnaire – the OSIVQ – which has 45 multiple choice questions (Blazhenkova & Kozhevnikov, 2008). These two instruments are described in more detail in sections 2.5.4 (page 56) and 2.5.5 (page 59) above. Some demographics were also collected but these were deliberately kept brief. The rationale for this was twofold: firstly to avoid cognitive fatigue as the respondents were already being asked to complete two surveys in the OSIVQ and the CSI, and secondly, due to the newness of the field and the diverse backgrounds of the respondents, it was decided not include questions regarding education or career paths, but to include this in the interviews instead. The rationale for this decision is that the multidisciplinary nature of the subject and the relative newness of the field make it likely that professionals would not have a clear and distinct career path, and due to the many different routes into the profession, previously obtained educational qualifications may bear little or no relevance to the practice.

The fields included were age, gender and role (Practitioner, Educator or 'Both'), followed by a free text field to include brief employment details. This was followed by the country in which they were based, their nationality, and their nationality at birth, if different; this question was included to satisfy the data requirements of the HCI and Education project that will make use of this data for cultural analysis (Abdelnour-Nocera et al., 2012; Austin & Abdelnour-Nocera, 2013; Austin, Michaelides, et al., 2012). The final questions in this section of the survey invited the respondents to provide personal and contact information if they were willing to participate further in the research, by submitting to interview, or if an educator by allowing access to students for the HCI and Education project, mentioned above.

Prior to release, the survey was tested by colleagues for completeness, usability and functionality, and minor amendments were subsequently made to the layout and structure of the survey and the phrasing of questions for clarity. The changes were for the most part cosmetic, such as improved use of white space and formatting to improve readability. For example, the navigation of the form was amended so that if informed consent was not granted the respondents immediately exited the survey, an extra field to identify ex-patriates was included, respondents were told at the start of each section how many questions to expect, and where idiom was employed in the Cognitive Style Index, explanatory text was included to explain the figurative meaning.

3.4.4 Creation of the survey

The survey was created with Google Forms, and hosted on Google Drive. The use of Google Forms generated a URL which was easily shared with potential users by means of an email or a post on LinkedIn. When a user clicked on the link, the form opened in their browser window. Each time a respondent completed the survey, a new row was generated in an online spreadsheet in Google Drive, with the questions providing the column headers. One additional column was generated by the software to provide a time stamp of the form completion. At the time of design, Google Forms was considered an appropriate choice to host the survey as there are no cost implications, or restrictions to the number of surveys that can be produced or the number of responses permitted. However, it emerged that it was not possible for respondents in China to participate due to internet restrictions placed by the Chinese government. Additionally, the European Court of Justice ruled in October 2015 that organisations can no longer rely upon the Safe Harbor arrangement in order to comply with Data Protection legislation when data is stored in the US, and the University of West London policy is now that researchers use the Bristol Online Survey tool.

The responses were downloaded from Google Drive at regular intervals and saved as a Microsoft Excel spreadsheet, providing a snapshot of all responses to date.

In order to automate the profile generation of the instruments, two additional Excel spreadsheets were created, one for each of the CSI and the OSIVQ surveys. Formulae were produced to read the response for each question and to convert this to a numerical value. These spreadsheets were all uploaded to a password protected cloud storage space.

The detail of the data manipulation for each of the surveys is described below.

3.4.5 Automation of the calculations of CSI and the OSIVQ

A Microsoft Excel template (HCI Professional CSI analysis.xltx) was created to automate the calculations of the CSI scores. This contains placeholders for the demographic data and the CSI responses, named ranges to identify the input and the output data, and a number of nested IF statements to read the response for each individual question and to code it in accordance with the Cognitive Style Index Scoring Key. There is some inbuilt error checking to identify any missing values, and vertical look up tables to convert the CSI score to the appropriate style on the analytical/intuitive spectrum, using the VLOOKUP function.

In order to populate this template, the raw data containing the demographics and the output from both surveys was downloaded from Google Drive. The timestamp, the demographic data and the CSI responses only were selected from the source spreadsheet, and copied and then pasted into the appropriate cells of the CSI analysis template.

Each of the questions of the CSI generated a possible response of ‘True’, ‘False’ or ‘Uncertain’ in the raw data. In order to make the template formulae easy to write and maintain, and to facilitate manual entry of the data for data validation purposes, shortcut characters of T, F and / are used to represent the responses True, False and Uncertain. This resulted in shorter formulae, for example, =IF(K2="T",2,IF(K2="/",1,IF(K2="F",0,"-"))), but as a result, before the formulae could be applied, some data manipulation was required. Multiple search and replace operations were performed on the named range ‘input’ to firstly replace the text string ‘Uncertain’ with ‘/’, ‘True’ with ‘T’ and ‘F’ with ‘False’.

The score calculations of the OSIVQ were handled in a similar way, using the template HCI Professional OSIVQ analysis.xltx. As the raw data generated a numeric output between 1 and 5, little manipulation of the data was necessary apart the application of a nested IF statement to invert the responses where the scoring indicated that a low score reflected a high ability and vice versa. The three scores for Spatial, Object and Verbal ability were derived by applying the AVERAGE function to the 15 questions that related to each of those abilities, as specified in the scoring instructions.

Once this process was complete, the online form and the associated spreadsheets were deleted from Google Drive.

3.5 Quantitative data analysis approach

This section details the analysis of the survey data; the analysis of the interview data is covered in section 3.6 on page 109.

3.5.1 Creation of new variables

Two new variables were created to support the data analysis. Respondents to this survey were asked to categorise themselves as either an Educator, a Practitioner, or ‘Both’ if they both practice and educate (Figure 3-2 below).

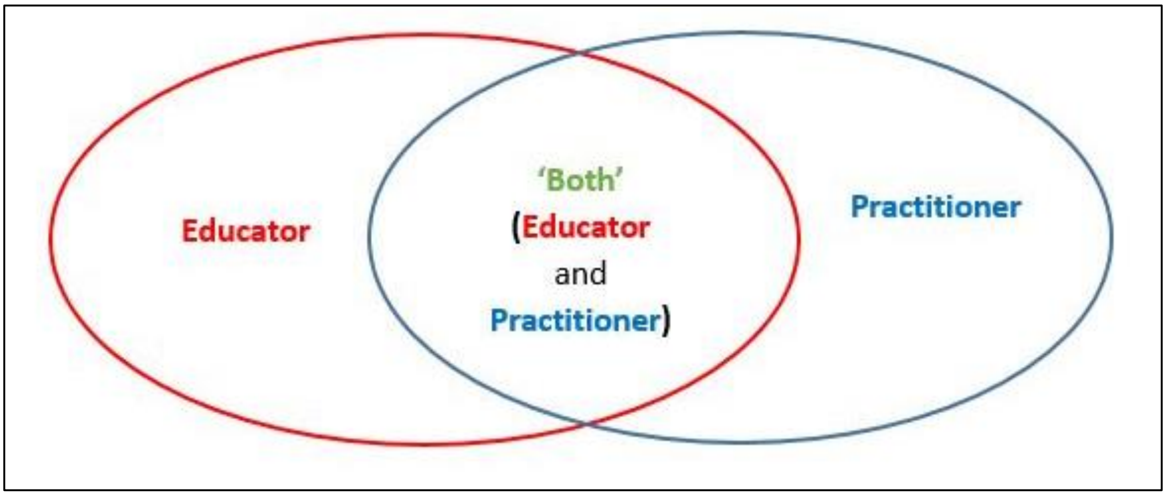


Figure 3-2: The roles of the professional

For the purpose of further analysis these definitions were extended as depicted in Figure 3-3 in order to compare those who practice (the Practitioner and 'Both') and the Educator who does not practice, and those who educate (the Educator and 'Both') with the Practitioner, who does not educate. Two new variables were created in the SPSS dataset which are referred to as All-Pract and All-Ed respectively.

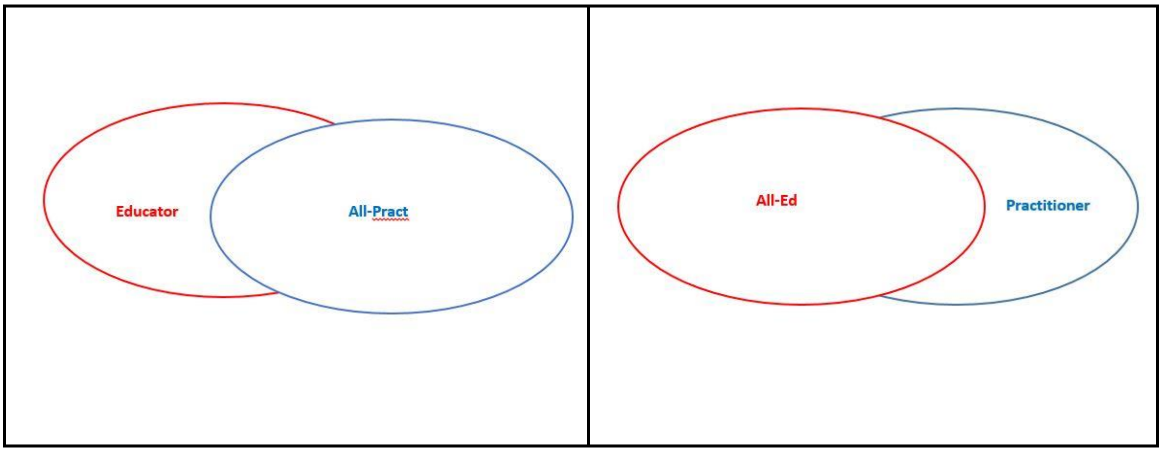


Figure 3-3: Those who don't teach (All-Pract) and those who don't practice (All-Ed)

Prior to undertaking the analysis the survey data was cleansed; this is described in section 3.4.2 (page 90).

3.5.2 Assumptions and research questions

The aim of the quantitative analysis was to partially address the following research question: RQ1: What are the differences in the cognitive profile of the HCI Practitioner, the HCI Educator and the general population?

This was addressed with particular reference to the following sub-questions

- RQ1a: How does the cognitive profile of the HCI professional differ from that of the general population?
- RQ1b: What are the differences between the Educator, the Practitioner and 'Both' in terms of their analytical/intuitive preferences, and their Visual Object, Visual Spatial and Verbal abilities?

As well as satisfying these research questions, certain assumptions were tested regarding the CSI and OSIVQ profiles of the professional. The assumptions and the rationale for making these assumptions is detailed below.

- Assumption 1: As the HCI professional makes use of tools and techniques that require both analytical and intuitive approaches, they are more likely to fall within the range of Quasi-Intuitive to Quasi-Analytical than the general population.

The HCI professional is discussed in the context of both those who practice in the field, and those who educate the next generation of practitioners. The reason for this assumption is that HCI practitioners routinely have to adopt both analytical and intuitive approaches to their work. For example, when they act as an interface between the developer and the users during the development of a computer application or website, they need analytical skills to understand the functionality of the software, and at the same time, they need to be able to see the ‘whole picture’ and put themselves in the shoes of the user. Some HCI evaluation techniques such as heuristic evaluations require an analytical approach. Others, such as the production of a persona need a more intuitive approach. In addition, whilst the software developer may be more concerned with the functionality of the application, the HCI Practitioner also needs to balance the need for the interface to be user friendly, and the layout, appearance and aesthetics of the interface will contribute to this. Whilst the HCI Educator may not be actively involved in practice, they will also need to adopt both approaches as they need to teach these skills to students. As a result, it is assumed that the professional is more likely to be either Quasi Intuitive, Adaptive or Quasi Analytical rather than Intuitive or Analytical. This assumption will be tested by comparing the CSI profile of the HCI professional with the normative data provided by Allinson and Hayes (2012).

- Assumption 2: The HCI professional will have greater Visual Object ability than a computer scientist or an engineer, and greater Visual Spatial ability than a visual artist.

The reason for the second assumption is that unlike programmers and engineers, HCI professionals routinely contribute towards interface design, and unlike graphic or interface designers, they also need to understand the architecture and functional design of the application. This assumption will be tested by comparing the OSIVQ scores with the normative data of the professionals provided by Blazhenkova and Kozhevnikov (2008).

3.5.3 Statistical testing

The raw data output from the two cognitive styles surveys are numerical scores. In the case of the CSI this is a single output which place the individual on a spectrum that ranges from the Intuitive to the Analytical with a scale ranging from 0 to 76; the OSIVQ generates three mean average scores for each respondent, each ranging from 0.00 to 5.00, and measuring Visual Object ability, Visual Spatial ability and Verbal ability.

In order to test the assumptions and to address the research questions above, a number of statistical tests were conducted using SPSS and these were complemented by the built in functionality of Excel. For all tests, the level of significance was set at 0.05 indicating a 95% certainty that the results are not due to chance. The tests were derived from the survey data and made use of the cognitive style test results, the roles of the professional and the age and gender of the respondents; they are described in more detail in section 4.2 on page 146 below.

RQ1a: How does the cognitive profile of the HCI professional differ from that of the general population?

Prior to comparing the professional with the general population, a series of Pearson product-moment r correlations were computed to produce a general profile of the professional. Correlations measure the strength and the relationship between two variables, with the Pearson correlation coefficient (r) ranging from 0, indicating no relationship, to 1 or -1, indicating a perfect linear relationship or a perfect negative linear relationship. The strength of the relationship was measured using Cohen's guidelines, where 0.10 to 0.29 represents a weak association between the two variables, 0.30 to .049 represents a moderate association, and 0.50 to 1.0 represents a strong association (Pallant, 2013). These measured the strength of the relationships between the CSI score and the cognitive style constructs of the OSIVQ, taking into consideration the age and the role of the respondents. The test was run a number of times to consider the whole cohort, each of the roles of Practitioner, Educator and 'Both', and the newly created variables All-Pract and All-Ed.

Following this, chi-square goodness-of-fit tests were conducted on the CSI data in order to establish whether the CSI profile of the HCI professional does indeed differ from that of the general population. In the chi-square goodness of fit test, sample data is divided into intervals. Then the numbers of points that actually fall into the interval are compared with the expected numbers of points in each interval. This test was used to assess whether the observed frequencies of HCI professionals falling into each of the five CSI categories differ from the normative data published by Hayes and Allinson. The test was repeated for all professionals, for Practitioner, Educators and ‘Both’, and for All-Pract and All-Ed.

A number of Welch's unpaired or independent t-tests were conducted on the OSIVQ data. Welch's unpaired t-test was selected as it allows for unequal variance, and the sample sizes and standard deviations for the normative populations are different to those of the HCI professional population (Ruxton, 2006). The summary t-tests option in SPSS was selected as the normative data was not part of the SPSS dataset and needed to be manually entered into SPSS.

Unpaired or independent samples t-tests are used to assess whether there are differences on a continuous variable score (the dependent variable), in this case, each of the OSIVQ constructs, and a dichotomous independent variable, in this case, the profile of the HCI professional and the profiles associated with the published norms. The OSIVQ normative data provides profiles for the general population as well as for scientists and engineers, visual artists, and linguists and historians.

These tests were conducted to test the assumption that as HCI professionals contribute towards the interface design, they would score more highly than computer scientists and engineers for Visual Object ability, and as they also to understand the architecture and functional design, they would score more highly than visual artists as for Visual Spatial ability. This addresses Assumption 2: **The HCI professional will have greater Visual Object ability than a computer**

scientist or an engineer, and greater Visual Spatial ability than a visual artist.

RQ1b: What are the differences between the Educator, the Practitioner and 'Both' in terms of their analytical/intuitive preferences, and their Visual Object, Visual Spatial and Verbal abilities?

In order to address RQ1b, tests were conducted on both the CSI and the OSIVQ data.

The CSI scores of the Practitioner, Educator and 'Both' were compared using a one-way between-groups analysis of variance (ANOVA). An ANOVA is used to compare the mean scores of more than two groups and to identify any differences between the groups, with the independent variable being the role, and the dependent variable being the CSI scores. As significant differences were observed, post-hoc tests were run to confirm where the differences occurred between groups. Finally, t-tests were conducted to test the new variables, All-Pract and All-Ed with Educators and Practitioners respectively.

For the OSIVQ, a one-way between-groups multivariate analysis of variance (MANOVA) was performed to investigate differences between the groups and the OSIVQ profile. A MANOVA is an extension of the ANOVA and appropriate for use when there is more than one dependent variable to be considered. Although the process is more complex, it is preferable to use a MANOVA rather than a series of ANOVAs to reduce the likelihood of Type 1 errors (Field, 2013, p. 624;

Pallant, 2013, p. 293). The MANOVA used the three constructs of the OSIVQ as dependent variables, namely Visual Object ability, Visual Spatial ability and Verbal ability. The independent variable was Role. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity (see Section 4.2.5.2 on page 170). Where statistically significant differences were noted on the combined dependent variables, a Bonferroni adjustment was made in order to reduce the chance of a Type I error when considering between-subjects effects, resulting in a new alpha level of .017.

Assumption 1: **As the HCI professional makes use of tools and techniques that require both analytical and intuitive approaches, they are more likely to fall within the range of Quasi-Intuitive to Quasi-Analytical than the general population** was tested by comparing the published normative data of the CSI with the CSI profile of the HCI professionals. The mean scores from the descriptive statistics were used, supported by some simple Excel manipulation.

3.6 Interviews

The interviews were completed over a 22 month period between April 2013 and January 2015; these provided the majority of the data for the qualitative phase of the project.

3.6.1 Recruitment of interview participants

152 of the survey respondents indicated that they would be happy to participate further in the study, and provided contact details. Prior to each of the blocks scheduled for interview, respondents were invited via a personal email to participate in an interview. Those who were willing to participate provided their geographical time zone and where possible, a mutual time was arranged to conduct the interview. It was possible to accommodate the majority of respondents who agreed to an interview, although in one or two cases, the interview did not materialise due to the time difference or work commitments on the part of the respondents.

In order to provide a rich picture of the sample population, it was necessary to include participants at all stages of their career, as well as representatives from each of the Practitioner, Educator and ‘Both’. The former condition was satisfied naturally. However, few Educators responded to the first request for further participation; in order to address this, the earlier respondents were emailed for a second time. This resulted in a total of 24 interviews, consisting of 10 Practitioners, 7 Educators and 7 who categorised themselves as ‘Both’, with interview lengths ranging between 27 and 70 minutes.

The initial tranche of interviews concentrated solely on the Practitioners. Subsequent interview blocks included ‘Both’ and Practitioners, and lastly Educators were added to the invitations. This allowed to interview questions to be reviewed and refined as the interviews progressed.

3.6.2 Interview process

Depending on the location of the respondent, these interviews were conducted via video call or by phone, or if the geographical location and logistics permitted, face to face interviews were conducted, with face to face or video being the preferred method. When technical difficulties resulted in poor quality of the audio, the video was sacrificed for audio only calls. Whilst technical issues did result in some repetition of questions, and some indistinct responses which caused problems with the transcription, it was not severe enough to result in any of the interviews to be aborted.

Respondents had already given informed consent when completing the survey, but this was requested again prior to the start of the interview. The audio of all of the interviews was recorded using a mobile phone app, and the audio file was uploaded to a password protected cloud storage space. The original was then deleted from the mobile phone.

Whilst it is recognised that self-transcription allows the researcher to familiarise themselves with the data, it is also recognised as being extremely time consuming (Samra-Fredericks, 2004; Willig, 2013), and it was decided to outsource most of the transcription to a professional service. The audio files were uploaded via the transcription company's secure website using SSL 128 bit encryption. The work was kept in the UK and not outsourced to any other country, and the files were deleted from their servers seven days after return of the transcripts.

Whether the transcriptions were done by myself or by the transcription service, the audio was listened to several times, and the transcripts were checked for accuracy and corrected as necessary, and then anonymised, with pseudonyms used to replace any potentially identifiable references to individuals, organisations or locations.

Two of these interviews were subsequently excluded from the analysis. The first was a 35 year old female Practitioner whose command of the English language was very poor, leading to doubts as to the value of her responses. The second was a 28 year old male who had identified himself as an educator when completing the questionnaire, but was in fact a researcher with no involvement in teaching and little knowledge of the curriculum. He felt that he had misclassified himself, telling me "*I'm not quite sure now why I filled that in as it is*". It was felt that he was a reluctant participant as he seemed uncomfortable and distracted during the interview, and as he had no experience as a practitioner, it was decided that he did not match the profile of Educator, Practitioner or 'Both', and this interview should be removed from the sample.

3.6.3 Interview questions

The purpose of this research is not to replicate or validate the recent work of Churchill et al. (2015) on HCI Education discussed in section 2.4.4 on page 46, but rather to investigate the differences between Educators, Practitioners and those who both practice and educate. Churchill et al. focussed on the curriculum, with goals including identification of core topics, understanding the curriculum, understanding the HCI education experience from the perspective of students, educators and practitioners, and the identification and curation of educational resources. In the course of their work, they surveyed both educators and practitioners. Although these interviews also cover current practice both in the field and in academia, the purpose of the questions is to provide some background and to put the respondent at ease. In addition, they serve to determine the direction of the interview, and to identify areas that might warrant further probing.

The interview questions were designed to satisfy RQ2 which considers whether the profile of the HCI professional varies from role to role in respect of their background, what is valued, and their concerns and issues, and RQ3 which asks what are the implications for the curriculum?

Three versions of the interview were produced; one for the Practitioner, one for the Educator and one for 'Both'. Before the interviews were conducted, the questions were reviewed for validity and completeness by two academics experienced in research. The structure and the design of the interview is described in more detail below, together with the minor changes that were implemented after the commencement of the interview phase.

3.6.3.1 Practitioner interview questions

The interview started with some general questions to gather background information such as age, level of education and prior experience. This extended the survey data which did not include the educational background or highest educational qualification. This omission was a deliberate design of the survey; the multidisciplinary nature of the field of HCI and the diverse entry routes makes it likely that any higher level qualification may be in an unrelated field. Interviewees were asked about their highest academic qualification as well as their route into the field, and the length of their experience in this field.

The next part of the interview concentrated on their role in the field. At this stage they were asked what the terms HCI and UX meant to them. They were also asked whether the subject had been studied formally, either on an academic course, or a commercial training course.

The next set of questions concentrated on practice. This was intended as an introduction to the area. Interviewees were asked to comment briefly on whether they used particular tools and techniques, and whether they had formally studied them. This list of tools and techniques was derived by examination of four texts[11] commonly recommended as essential reading for students of HCI in the UK, three of which appear on the SIGCHI list of stand-alone textbooks that commonly support HCI education globally (SIGCHI, no date). The intention was threefold: to put the interviewee at ease, to act as a reminder for later discussion, and whilst this list was not designed to be exhaustive, to determine whether the curriculum reflected current practice, partially addressing RQ3. This list deliberately included

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Benyon, D. (2013) Designing interactive systems: a comprehensive guide to HCI and interaction design. 3rd edition. Harlow, England: Pearson.

Dix, A. J. (2004) Human-computer interaction. 3rd ed. Harlow: Pearson.

Preece, J., Sharp, H. and Rogers, Y. (2015) Interaction design: beyond human-computer interaction. 4th edition. Hoboken: John Wiley & Sons.

Shneiderman, B., Cohen, M., Jacobs, S. M. and Plaisant, C. (2014) Designing the user interface: strategies for effective human-computer interaction. Pearson new international edition. Harlow, Engand: Pearson.

the topic of model based evaluation, specifically mentioning task network models, cognitive architecture models and GOMS; whilst the importance of these topics is not disputed from an academic point of view, their relevance and application to practice, particularly in the context of modern day use of technology is less immediately apparent. Initially, the interviewees were asked for yes/no responses as practice is covered in more detail later in the session. However, it emerged that the interviewees often wished to expand on their response and as the interviews progressed, this was not discouraged; as previously discussed, the focus of this study is not actual practice, but rather the perception of the practice. Additionally, this list was expanded following suggestions by some interviewees who included specific topics such as Wizard of Oz prototyping. This section of the interview concluded by asking the interviewee to reflect on the aspects of their education or training that prepared them for their role.

The next section of the interview concentrated on their current practice and consisted of open questions designed to directly address RQ2, and indirectly RQ3. The goal of these questions was to explore the varying reports of practice, the various career paths, and the variety of roles within the field. Questions such as ‘How do you elicit requirements’ and ‘Which tools do you prefer (and why)?’ together with questions targeting success and failure provided a broad framework for discussion, with the open nature of the questions allowing the interviewee to choose the direction of the conversation. Whilst the mechanism for capturing the cognitive style preferences was by means of the surveys, cognitive style is only one aspect of the profile of the professional. This section of the interviews was specifically designed to facilitate the exploration of values, priorities, concerns and issues. The final question for this section – ‘If you could change anything in the way you do your work, what would that be and why?’ was included to provide a final opportunity for the interviewee to highlight any concerns and issues before moving on to the topic of cognitive preferences.

The final section of the interview turned to the cognitive style tests that the interviewees had completed, and they were provided with a brief summary of what each instrument was measuring, followed by their individual cognitive style profile. The Object-Spatial Imagery and Verbal Questionnaire (OSIVQ) produces 3 scores for cognitive problem solving, one for Visual Object ability (a style typically preferred by visual artists), one for Visual Spatial ability (typically preferred by scientists) and one for Verbal ability (typically preferred by philosophers – or educators – who prefer to use verbal analytical approaches), and the Cognitive the Styles Index (CSI) places individuals on a spectrum between Intuitive and Analytical. These results were explained and presented neutrally, and then the interviewee was asked whether these were at all surprising to them. One of the limitations of this approach was that the interviewee tended to address only the CSI results; in later interviews, this line of questioning was modified to provide the OSIVQ results and discussion separately from the CSI discussion. The interviewee was next asked to consider occasions when they had taken a particularly intuitive approach to tasks, and then a particularly analytical approach, and finally, which approach they felt most comfortable with, intuitive or analytical.

3.6.3.2 Educator interview questions

The first part of the interview covered the same areas as the Practitioner interviews – demographics, route into the field of HCI and what the terms HCI and UX mean to them. The next set of questions explored both the curriculum delivery, and the position and perception of the discipline within the educational institution, as well as the priorities given to the subject when delivering the curriculum. The goal of this set of questions was to explore the esteem with which the discipline is regarded within the organisation by probing the reasons why the subject is delivered, and how it is perceived within the institution, examining the influence and freedom of the academic to shape the curriculum, and which aspects of the subject are considered most important. These questions were designed to address research questions RQ2 and RQ3.

In order to test whether the curriculum matched the practice, and the influence of text books on the curriculum, the Educator was asked to consider their teaching practice. They were offered the same list of tools and techniques and asked whether these topics were taught, and which areas were perceived to be most relevant by academics and by students, which topics were most satisfying to deliver and to study, and whether there was a mismatch between what the student valued and what the Educator valued.

The Educator was next asked to reflect on practice in the field. The topics covered in this section were very similar to the questions posed to the Practitioner: the Educator was asked about the tools the Practitioner uses and prefers or values, about practice in HCI projects and the measure of success or failure. Whereas these questions were posed to the Practitioners to explore their values, priorities, concerns and issues, in this case they were posed to the Educators to probe the gap between education and practice, and to explore the Educator's perception of the Practitioner. To some extent, this section of the interview addressed all of the research questions by focussing the Educator's responses on to practice.

The latter parts of the interview covered the same area and structure as that of the Practitioner.

3.6.3.3 'Both'

The framework for 'Both' combined the questions detailed above, with the additional question of which of the two roles they would consider the primary role. As discussed above, the definition of what constituted 'Both' was variable, with many practitioners who mentor or deliver training courses to colleagues also considering themselves as 'Both'. Interview questions were tailored to suit the particular circumstances of each interviewee.

3.6.3.4 Limitations of the interview questions

The findings of the interviews will be discussed in more detail later in this thesis. Whilst the interviews did provide rich data that has contributed towards understanding the profile of the professional, it would have been beneficial to include a few more direct questions regarding how the interviewee perceives the different roles of HCI professionals (e.g. Designer, UX Architect) rather than having to depend on these perceptions naturally emerging from the conversation;

this would have simplified the analysis process and supported the use of technological frames (e.g. Bijker, 1987; Orlikowski & Gash, 1994) in the analysis phase.

3.7 Qualitative data analysis approach

A thematic approach was adopted for the analysis of the interview data, making specific use of the Template Analysis method (King, 2004). The rationale for selecting this particular method was that it is a well-established method often used within social science studies to analyse interview data that does not align itself to a particular methodology or epistemological stance, lending itself to a mixed methods study. The use of the method is supported by literature clearly describing the technique and application (Brooks & King, 2014; Brooks, McCluskey, Turley, & King, 2015), as well as a website hosted by the University of Huddersfield (King, 2016) and a Facebook group (King, 2015) which offers more informal support. The flexibility of Template Analysis allows not only an inductive approach to discover emergent themes, but also acknowledges the existence of explicit themes deriving from the research questions and the interview structure. Template Analysis will be discussed in more detail in the next section.

The software package NVivo was used to support the analysis of the data. NVivo is categorised as qualitative data analysis software, and the use of NVivo will be discussed in more detail in section 3.7.3 on page 129 below.

3.7.1 Template Analysis

Unlike grounded theory, Template Analysis (King, 2004) is not a methodology, but rather a flexible style of thematic analysis that does not depend on particular ontological or epistemological assumptions. It has some similarity to Framework Analysis (Ritchie & Spencer, 2002) but whilst Framework Analysis was originally designed for use in health policy research, Template Analysis originated from organisational research and is used in a wide range of applications (King, 2015).

This method provides guidance; however, it is not designed to be rigid in its application, but rather should be adapted as appropriate for the research design. It facilitates the identification of themes across a data set. Some activities are common with other thematic analysis approaches, or the early stages of a grounded theory approach. However, unlike the grounded theory approach, some *a priori* codes are permitted as Template Analysis is designed to be a mixture of the top down and bottom up approach. It acknowledges the fact that it is not possible to go in with a complete blank slate and find emergent themes, and a preferable approach is to acknowledge that these *a priori* themes are tentatively present (Gibbs, 2012); the flexibility of this method permits the early inclusion of these themes, allowing them to later be discarded if they are later found not be required.

Unlike the Braun and Clark (2006) approach of three levels of analysis consisting of descriptive code, interpretive code and then overarching themes, the Template Analysis method neither prescribes nor precludes differentiation between interpretative and descriptive themes, or a particular number of levels of coding. Instead, a flexible approach is suggested, allowing more detailed analysis of the richer data; focussing on areas that provide more interest, or may relate particularly closely to a research question, can subsequently result in an increased hierarchical structure for these particular areas, and fewer levels for areas that are not of such interest. The method encourages you to return to areas of interest and to dig deeper into those areas that may be of particular interest (Gibbs, 2012).

The first template is created from a subset of the data set rather than coding the whole sample. This subset is then analysed with bottom up approach. Once a common pattern of codes emerges, these codes can be organised into themes, assembling them into meaningful clusters and establishing the nuances that produce the sub themes; this forms the first version of the template (the coding framework). An iterative approach is taken to the development of the template by applying this template to more data, and revising and refining the template accordingly. Subsequent transcripts are coded with the template in hand to see whether the data can be encoded to one of these themes. If not, then this should be noted with a view to possibly modifying the template. This iterative process of looking at template, looking at fresh material and then seeing whether new material requires the template to be modified provides greater flexibility than a Framework Analysis approach when the framework is fixed and not reviewed, and is particularly applicable to applied research (Gibbs, 2012).

3.7.2 Analysis of the interview data

As discussed above, the method used to analyse the data was Template Analysis, supported by use of both NVivo and manual methods. This section will detail the process of the analysis and describe the development of the template.

Although each interview transcript had already been checked for accuracy and completeness, prior to the development of the initial template, the audio recording was replayed whilst simultaneously reading the transcript. The use of the audio recording served to refresh the memory and to inform the data analysis process, with nuances such as hesitation, tone of voice and laughter providing a fuller recollection of the interview than the words of the transcript alone.

In order to support this process, Express Scribe transcription software was used in conjunction with an Infinity foot pedal, facilitating the navigation within the audio file. Each audio file was listened to at least once, with some elements of the interview being replayed several times. As the interview progressed, brief notes were made for each interview. These notes contained in some cases background summary information, as well as summary records of the direct words of the interviewees, and interpretive notes, signposting some of the latent issues and potential emergent themes. An example of this annotation can be seen in Figure 3-4 below.

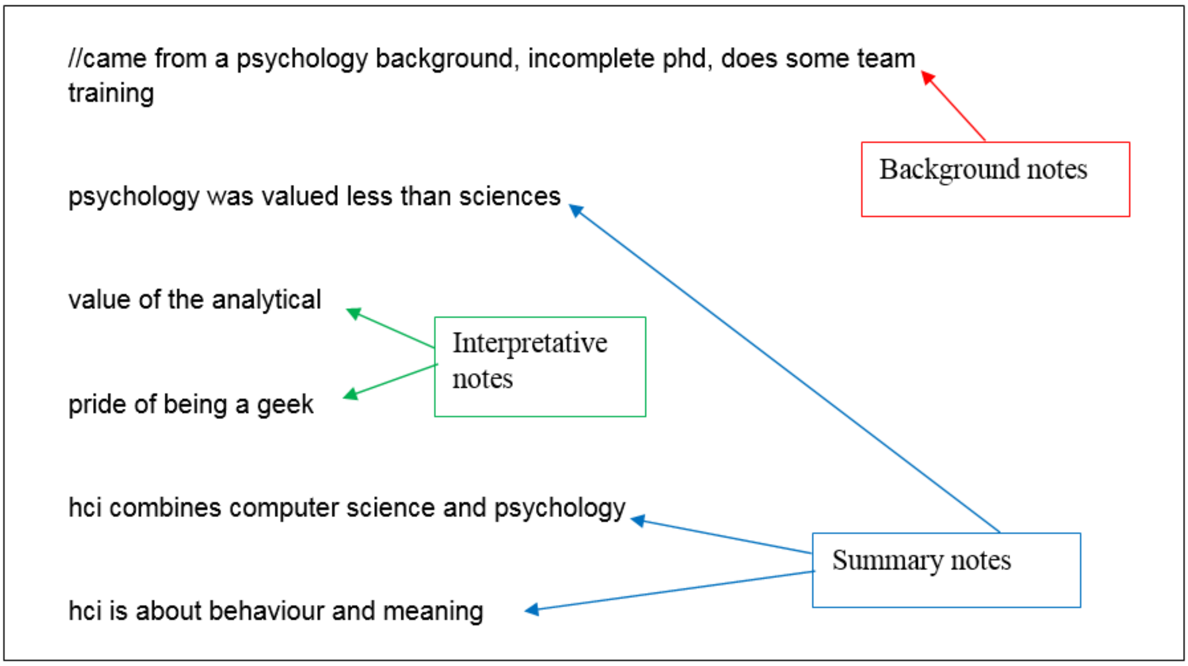


Figure 3-4: Preliminary analysis of the data

When each of the interviews had been summarised, the whole set of notes was analysed for common themes and a list of 175 candidate codes was produced for further analysis. The majority of these candidate codes were derived inductively from the notes resulting from the analysis of the interviews. However, Template Analysis also permits the use of *a priori* codes, and additional candidate codes were produced to support RQ1: How does the profile of the Educator differ from that of the Practitioner? The Myers-Briggs Type Indicator (MBTI), based on Jung's theory of psychological types, identifies four bipolar scales – Extroversion/Introversion, Sensing/Intuitive, Thinking/Feeling and Judging/Perceiving – and these eight constructs, along with the object and spatial visualiser and the verbaliser attributes, were included as *a priori* codes for the initial analysis of the data (Blazhenkova & Kozhevnikov, 2008; Myers, McCaulley, Quenk, & Hammer, 1998). It should, however, be noted that it was never the intention to use the MBTI to profile the interviewees, and these personality types are used solely as candidate themes to further explore the data.

Each candidate code was transferred to a card, and these were manually arranged into categories and subcategories, with additional cards created as potential themes emerged. An example of this is shown in Figure 3-5 below.

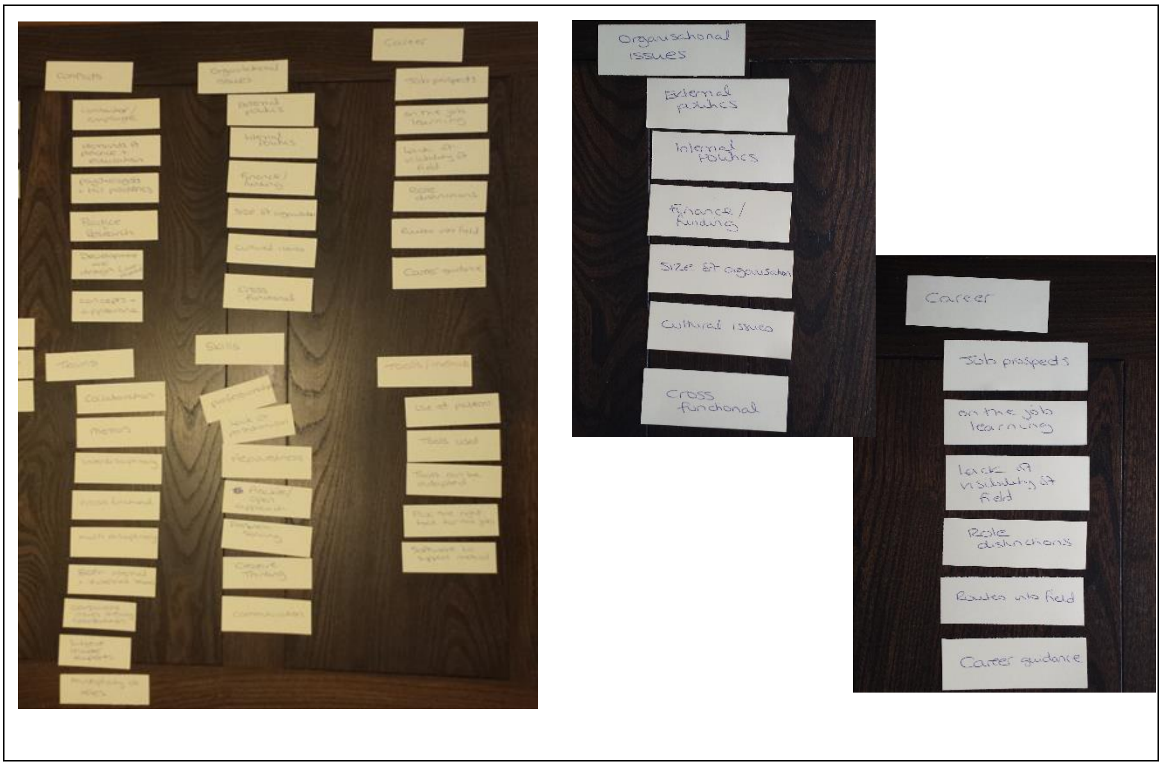


Figure 3-5: Development of themes from candidate codes

This was a reflective process completed over a period of time, with constant reference back to the research questions, the literature and the interview transcripts. Once the initial template was stabilised, the detail was transferred to an Excel spreadsheet to produce a hard copy of the codes for ease of reference.

This tree structure was then reproduced in Nvivo, making use of the tree node functionality to structure the template; in NVivo you code to a node. One additional node 'Other' was created to act as a repository for any data that was deemed interesting, but did not fall into a predefined node, and at the end of each iterative cycle the contents of 'Other' were reviewed as part of the development process. An example of this can be seen in Figure 3-6: below.

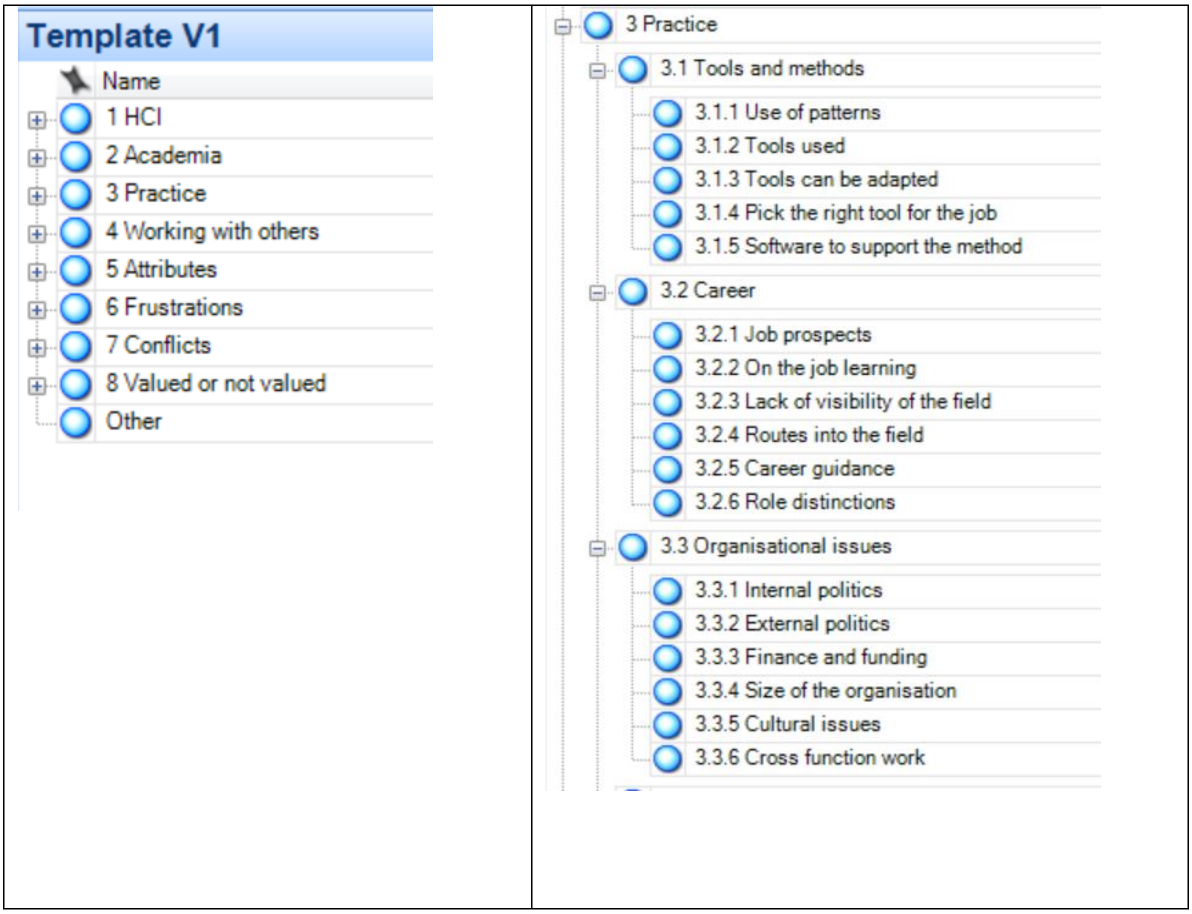


Figure 3-6: Unexpanded nodes, and sample of expanded NVivo nodes for Template V1

For each iteration of the template, use was made of the Memo facility within NVivo. This supported reflexivity and additionally served both as a record of the thought process and the rationale for changes made to the existing template. An example of this can be seen in Figure 3-7 below.

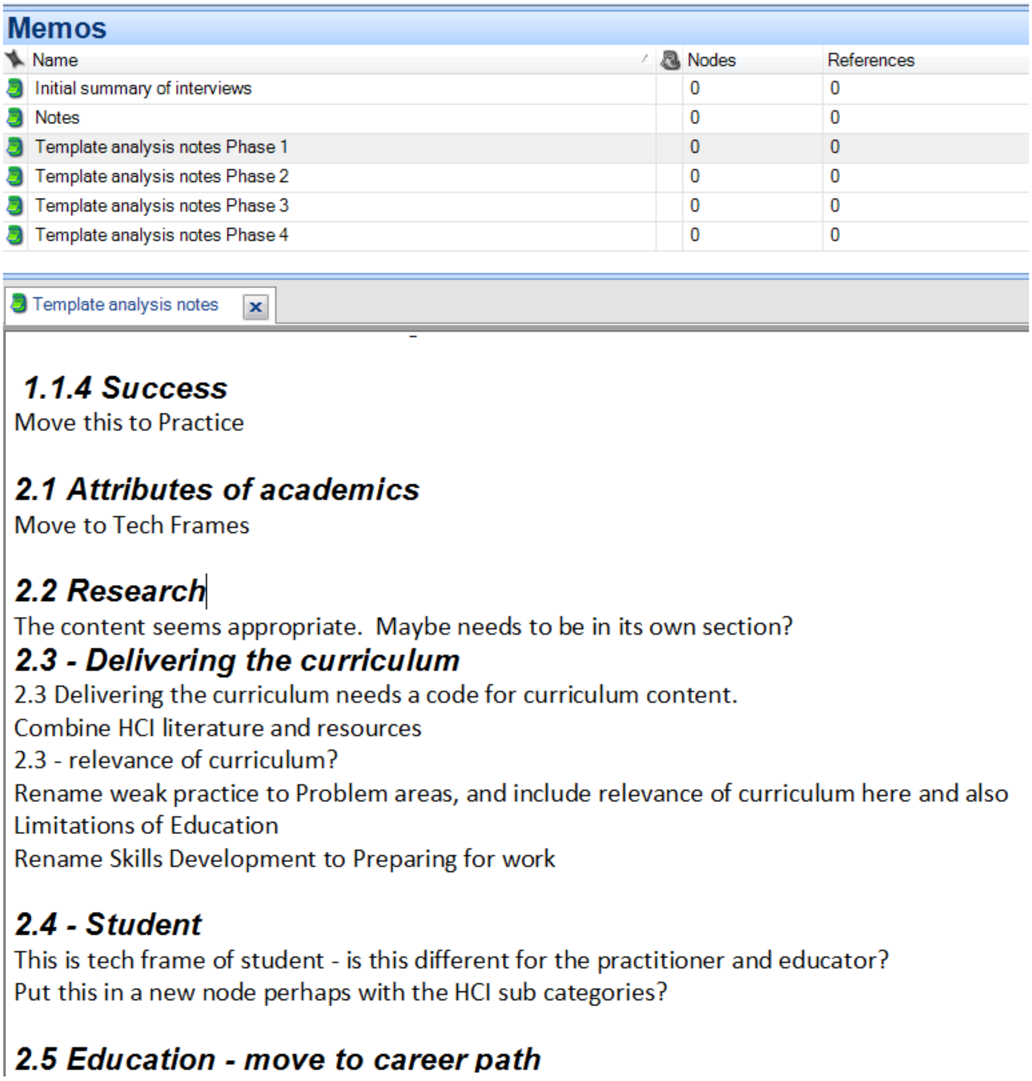


Figure 3-7: The use of the Memo facility within NVivo

Four more iterations followed until saturation point was reached and this resulted in the final version of the template. An extract from this can be seen in Figure 3-8 below and a full copy of the final version can be found in section 9.1 of the Appendix on page 300.

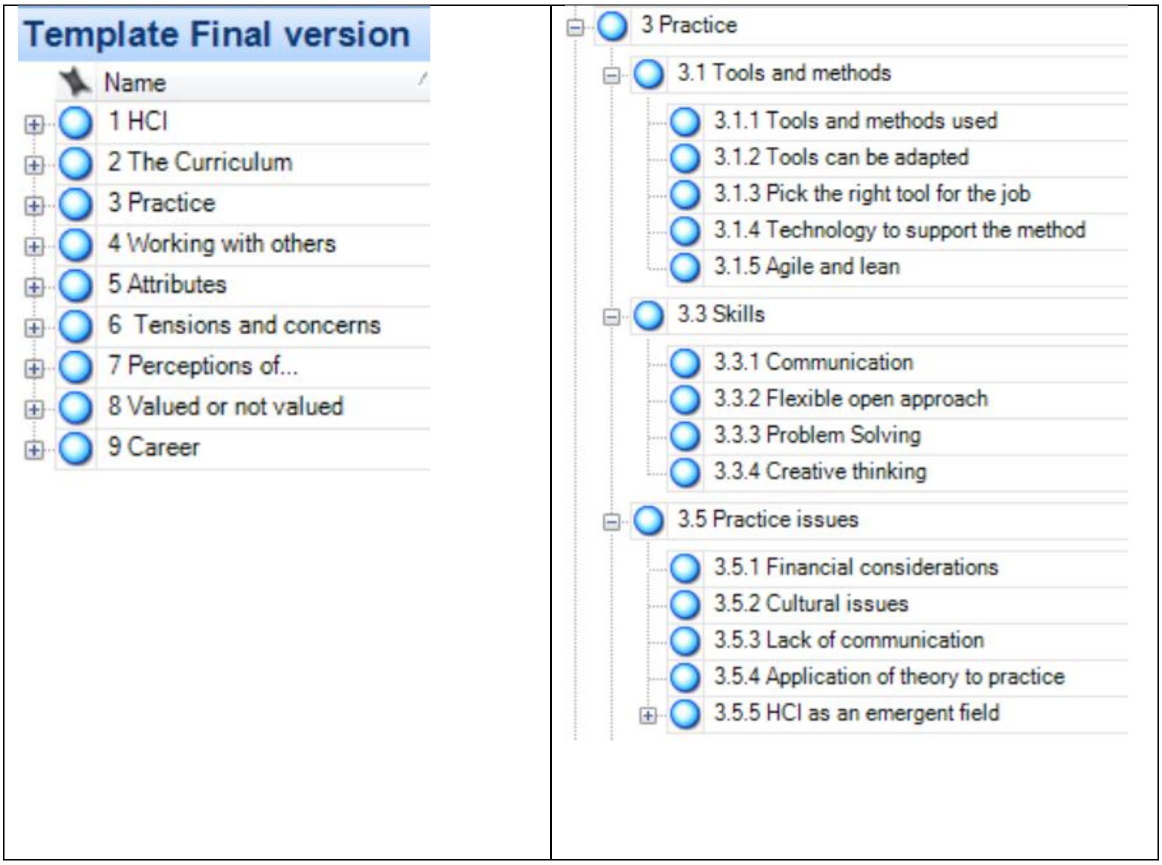


Figure 3-8: Unexpanded nodes, and sample of expanded NVivo nodes for final Template

Although consideration of the research questions was integral to the process of constructing the template, the majority of the themes were derived inductively from the process, and these did not always map neatly to the areas of consideration for RQ2 (background, what is valued, concerns and issues). In order to address this and to facilitate the discussion, each of the themes was mapped to one or more of these areas. An example of this is shown below, and the full mapping can be found in section 9.1 of the Appendix on page 300.

Final Template	Background	Values and priorities	Concerns and Issues
7.5 Research			
7.5.1 Scientific approach		x	
7.5.2 Relevance to practice			x
7.5.3 Dissemination		x	
7.5.4 Data and results		x	
7.6 Client	x		
8 Valued or not valued			
8.3 Valued by academia		x	
8.4 Not valued by academia			x
8.5 Valued by practice		x	
8.6 Not valued by practice			x
9 Career			
9.1 Job prospects	x		
9.2 Education			
9.2.1 Formal Education	x	x	
9.2.2 On the job learning	x	x	
9.2.3 CPD	x	x	
9.3 Lack of visibility of the field			x
9.4 Routes into the field	x		
9.5 Role distinctions	x		
9.6 Value of experience	x	x	

Figure 3-9: Sample of final template and mapping of research questions

To further facilitate the analysis of the interview data, an NVivo classification was created that assigned each respondent to one professional job title. These job titles were extrapolated from the interviews and consisted of Researcher, Designer, UX Architect, Software Developer and Educator. The role of the 'Both' is also differentiated to distinguish between the Practitioner who educates in a university setting, and the Practitioner who educates within practice as a mentor or trainer, with 'Both' being allocated to one of the job titles detailed above, and their educator role was refined to be either Education or Training. The classification also retained the original roles of Educator, Practitioner and 'Both' for all respondents. An example of this is shown in Figure 3-10 below.

Respondents	Role	Job title	Practitioner educator role
5 : 185-F-B-34-R Lucy	Both	Researcher	Training
7 : 210-F-B-34-R Josephine	Both	Researcher	Education
8 : 215-F-B-67-R Agnete	Both	Researcher	Education
11 : 256-M-B-51-P Larson	Both	s/w dev	Education
15 : 275-M-B-39-UX Eli	Both	UX Architect	Training
17 : 312-F-B-57-UX Mila	Both	UX Architect	Education
18 : 315-M-B-48-R Roger	Both	Researcher	Education
19 : 35-F-B-53-R Clara	Both	Researcher	Education

Figure 3-10: NVivo classification showing job titles and educator roles of 'Both'

The job titles of the classification was used to create a series of matrix queries within NVivo that allowed the data extracted for each node created to be separated by the job title, thereby facilitating an easy comparison the responses by job title, or by role. These are described in more detail on page 136 below.

The use of qualitative data analysis software is discussed in more detail in the next section.

3.7.3 Use of qualitative data analysis software

NVivo is one of the family of qualitative data analysis software (QDAS) that supports a wide range of methodological approaches, including Template Analysis (Brooks et al., 2015). NVivo does not do the analysis for you, but is rather a data management tool that supports analysis by speeding up the process and providing an automated information retrieval capability (Welsh, 2002). As discussed above, the initial analysis was a manual process; the subsequent use of NVivo to organise the data speeded up the coding process, and additionally supported not only the management of the data, but also the management of the ideas, with its search and query functionality and its integrated memo capability.

There are both advantages and disadvantages to using QDAS to support the process of data analysis (John & Johnson, 2000; Johnston, 2006; Welsh, 2002), and these will be discussed in more detail below.

The obvious advantage of using QDAS is that the use of software facilitates the interrogation of the data, and as detailed above, the inbuilt classification and query functions supported analysis of the data that would have been time consuming to produce manually. Once familiar with the software, the process of the coding was quick and easy, and when themes needed to be consolidated or the tree structure rearranged, this was easily done. In order to produce an audit trail and record of the template development, the memo facility within NVivo was used to record changes made to each version of the template. By using the inbuilt memo functionality, it was possible to record the development of each template in the same repository as the source data, and the interim versions of the template. This facilitated cross referencing and validation of the templates as they evolved, simplified the process of backup of the data, and supported the write up of the research.

Although the use of NVivo was for the main part a positive experience, I also shared some of the frustrations experienced by other researchers using QDAS rather than manual methods (Bazeley & Jackson, 2013; Johnston, 2006). There was a steep learning curve before I was efficiently using the software, and the coding process was tedious and at times felt mechanistic. The size of the computer screen constrained the tree view of the coding hierarchy, making the coding process clumsy, and at times frustrating, as I had to either collapse and expand the tree structure, or use the scroll bar to navigate the themes, meaning it was not possible to see the entire template at any single point. The focus of the analysis was on the words, sentences and perhaps paragraphs rather than the interview as a whole, as it was not possible to skim read the entire document to put the text in the context of the conversation, as would be the case with a hard copy of the interview. This had the effect of putting the focus on the coding process rather than analysis of the data, and there was a danger of losing closeness to the data due to the mechanistic nature of the coding. To counter this, manual methods were combined with the use of the software (Bazeley & Jackson, 2013). Each version of the template was reproduced in Excel and printed out so that hard copies could be pinned to the wall of my office; a sample of this is illustrated in Figure 3-11 on page 132 below. In addition, each of the interviews was printed out, so that I could skim read, or annotate the hard copy as my thoughts developed, and this combination of manual methods to support the digital allowed me to immerse myself in the data and somewhat mitigated the negative effect of using the technology.

	A	B	C
30	**3 Practice**		
31			
32	**3.1 Tools and methods**		**3.5 Practice issues**
33	3.1.1 Use of patterns		3.5.1 Financial contraints
34	3.1.2 Tools used		3.5.2 Lack of a clear identity
35	3.1.3 Tools can be adapted		3.5.3 Lack of communication
36	3.1.4 Pick the right tool for the job		3.5.4 Application of theory to practice
37	3.1.5 Software to support the method		3.5.5 Lack of common terminology
38			3.5.6 Lack of set procedures
39			3.5.7 Undisciplined approach
40	**3.2 Career**		
41	3.2.1 Job prospects		
42	3.2.2 On the job learning		**3.6 Practice processes and procedures**
43	3.2.3 Lack of visibility of the field		3.6.1 Rigour and a disciplined approach
44	3.2.4 Routes into the field		3.6.2 Iterations
45	3.2.5 Career guidance		3.6.3 UX and agile
46	3.2.6 Role distinctions		3.6.4 Testing
47			3.6.5 Information architecture
48			3.6.6 Risk assessment
49	**3.3 Organisational issues**		3.6.7 Flexible approach
50	3.3.1 Internal politics		3.6.8 Active participation of users
51	3.3.2 External politics		3.6.8.1 Mental models
52	3.3.3 Finance and funding		3.6.8.2 Managing expectations
53	3.3.4 Size of the organisation		3.6.8.3 The user as a consumer
	3.3.5 Cultural issues		3.6.8.4 Involving the user in evaln and testing

Page 2

Sheet1

Figure 3-11 Hard copy of NVivo themes

One unforeseen problem of using QDAS was caused by the use of the cloud storage service Dropbox. Dropbox works in the background automatically backing up (‘syncing’) your files to the ‘cloud’ as you work on them. If you have more than one computer, for example, one at work and one at home, and Dropbox is installed on each, you can start work on a document at home, and complete it the next day in the office without the need to manually back up or transfer the file on a USB stick. You automatically see the most up to date version of the document. If you make some edits, but later change your mind, you can go back to a previous version. If your computer fails, you haven’t lost all of your work. Additionally, you can share folders, making collaboration easy. For these reasons, Dropbox has been used to store all files associated with my research. NVivo, however, does not work well with Dropbox, as it has a database component, and while NVivo is making use of the database, it locks the file, and does not allow the file to ‘sync’. This caused NVivo to crash, and corruptions of the database resulted in the loss of many hours of coding effort. Subsequently, the NVivo file was moved from the Dropbox folder to another folder on the hard drive, and the file was instead was backed up manually at regular intervals.

3.7.4 The application of technological frames of reference

A technological frame of reference is a cognitive device that allows an individual to make sense of technology in a particular context by structuring their previous experiences and knowledge (Lin & Silva, 2005). Technological frames can also provide a framework with which to systematically analyse the perceptions of members of the same social group and compare them with the perceptions of another social group, and to explain the differences between the groups (Bijker, 1987; Orlikowski & Gash, 1994); this is covered in more detail in section 2.6 on page 65. In this thesis, the concept of technological frames have been loosely adopted to facilitate the analysis of the data and to differentiate between the perspectives of the different professionals. However, no attempt has been made to replicate the methodology of previous technological frames studies as technological frames of reference are not the primary focus of this study.

As noted in section 2.6.2 (page 71), much of the technological frames literature centres on the implementation of information systems within an organisation and whilst some parallels can be drawn with this research, this thesis discusses a far broader issue. The implementation of an information system implies a project, with discrete deliverables, a temporary venture with a clear start and end. This thesis is not studying a project, but rather HCI practice, which in common with other technology practice is not static, but necessarily evolves in order to satisfy the changing needs of the face of technology. Additionally, it should be noted that unlike the approaches of adopted by other researchers (Abdelnour-Nocera et al., 2007; Davidson, 2002; Lin & Silva, 2005; Olesen, 2014), this is not a longitudinal study, and neither is the study focused on a particular organisation, so the findings are not replicable.

As this is not a case study investigation, and neither is it investigating a specific technology, no single framework of technological frames has been adopted. Rather, particular concepts and perspectives from Bijker, Orlikowksi, and Gash, Davidson and Kaplan and Tripsas have been integrated (Bijker, 1987; Davidson, 2002; Kaplan & Tripsas, 2008; Orlikowski & Gash, 1994), resulting in a tailored framework for analysis to suit this particular study. This tailored framework concentrates on Bijker's emphasis on the interaction between actors, with the positioning of frames between the actors, and frames encompassing the problem solving concepts and theories of the community which include current theories, tacit knowledge, goals and practice. It also incorporates Davidson's methodology and the Orlikowski and Gash emphasis on the interpretative value of the interaction with technology, with HCI, in this case, being the technology in question.

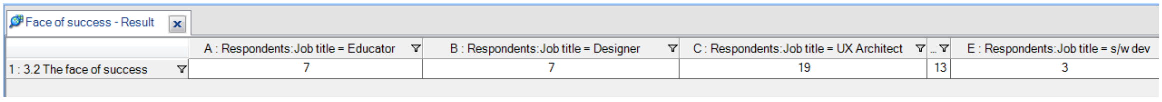
The metaphor of HCI as a technology is extended to incorporate Kaplan and Tripsas's discussion of technological frames in the context of evolutionary models of technological change, with the predefined actor roles of producer, user and institutional actor. To facilitate the analysis and discussion, this framework will be discussed in the context of the reporting of practice, and the perceptions of practice.

The equivalent of engineering practice and specialised testing procedures (Bijker, 1987) are discussed broadly during the interviews, but are not the main focus of this investigation, so are not part of the framework for analysis. However, the identification of current theories, tacit knowledge, goals and practice of use do contribute to the profile of the practitioner and therefore are included in the analysis which will addresses Does the profile of the HCI professional vary from role to role in respect of their background, their perception of the field, and their values, priorities, concerns and issues?

Davidson's (2006) survey of previous technological frames studies identifies typical frame domains as related to IT features, potential organisational application, incorporation of IT into work practice, or developing IT within organisations. The primary stages of a technological frames study include firstly identifying stakeholder groups, and then analysis of how the frames influence the sense making. A typical technological frames study would then investigate any incongruence of frames and evaluate the consequences of the incongruence. The primary focus of this thesis is not a technological frames study and neither does this study concentrate on one particular organisation, but rather it takes a broad view of the role of the professional. As a result, this thesis is concerned only with the first two phases of this process, namely the identification of the stakeholder groups, and the analysis of how the frames influence the sense making, and these two phases are described below.

The stakeholder groups were initially defined as the Practitioner, the Educator, and ‘Both’. This was further refined to include the job titles of Researcher, Designer, UX Architect, Software Developer and Educator. These job titles were extrapolated from the interview findings and confirmed by referencing the original survey responses. The role of ‘Both’ is included in the stakeholder group to facilitate the comparison of this group with that of the Educator, as the quantitative analysis had identified some differences between these two groups.

In order to analyse how technological frames influence the sense making, as part of the NVivo analysis, matrix queries were run that incorporated the job titles of the classification. Double clicking on the relevant cell of the output permitted the responses of each of the roles to be viewed in isolation. NVivo further supported the process indicating the number of references coded, indicating the potential richness of the data. The output of each cell grouped the coded sections by respondent, so that it was easy to see whether the responses came from a number of sources, suggesting consensus, or perhaps from one interviewee with strong opinions on a particular subject. An example of the output from one of the matrix queries can be seen in Figure 3-12 below.



Face of success - Result

	A : Respondents:Job title = Educator	B : Respondents:Job title = Designer	C : Respondents:Job title = UX Architect	...	E : Respondents:Job title = s/w dev
1 : 3.2 The face of success	7	7	19	13	3

Figure 3-12: Analysis according to the role of respondent - sample output from a matrix query

3.7.5 Quality checks

There is no universal consensus regarding which quality checks should be undertaken for qualitative research. King (2016) suggests a number of approaches may be appropriate when using Template Analysis.

As this was a solo project, there was no team of researchers to independently scrutinise the analysis of the data. However, as the template developed it was reviewed and discussed during supervisor meetings. These meetings encouraged reflection, and ensured that the focus of the analysis remained on the research questions. To support this, notes were made of the process and rationale for each version, providing an audit trail of the process. Additional quality checks included checking of the transcriptions against the original audio files, are described in section 3.7.2 above.

3.8 Conclusion: methodology

This chapter has detailed the research design and the rationale for a mixed methods approach, necessitating both a qualitative and a quantitative approach, and adopting a pragmatic approach (Teddlie & Tashakkori, 2009).

The project was initiated with a correlational survey design using self -report measures, assuming a postpositive epistemological stance. This survey collected some demographic data and incorporated the cognitive style surveys which addressed RQ1 as well as identifying potential candidates for interview. The demographic data and the results of the cognitive style tests were analysed making use of various statistical tests. Pearson product-moment r correlations were computed to produce a general profile of the professional, followed by chi-square goodness-of-fit tests and Welch's unpaired t-tests in order to establish whether the cognitive profile of the HCI professional does indeed differ from that of the general population (RQ1a). In order to address whether there were differences between the roles of professional, a series of ANOVAs and MANOVAs were conducted (RQ1b).

The survey provided a partial profile of the roles of professional and also tested some assumptions regarding the differences between the HCI professional and the general population, and differences between HCI roles and was complemented by a series of interviews. The findings of the quantitative data analysis phase are detailed in Chapter 4 on page 139.

The interview phase adopted a constructionist approach which supported the probing of RQ2 and RQ3 to provide a fuller picture of human-computer interaction and the profiles of the HCI professional. A thematic data analysis approach was adopted, with the interview data being analysed using Template Analysis (King, 1998) and supported by a technological frames approach to differentiate the difference between the roles. NVivo software was used to support this phase of the study. The findings of the qualitative data analysis phase can be found in Chapter 5 on page 180.

4 Survey results

The previous chapter describes the design and delivery of the survey which embedded the OSIVQ of Blazhenkova & Kozhevnikov (2008) and the CSI of Allinson & Hayes (1996), together with some demographic information. This chapter describes the results of the quantitative data analysis that was undertaken in order to provide a snapshot of the profile of the professional, and specifically, to address the following research questions and assumptions:

- RQ1a: How does the cognitive profile of the HCI professional differ from that of the general population?
- RQ1b: What are the differences between the Educator, the Practitioner and 'Both' in terms of their analytical/intuitive preferences, and their Visual Object, Visual Spatial and Verbal abilities?
- Assumption 1: As the HCI professional makes use of tools and techniques that require both analytical and intuitive approaches, they are more likely to fall within the range of Quasi-Intuitive to Quasi-Analytical than the general population
- Assumption 2: The HCI professional will have greater Visual Object ability than a computer scientist or an engineer, and greater Visual Spatial ability than a visual artist.

In the context of these research questions, the term ‘general population’ is considered from three different perspectives. Firstly, it is considered from the perspective of the profiles generated by the OSIVQ of Blazhenkova and Kozhevnikov (2008) and secondly, from the perspective of the profiles generated by the CSI of Allison and Hayes (1996) and the Technical Manual and User Guide of the CSI additionally provides norms and reliability data for 106 studies which have made use of the CSI (Allinson & Hayes, 2012). The data provided includes the role of the sample participants, the number of participants and the mean and standard deviation for each study which has allowed some further comparison between the HCI roles generated in this thesis and the general population. Finally, where applicable, there is reference to Hedden and Gabriel’s (2004) longitudinal study of the cognitive neuroscience of human aging.

As detailed in Section 3.2 page 82 above, a correlational survey design using self -report measures was adopted for the quantitative phase of data collection, the results of which are discussed below.

4.1 Participants

As described in section 3.4.2 on page 90, 301 records were retained for further analysis once the data had been cleansed. The survey provided some demographic data, which is summarised below. An overview of the entire sample is provided, followed by a summary of each of the roles of Practitioner, Educator and ‘Both’. This is followed by the findings from the various statistical tests that were computed to address research questions above.

4.1.1 Profile of the respondents

The 301 professionals who responded to the survey (M=143, F=158), provided some demographic data and then completed the CSI and the OSIVQ cognitive style surveys. The respondents were made up of Practitioners, who practice but do not educate (n=171), Educators, who educate but do not practice (n=58), and 'Both', who both practice and educate (n=72). The respondents ranged in age from 22 to 79, and there were representatives from 36 countries covering Europe, North and South America, South Africa, Asia and Australia/Oceania. 48 (16%) of the respondents were not nationals of the country in which they practice; 16 of these ex-patriates were based in the UK and 12 in the USA. The following sections will describe the demographics of the Practitioners, Educators, and 'Both'.

4.1.2 Description of the Practitioners

171 respondents aged between 22 and 69 identified themselves as Practitioners (M=75, F=96); only 44% of the respondents were male which is in contrast to the findings of Gulliksen et al. (2004) when 59% of their sample was male. Of the 171 respondents, 86 were based in North America, 38 in the UK, 30 in other mainland Europe countries, and 8 in India. 31 (18%) of the practitioners were not citizens of the country in which they were currently working; 11 of these ex-patriates were working in the UK, and 9 in the USA, and combined they represented 20 different nationalities.

A wide range of Practitioners responded to the survey, providing a good cross section of the population. They worked for a range of organisations, some for household names such as Facebook, Netflix and Google, and others worked for small independent organisations, or were employed as consultants. Some had been working for many years in the field and had senior positions within their organisation or headed up their own company; others were at the start of their career.

The majority of the respondents described themselves as either user experience (UX) designers or UX architects, with the third most common description being researchers, followed by other sorts of design roles such as interaction design. Generally, those who identified themselves as designers, (but not UX designers) were not involved with research work, and likewise, researchers were not involved with design work. The exception to this was those who had consultancy roles, where their areas of expertise appear to be much broader. Of those who indicated that they were consultants, some did not specify in which area they specialised, but many consultants indicated that they supported both design and research activities. It was interesting and encouraging to see that three respondents described their roles as being concerned with UX strategy, suggesting that in some organisations the user experience is valued and consciously planned for.

4.1.3 Description of the Educators

Prior to describing the respondents who were Educators it is pertinent to note that there are differences in the terminology used by educational establishments in different parts of the world. For example, in the United States all lecturers are referred to as professors, what we in the UK referred to as a module or a unit, they describe as a course, and the term college is used to describe a university ('Academic Terminology Differences - Study USA | US-UK Fulbright Commission', n.d.). In the UK colleges are differentiated from universities; they tend to be smaller institutions and they do not have degree awarding power (but may often deliver degrees in partnership with a university, or some other externally awarded higher education qualification such as the BTEC Higher National Diploma in Computing and Systems Development).

58 respondents (M=34, F=24) aged between 26 and 79 were categorised as educators. Of these, 2 identified themselves as PhD students, and 2 as researchers; as many researchers and PhD students have teaching responsibilities, this classification was felt to be appropriate. Of these 58 Educators, 22 were based in the UK, 10 in North America and 15 were from mainland Europe. 6 (10%) of the Educators were ex-patriates; two were based in the UK and one in the USA.

Some Educators worked part time, and some full time, with a range of academic experience reported from full Professorship, to include lecturers, senior lecturers and visiting and adjunct professors. Membership of specialist HCI organisations such as SIGCHI was also mentioned, and some mentioned that they have more than 20 years' experience of teaching HCI. Three mentioned that they had previous experience as a practitioner, and one that they maintained their industry links.

Where institutions were mentioned, apart from one which was described as a UK college the rest were universities. A range of subjects are delivered, with modules covering multimedia and web development, interactive game design, interaction design, technology enhanced learning and information architecture, as well as the expected human-computer interaction and user experience modules.

It is worth noting at this point that fewer Educators responded to the initial Linked In invitations to complete the survey, necessitating a separate invitation focussed directly at Educators. This may suggest that perhaps Educators are less likely to use Linked In than Practitioners.

4.1.4 Description of respondents who describe themselves as 'Both':

72 respondents (M=34, F=38) with ages ranging from 31 to 68 identified themselves as 'Both'. 22 were based in the UK, 21 were from North America, and 19 from mainland Europe. Of these, 12 (16%) were ex-patriates but there was not the same concentration of settlers located in the UK and the USA as was observed with the Practitioners and Educators; the 'Both' ex-patriates were spread over 7 different countries, with the UK and USA combined hosting only 5.

As with the Practitioners, there was a broad range of experience, and organisations ranged from small independent practices to large well-known brands such as IBM and Deutsche Bank. The practice element of this set of respondents was more diverse than those reported by the full time Practitioners, and included more involvement in research; 5 respondents from this category described themselves as scientists or industrial scientists (only 1 of the

Practitioners was an industrial scientist); 4 respondents described themselves as academic researchers. The other practitioner roles were very similar to those reported by the Practitioner set, including web design, user experience design and consultancy.

The majority of respondents who specifically mentioned the Educator element of their role were part time university lecturers, although two identified themselves as providing commercial training, and two others mentioned a mentoring role. 13 of the respondents provided only brief details containing job titles, but no detail of lecturing, training or mentoring. The survey design is discussed in more detail in section 3.4.2.2 on page 93 where it is noted that the lack of educator detail in the free text field is not considered to indicate that these particular respondents have misclassified themselves. However, it would have been beneficial to further differentiate the role of ‘Both’ to distinguish between academic and commercial education, and it may be that another category should have been considered to differentiate between those who are practitioners who educate and practitioners who train or mentor.

4.1.5 Global representation

Another consideration is that the survey responses are unlikely to reflect the HCI profession globally. For example, two of the four mailing lists used to invite respondents are UK based organisations, and it is noted that there are a large proportion of the Educator responses are from the UK. As a result, comments on curriculum may be more representative of UK HCI education than global HCI education.

Additionally, it is noted that whilst there is a growing HCI community in China, there were no Chinese respondents to the survey; the survey was created using Google Forms. Whilst it is likely that HCI professionals would have seen the post as access to LinkedIn is permitted by the Chinese authorities, they would not have been able to access the survey as the use of Google products such as Google Drive is blocked in China. Use of a different survey tool may have remedied this.

4.2 Statistical testing

The roles of the professionals and the creation of the two new variables are discussed in section 3.5.1 (see page 101 above), but for ease of reference are summarised in Figure 4-1 below. Practitioner, Educator and 'Both' are discrete, as are All-Pract and Educators, and All-Ed and Practitioners.

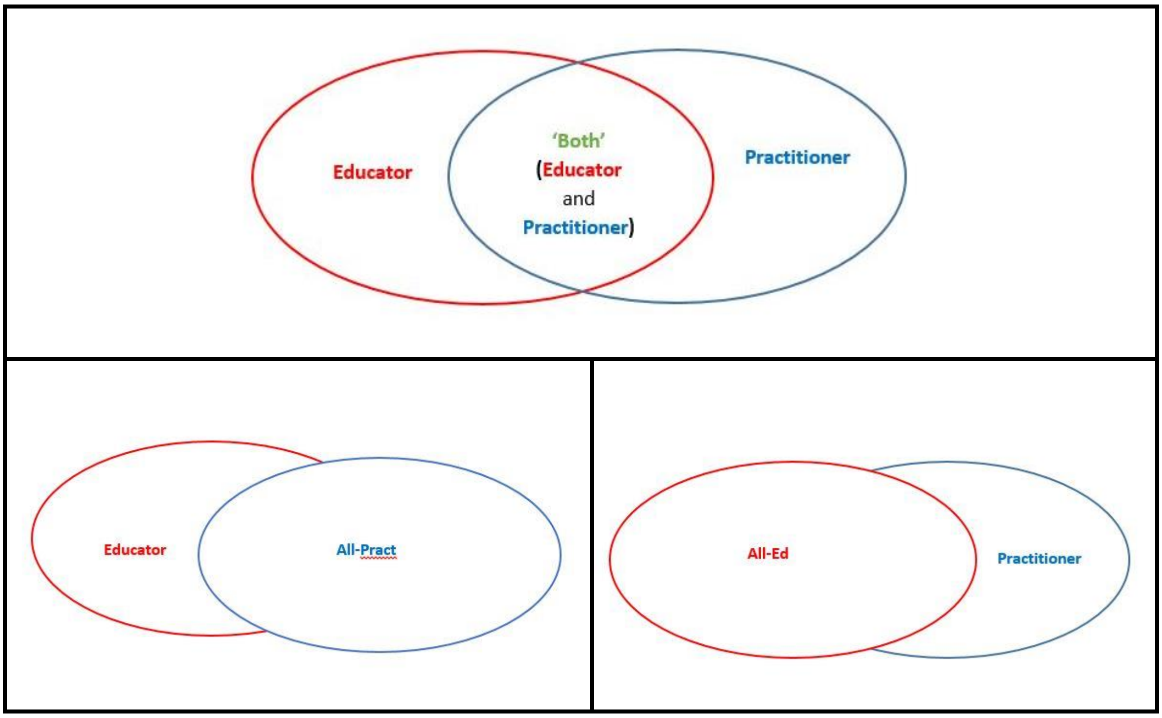


Figure 4-1 : The roles of the professional

A number of statistical tests were computed to address the research questions detailed at the start of this chapter. These utilised the roles of the professional (Practitioner, Educator, 'Both', All-Pract and All-Ed) and the raw data output from the two cognitive styles surveys. The Cognitive Styles Index (CSI) produces one single output which places the individual on a spectrum that ranges from the Intuitive to the Analytical with a scale ranging from 0 to 76; the Object-Spatial Imagery and Verbal Questionnaire (OSIVQ) generates three mean average scores for each respondent, each ranging from 0.00 to 5.00, and measuring Visual Object ability, Visual Spatial ability and Verbal ability. Both cognitive style instruments are described in more detail in sections 2.5.4 (page 56) and 2.5.5 (page 59).

4.2.1 Data analysis strategy

A number of statistical tests including Pearson product-moment r correlations, chi-square goodness-of-fit and Welch's unpaired t-test were employed to address RQ1a: How does the cognitive profile of the HCI professional differ from that of the general population?

These were followed by a series of ANOVAs and MANOVAs in order to address RQ1b: What are the differences between the Educator, the Practitioner and 'Both' in terms of their analytical/intuitive preferences, and their Visual Object, Visual Spatial and Verbal abilities? The ANOVAs served to compare the mean CSI scores of the groups of professional and to identify any differences between the roles. The OSIVQ generates three outputs which serve as dependent variables. In order to compare the mean score of each of these, a series of MANOVAs rather than multiple ANOVAs was employed to reduce the likelihood of Type 1 errors (Field, 2013, p. 624; Pallant, 2013, p. 293).

4.2.2 Results: the Cognitive Style Index

The CSI measures whether a subject tends more towards an intuitive or an analytical approach. In order to establish whether profile of the HCI professional does indeed differ from the profile of the general population as defined by Hayes and Allinson, chi-square goodness-of-fit tests were conducted to assess whether the observed frequencies of HCI professionals falling into each of the five CSI categories differ from the score ranges published by Hayes and Allinson (1996). The score range of the 20th, 40th, 60th and 80th percentile of their sample of 1180 British managers and professionals provide the range boundaries for each of the five notional styles of Intuitive, Quasi-Intuitive, Adaptive, Quasi-Analytical and Analytical, with 20% of their sample fitting into each of the categories. The Hayes and Allinson CSI score ranges are summarised in Table 4-1 below, and the CSI scores and profile for the HCI professionals is presented in Table 4-2 below.

Table 4-1: Hayes and Allinson CSI score ranges for the five cognitive styles

Intuitive	Quasi-Intuitive	Adaptive	Quasi-Analytic	Analytic
20%	20%	20%	20%	20%
0 – 28	29 – 38	39 – 45	46 – 52	53 – 76

Table 4-2: The CSI profile for the roles of professional

Role	Gender	Number	CSI mean score	SD	Profile
All HCI professionals	All	301	40.14	12.00	Adaptive
	Female	158	40.76	11.52	Adaptive
	Male	143	39.45	12.51	Adaptive
Practitioner	All	171	40.22	11.01	Adaptive
	Female	96	40.54	10.84	Adaptive
	Male	75	39.81	11.29	Adaptive
Educator	All	58	43.34	13.79	Adaptive
	Female	24	45.58	11.76	Adaptive
	Male	34	41.76	15.02	Adaptive
Both	All	72	37.35	12.26	Quasi-Intuitive
	Female	38	38.26	12.40	Quasi-Intuitive
	Male	34	36.32	12.09	Quasi-Intuitive
All-Pract	All	243	39.37	11.43	Adaptive
	Female	135	39.90	11.30	Adaptive
	Male	109	38.72	11.60	Quasi-Intuitive
All-Ed	All	130	40.02	13.23	Adaptive
	Female	62	41.10	12.58	Adaptive
	Male	68	39.04	13.81	Adaptive

The chi-square results identified a significant difference when considering the entire cohort of HCI professionals and the general population (χ^2 (4, n = 301) = 15.40, p=.004). However, when this test was replicated for the categories of roles of professional, this difference was observed only for the roles of Practitioner (χ^2 (4, n = 171) = 10.082, p = .039) and All-Pract, that is the Practitioners and ‘Both’ combined: (χ^2 (4, n =243) = 14.387, p = .006). No difference was observed when considering the Educators (χ^2 (4, n = 58) = 7.000, p = .136), ‘Both’ (χ^2 (4, n = 72) = 7.722, p = .102) or All-Ed, that is the Educators and ‘Both’ combined (χ^2 (4, n = 130) = 7.538, p = .110). Although this is not conclusive as ‘Both’ and All-Ed are also involved in practice, it may suggest that there is a difference between the HCI professional who practices and the HCI professional who does not practice, and also a difference between the HCI professional who practices and the general population. In contrast, the HCI Educator does not differ from the general population in respect of their CSI profile. It is, however, noted that although the role of All-Pract (which consists the roles of Practitioner and 'Both' combined) differs from the general population, this was not the case when considering the role of 'Both' (see Figure 4-2 on page 74 below).

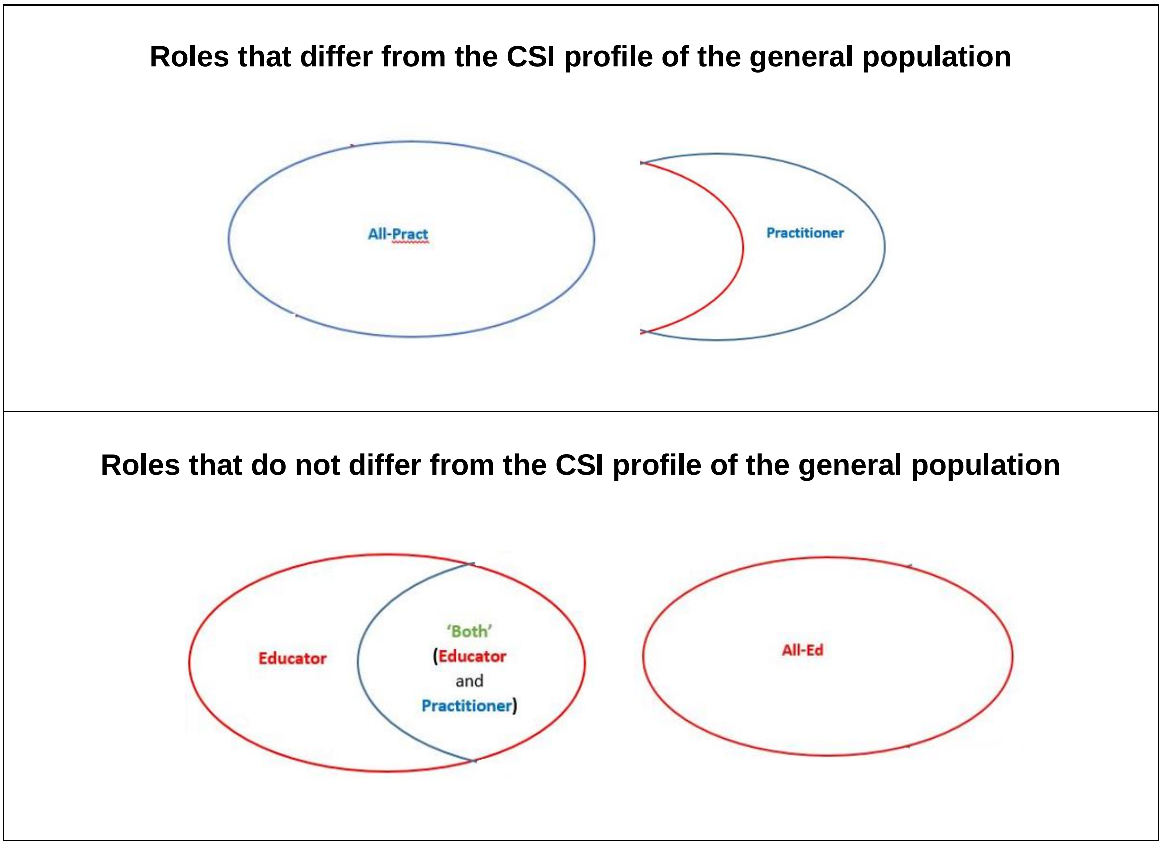


Figure 4-2: Comparison of the roles with the CSI profile of the general population

No significant gender differences were noted for any of the roles, although it is noted that in accordance with the findings of other CSI studies (Allinson & Hayes, 2012), the mean score was higher for the females of the sample of HCI professionals (M=40.76, SD=11.52, n=158) than for the males (M=39.45, SD=12.51, n=143); t (299) = .95, p = .34, indicating that the females adopt a more analytical approach (see Table 4-2 above).

In order to explore the differences further, a number of comparisons were made between the published normative data of the CSI and the CSI profile of the HCI professionals. These made use of the mean scores from the descriptive statistics, supported by some simple Excel manipulation and served to test Assumption 1: As the HCI professional makes use of tools and techniques that require both analytical and intuitive approaches, they are more likely to fall within the range of Quasi-Intuitive to Quasi-Analytical than the general population.

As indicated in Table 4-1, the distribution of the CSI scores resulted in 60% of the Allinson and Hayes sample (hereafter referred to as the CSI sample) falling into the middle range of Quasi Intuitive to Quasi Analytic, and similarly, 40% falling into the two categories of Intuitive and Quasi Intuitive, and Analyst and Quasi Analyst respectively at each of the extreme ranges of the scale. This is illustrated in Figure 4-3 below.

<table>
<tr><td></td><td colspan="3">Range Quasi-Intuitive to Quasi-Analytic
60%</td><td></td></tr>
<tr><td>Intuitive
20%</td><td>Quasi-Intuitive
20%</td><td>Adaptive
20%</td><td>Quasi-Analytic
20%</td><td>Analytic
20%</td></tr>
<tr><td colspan="2">Range Intuitive to Quasi-Intuitive
40%</td><td></td><td colspan="2">Range Quasi-Analytic to Analytic
40%</td></tr>
</table>

Figure 4-3: Profiles of the Allinson and Hayes CSI sample

It should be noted that the population for this study which includes both practitioners in the field and educators differs from that of the Allinson and Hayes study which consisted of managers and business professionals. The expectation was that although both the CSI sample and this sample consist of professionals, and although 20% of the CSI sample fell into each categories indicated in Table 4-1, more than 60% of the sample consisting of the HCI professional would fall within the range of Quasi-Intuitive to Quasi-Analytical as the HCI professional makes use of tools and techniques that require both analytical and intuitive approaches. This was indeed found to be the case, as can be seen in Table 4-3 below, with the HCI professionals tending more towards the intuitive than the analytical.

Table 4-3: The HCI professional sample

Role	**Number**	**Quasi intuitive – Quasi analytical** (60% of the CSI sample)	**Intuitive – Quasi intuitive** (40% of the CSI sample)	**Quasi Analyst – Analyst** (40% of the CSI sample)
HCI professionals	301	64%	47%	34%

This differentiation between the CSI sample of managers and professionals and that of the HCI professional becomes even more pronounced when considered in relation to the various roles of the HCI professional (Table 4-4) where it is particularly apparent in those professionals who are involved in practice: for the roles of Practitioner and All-Pract, the assumption that more than 60% of the population would fall into the range of Quasi-Intuitive to Quasi-Analytical is correct, although this does not hold true for the role of ‘Both’ who are observed to be the most intuitive of the professional roles. Of all of the roles, the profile of Educator is closest to that of the CSI profile provided by Hayes and Allinson.

Table 4-4: Comparison of the HCI professionals and the CSI sample

Role	**Number**	**Quasi intuitive – Quasi analytical** (60% of the CSI sample)	**Intuitive – Quasi intuitive** (40% of the CSI sample)	**Quasi Analyst – Analyst** (40% of the CSI sample)
Practitioner	171	68%	45%	34%
Educator	58	57%	43%	40%
Both	72	58%	56%	29%
All-Pract	243	65%	48%	33%
All-Ed	130	58%	50%	34%

Further comparisons were made using the normative data provided by Allinson and Hayes in the Technical Manual and User Guide of the CSI (2012) which is summarised in Table 4-5. This places computing professionals and graduate psychology students in the Adaptive band with mean scores ranging from 43.34 to 38.01; this data confirms findings from our previous research into Human-Computer Interaction Education which involved a global study of students studying HCI subjects on computing based courses (Abdelnour-Nocera et al., 2013) and resulted in a CSI mean score of 41.35 for the students. There is no data supplied specifically for HCI students, but as the subject of HCI generally has some psychology content, it would not be unreasonable to expect some similarity in the profile of HCI students on computing based courses, psychology students and computing professionals.

The normative data provided for university lecturers is 39.64 and 37.68, in the Adaptive and Quasi Intuitive band; this sample consisted of management lecturers situated within a business school (Armstrong & Allinson, 1997). The mean score of the Educators surveyed in this thesis is 43.34, which is closer to the mean score of the computing professionals and the psychology graduate students than that of the university lecturer provided in the CSI normative data, suggesting that the lecturer involved with HCI education differs from the management lecturer.

There is no normative data that specifically relates to designers, but some normative data is provided for employees in the creative arts, who have a mean CSI score of 35.13. The sample size of this study was comparatively small (38 participants), but this score is significantly lower than the profile of the computing professionals and the psychology students, suggesting a more intuitive approach for the CSI sample. It is interesting to note that in this current study of HCI professionals, one of the respondents with the lowest CSI score, falling firmly into the category of the Intuitive, is an Educator in a design school.

Comparison of the HCI professional CSI scores with the CSI normative data appears to support the findings above that those in practice differ from those in education, with the CSI profile of the HCI professional who is involved in practice having a different profile from the HCI Educator, who is not involved with practice. The HCI professional who is involved in practice also appear to differ from the general population and is more likely to fall within the range of Quasi-Intuitive to Quasi-Analytical.

Table 4-5: CSI normative data provided by Allinson and Hayes (2012) compared with the sample in the current study

Source	Sample	n	Mean	SD	CSI Style
PhD (This study)	Educators	58	43.34	13.78	Adaptive
PhD (This study)	Practitioners	171	40.22	11.01	Adaptive
PhD (This study)	Both	72	37.35	12.21	Quasi-Intuitive
PhD (This study)	All professionals	301	40.14	12.00	Adaptive
Abdelnour-Nocera *et al* (2013)	HCI students	101	41.35	9.37	Adaptive
Moore, O'Maiden & McElligott (2003)	Irish computer systems students	145	43.34	11.43	Adaptive
Papavero (2005)	Chinese software engineers	314	42.84	9.6	Adaptive
Allinson & Hayes (1996)	Teachers	74	42.54	13.47	Adaptive
Frampton *et al* (2006)	Australian IT architects	40+	41.85	10.3	Adaptive
Park & Black (2007)	US psychology grad students	31	41.77	10.74	Adaptive
Papavero (2005)	US software engineers	158	40.45	11.5	Adaptive
Armstrong, Allinson & Hayes (1997)	University lecturers	11	39.64	9.1	Adaptive
Allinson & Hayes (1996)	IT managers	40	38.28	12.09	Quasi-Intuitive
Corbett (2007)	US technology professionals	380	38.01	12.8	Quasi-Intuitive
Armstrong, Allinson & Hayes (1997)	University lecturers	19	37.68	12.84	Quasi-Intuitive
Bennett (2010)	Employees in the creative arts	38	35.13		Quasi-Intuitive

4.2.3 Results: the Object-Spatial Imagery and Verbal Questionnaire

The previous section has centred on the intuitive/analytical preferences of the HCI professional. The next section moves on to discuss the results of the OSIVQ which produces a profile for an individual measuring the dimensions of Visual Object ability, Visual Spatial ability and Verbal ability.

Blazhenkova and Kozhevnikov (2008) examined the correlations between the OSIVQ results of professionals with at least two years working experience in their specialisms and found significant differences between three particular groups: scientists and engineers, visual artists, and linguists and historians. As detailed in section 3.5.2 on page 103 above, one of the assumptions of this thesis is that as HCI professionals, unlike computer scientists, routinely contribute towards interface design, and as they also need to understand the architecture and functional design of the application, unlike graphic or interface designers, the HCI professional will have greater Visual Object ability than a computer scientist or an engineer, and greater Visual Spatial ability than a visual artist. Therefore, of particular interest to this thesis are Blazhenkova and Kozhevnikov's profiles of the scientist, which included the role of computer scientist, and of the visual artist, which included the role of designer, and specifically, the Visual Object ability and the Visual Spatial ability of those roles. The Blazhenkova and Kozhevnikov profiles of the Scientist and the Visual Artist are summarised in Table 4-6 below.

Table 4-6: Blazhenkova and Kozhevnikov profile of Scientist and Visual Artist

	Role	**Mean**	**Std. Deviation**	**Number**
Visual object ability	Scientists	3.23	0.68	64
	Visual artists	4.01	0.52	79
Visual spatial ability	Scientists	3.41	0.55	64
	Visual artists	2.92	0.65	79

In order to establish whether the OSIVQ profile of the HCI professional does indeed differ from the Blazhenkova and Kozhevnikov sample, a number of Welch's independent t-tests were conducted to test the assumptions above.

The first part of the assumption, that the HCI professional will have greater Visual Object ability than a computer scientist or an engineer, was not found to be the case, with no significant differences being found between the Visual Object scores of the HCI professional (M = 3.34, SD= .69) and the scientist (M = 3.23, SD = .68; t (93) = 1.19, p = .23, two tailed). The magnitude of the differences in the means (mean difference = -.11, 95% CI: -.30 to .07) was very small (eta squared = .004). This test was replicated for each of the roles of the professional, but again, no significant differences were observed.

The second part of the assumption, that the HCI professional would have greater Visual Spatial ability than a visual artist was, however, confirmed, with differences noted between the Visual Spatial ability of the HCI professional ($M = 3.20$, $SD = .65$) and the visual artist ($M = 2.92$, $SD = .65$); $t (122) = -3.38$, $p = .001$, two tailed). The magnitude of difference in the means (mean difference = -.28, 95% CI: -.44 to -.12) was moderate (eta squared = .03). Significant differences were noted not only for the HCI population as a whole, but also for each of the roles of the professional ($p<.01$ for Practitioner, Educator, All-Pract, All-Ed, $p<.05$ for 'Both').

In summary, it appears that the HCI professional resembles the general population of scientists and engineers in respect of their Visual Object ability, but that they differ from visual artists in respect of their Visual Spatial ability, perhaps suggesting that their profile is more similar to the computer scientist than the graphic designer.

4.2.4 Results: the profile of the professional

Having established that there appear to be differences between the roles as well as between the HCI professional and the general population, a series of Pearson product-moment r correlations were computed to further explore the profile of the professional. These served to explore the strength of the relationships between the CSI score and the cognitive style constructs of the OSIVQ, taking into consideration the gender, the age and the role of the respondents. As the output of the CSI places the individual on a spectrum that ranges from the Intuitive to the Analytical with a scale ranging from 0 to 76, negative correlation reflects a bias towards the Intuitive, and positive correlation reflects a bias towards the Analytical. The OSIVQ generates three mean average scores for each respondent, each ranging from 0.00 to 5.00, and measuring Visual Object ability, Visual Spatial ability and Verbal ability.

Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity or homoscedasticity. Using Cohen's guidelines where 0.10 to 0.29 represents a weak association between the two variables, 0.30 to .049 represents a moderate association, and 0.50 to 1.0 represents a strong association, numerous weak associations were discovered when considering the entire dataset, the most relevant of which are described below. Some stronger associations were revealed when considering the differing roles of the professional.

Of particular interest were the relationships between age and intuition, verbal and visual ability, age and verbal ability, intuition and visual ability, and gender differences; each of these is discussed below with the data presented in Table 4-7 (page 165) and Table 4-8 (page 166).

4.2.4.1 Age and intuition

No differences were noted between the general population and the entire HCI professional population when comparing the age of the respondent and intuition.

Defining intuition as *“the rapid application of principles learned through experience”*, Allinson and Hayes (1996, p. 130) observed a correlation with age and intuition (as measured by a low CSI score) for their sample of miscellaneous managers (r= -.20, n=130, p <.05) suggesting that people become more intuitive as they grow older, and this is supported by cognitive neuroscience (Hedden & Gabrieli, 2004). Confirming these findings, there was found to be a weak negative correlation between the CSI score and the age of the respondent when considering all HCI professionals (r = -.173, n = 301, p = .003). However, gender differences were noted: the association between age and intuition was only present for the females (r = -.194, n = 158, p = .015).

Having considered the entire population of the HCI professional, each of the roles of professional were considered. The overall profile of Practitioner (r = -.221, n = 171, p =.004) reflects the CSI profile of the general population with a weak negative correlation between the CSI score and the age of the respondent, but again, there were gender differences with the association only present for the female Practitioners (r = -.231, n =96, p =.024), female ‘Both’ (r = -.336, n =38, p =.039) and female All-Pract (r = -.277, n =134, p =.001), each of whom are involved in practice. The association was not, however, present for the female All-Ed (n=62), 38 of whom are involved in practice. In contrast, there was no association noted between intuition and the age of either the male or female Educator, male or female All-Ed or male ‘Both’. Although there is some inconsistency in these findings it may suggest that in this respect, the profile of both male and females who are involved in education, (whether or not they also practice), and the profile of the male Practitioner differs from both that of the female who is involved in practice and that of the general population.

To summarise, there are gender differences in the role of the Practitioner, with the female resembling the general population and exhibiting an association between age and intuition. In contrast, the male Practitioner and all of those who are in some way involved in education differ from the general population in this respect.

4.2.4.2 Age and Verbal ability

Next, the association between age and Verbal ability was considered. Just as cognitive neuroscience has identified an association with age and increased intuition, it has also identified that Verbal ability improves with age up until the age of 55 when cognitive decline starts to be apparent for all cognitive domains (Hedden & Gabrieli, 2004). The data provided for Hedden and Gabrieli's longitudinal study suggests that the decline in Verbal ability becomes more apparent after the age of 67, and this may be explained by conditions associated with an aging population such as dementia. This sample of HCI professionals includes 7 individuals who are over the age of 67; this equates to approximately 3% of the whole sample and consists of one male Practitioner, two male Educators and two males and two females who are categorised as 'Both'. A medium positive association was confirmed both for the cohort as a whole ($r = .277$, $n = 301$, $p < .01$), and for all roles with the exception of the Educator.

When considering gender differences, it was found that the association between age and Verbal ability was not present for either the female Educators (n=24) or for the male ‘Both’ (n=34) category. Although the latter result was unexpected, the association was, however, present for All-Ed, which combines the Educators and ‘Both’ ($r = .308$, $n = 130$, $p < .01$), and for the male All-Eds ($r = .295$, $n = 68$, $p < .05$). In view of the contradictory results and the small sample sizes of the female Educators and male ‘Both’, it is not possible to reach any meaningful conclusion regarding gender differences and the association of age and Verbal ability without more research into this area.

4.2.4.3 Intuition and Verbal ability

A weak association between intuition (as measured by a low CSI score) and Verbal ability was noted only for the role of the female Practitioner ($r = -.265$, $n = 96$, $p = .009$); this association was not evident elsewhere.

4.2.4.4 Verbal and visual ability

The next association to be considered was that of Verbal and visual ability (both Visual Object, and Visual Spatial ability). Although Blazhenkova and Kozhevnikov (2008) found that there was no relationship between the Object and Verbal scales, a weak negative association between Verbal ability and Visual Object ability was observed for the HCI professionals ($r = -.156$, $n = 301$, $p = .007$). However, as before, gender differences were observed with the association apparent for the female professionals ($r = -.15$, $n = 158$, $p = .049$), but not the males ($r = -.157$, $n = 158$, $p = .062$).

Next to be considered was the association of verbal skills and Visual Spatial ability. Blazhenkova and Kozhevnikov (2008) observed a negative association between verbal and Visual Spatial ability, and this negative association was evident when considering the whole population of HCI professionals ($r = -.219$, $n = 301$, $p < .01$). However, when considering the individual roles of HCI professional, this association was present for all roles apart from that of Practitioner ($r = -.133$, $n = 171$, $p = .083$), suggesting that in this respect Practitioners differ from the general population, and also they differ from those who have some involvement in education.

Blazhenkova and Kozhevnikov (2008) also observed a negative association between Visual Object and Visual Spatial ability. However, the findings for this sample were inconclusive, with no clear pattern being observed in the associations. For example, a moderate negative association was observed for the Educators ($r = -.311$, $n = 58$, $p = .018$) and a low positive association with 'Both' ($r = -.297$, $n = 72$, $p = .011$) yet no association was evident for the group All-Ed ($r = -.091$, $n = 171$, $p = .236$) which is the Educators and 'Both' combined.

4.2.4.5 Intuition and visual ability

The final associations to be considered were those of intuition and visual ability. Allinson and Hayes (1996) in their review of the literature report that intuitivists recall spatial images most readily and analysts remember verbal material most easily. However this viewpoint is in contrast to that of Blazhenkova and Kozhevnikov (2008) who find that scientists report themselves as spatial visualisers. Further, they noted that whereas those with Visual Spatial ability tend to process images analytically, those with Visual Object ability process images holistically but can equally apply analytical reasoning in verbal tasks, and therefore cannot be considered to be holistic thinkers overall (Kozhevnikov et al., 2005).

The expectation was that within this sample of HCI professionals a correlation would be noted between Visual Spatial ability and an analytic approach (as evidenced by a high CSI score) but that there would be no correlation between Visual Object ability and an intuitive approach (as evidenced by a low CSI score). However, for the main part, this was not found to be the case, and the profile of the HCI professional appears to differ from the profile of the general population generated by Blazhenkova and Kozhevnikov. In particular, no association was noted between Visual Spatial ability and an analytic approach (as evidenced by a high CSI score) for any groups of professional. Rather the reverse was noted for the female Practitioner, with a small negative association being observed between the CSI score and Visual Spatial ability, suggesting instead an association between intuition (as evidenced by a low CSI score) and Visual Spatial ability ($r= -.245$, $n = 96$, $p = .016$) which is more like the profile reported by Hayes and Allinson above.

There was no association noted between Visual Object ability and intuition for the roles of Practitioner and Educator who conform to the profile of the general population and confirm the findings of Kozhevnikov et al (2005). However, this was not the case when considering the profile of those who combine practice and education: a moderate negative correlation suggesting an association between intuition (as evidenced by a low CSI score) and Visual Object ability was noted for the role of 'Both' ($r = -.327$, $n = 72$, $p = .005$). Importantly, this may suggest that the profile of the professional who is involved in both academia and practice differs from the professional who prefers to specialise. It is also noted that low negative correlations were observed for the roles of All-Pract ($r = -.155$, $n = 243$, $p = .016$) and All-Ed ($r = -.209$, $n = 130$, $p = .017$), both of which incorporate the role of 'Both' in their composition (see Figure 4-1 on page 146).

In summary, when comparing the profile of the HCI professional with the general population, some interesting differences were noted between the role of Practitioner, and those who are involved in education, and also between those who are involved with both education and practice, and those who specialise in one or the other. Some gender differences are noted both between the roles and between the role and the general population.

The next section will consider RQ1b: What are the differences between the Educator, the Practitioner and 'Both' in terms of their analytical/intuitive preferences, and their Visual Object, Visual Spatial and Verbal abilities?

Table 4-7: Correlations of age, CSI and OSIVQ scores for HCI professionals

Role		CSI	Visual object ability	Visual spatial ability	Verbal ability
All HCI Professionals	**Age**	$-.173^{**}$	-0.039	-0.096	$.277^{**}$
	CSI		$-.131^{*}$	-0.067	$-.125^{*}$
n=301	**Visual object ability**			0.060	$-.156^{**}$
	Visual spatial ability				$-.219^{**}$
Practitioner	**Age**	$-.221^{**}$	-0.141	-0.097	$.229^{**}$
n=171	**CSI**		-0.057	-0.149	$-.235^{**}$
	Visual object ability			0.091	$-.164^{*}$
	Visual spatial ability				-0.133
Educator	**Age**	-0.044	-0.030	-0.127	0.249
n=58	**CSI**		-0.011	-0.021	-0.034
	Visual object ability			$-.311^{*}$	-0.106
	Visual spatial ability				$-.360^{**}$
Both	**Age**	-0.196	0.114	-0.138	$.359^{**}$
n=72	**CSI**		$-.327^{**}$	0.000	0.020
	Visual object ability			$.297^{*}$	-0.189
	Visual spatial ability				$-.350^{**}$
All-Ed	**Age**	-0.132	0.060	-0.140	$.308^{**}$
n=130	**CSI**		$-.209^{*}$	0.022	-0.005
	Visual object ability			0.017	-0.151
	Visual spatial ability				$-.351^{**}$
All-Pract	**Age**	$-.230^{**}$	-0.034	-0.103	$.281^{**}$
n=243	**CSI**		$-.155^{*}$	-0.103	$-.162^{*}$
	Visual object ability			$.157^{*}$	$-.164^{*}$
	Visual spatial ability				$-.196^{**}$

$^{**}p<.01$
$^{*}p<.05$

Table 4-8: Correlations of age, CSI and OSIVQ scores for HCI professionals separated by gender

Role	Gender		CSI	Visual object ability	Visual spatial ability	Verbal ability
All Professionals	**Female**	**Age**	-.336*	0.217	-0.229	.519**
		CSI		-.415**	0.169	0.153
	n=158	**Visual object ability**			0.147	-0.230
		Visual spatial ability				-.347*
	Male	**Age**	-0.040	-0.007	-0.198	0.190
		CSI		-0.211	-0.121	-0.127
	n=143	**Visual object ability**			.495**	-0.147
		Visual spatial ability				-.500**
Practitioners	**Female**	**Age**	-.231*	-0.035	-0.071	.214*
		CSI	1	-0.057	-.245*	-.265**
	n=96	**Visual object ability**	-0.057	1	0.100	-0.166
		Visual spatial ability	-.245*	0.100	1	-0.098
	Male	**Age**	-0.205	-.269*	-0.168	.259*
		CSI		-0.070	-0.025	-0.194
	n=75	**Visual object ability**			0.151	-0.163
		Visual spatial ability				-0.198
Educators	**Female**	**Age**	0.091	0.097	-0.163	0.040
		CSI	1	-0.030	-0.051	-0.165
	n=24	**Visual object ability**	-0.030		-0.213	-0.057
		Visual spatial ability	-0.051			-.556**
	Male	**Age**	-0.107	-0.124	-0.126	.383*
		CSI	1	-0.105	0.094	0.014
	n=34	**Visual object ability**	-0.105	1	-0.182	-0.259
		Visual spatial ability	0.094	-0.182	1	-0.140
Both	**Female**	**Age**	-.336*	0.217	-0.229	.519**
		CSI		-.415**	0.169	0.153
	n=38	**Visual object ability**			0.147	-0.230
		Visual spatial ability				-.347*
	Male	**Age**	-0.040	-0.007	-0.198	0.190
		CSI		-0.211	-0.121	-0.127
	n=34	**Visual object ability**			.495**	-0.147
		Visual spatial ability				-.500**
All-Ed	**Female**	**Age**	-0.170	0.171	-0.198	.330**
		CSI		-0.238	0.110	0.058
	n=62	**Visual object ability**			0.012	-0.155
		Visual spatial ability				-.419**
	Male	**Age**	-0.097	-0.014	-0.171	.295*
		CSI		-0.213	0.006	-0.061
	n=68	**Visual object ability**			0.175	-0.155
		Visual spatial ability				-.332**
All-Pract	**Female**	**Age**	-.277**	0.045	-0.132	.306**
		CSI		-.171*	-0.110	-0.145
	n=134	**Visual object ability**			0.112	-.183*
		Visual spatial ability				-0.167
	Male	**Age**	-0.173	-0.117	-0.139	.254**
		CSI		-0.143	-0.072	-0.184
	n=109	**Visual object ability**			.277**	-0.130
		Visual spatial ability				-.271**

**p<.01
*p<.05

4.2.5 Results: comparison of HCI professional roles

The tests above addressed RQ1a which investigates the differences between the HCI professional and the general population. A number of differences were noted between the professional and the general population, but some of these differences were not found to be consistent for the whole population of HCI professional, but rather varied according to the role of the professional. RQ1b explores these differences further, considering the intuitive/analytical preferences, and their Visual Object, Visual Spatial and Verbal abilities of each of the roles of the Educator, the Practitioner and ‘Both’.

In order to explore these differences further, a one-way between subjects ANOVA was conducted to compare the CSI scores for each of the roles of professional, and this was followed by a one-way between-groups multivariate analysis of variance (MANOVA) to compare the three constructs of the OSIVQ for each of the roles. Full details of these results are below, but in summary, the differences noted above between those who practice, and those who specialise in education were reflected in the results of the ANOVA comparing the CSI scores; when considering the results of the MANOVA which compared the OSIVQ scores, the results were less conclusive. Details of both sets of results are provided below.

4.2.5.1 CSI differences

In order to explore the intuitive/analytical preferences of the professionals, a one-way between subjects ANOVA was conducted to compare the CSI scores for each of the roles of Practitioner, Educator and 'Both' with a statistically significant difference noted of $F (2, 298) = 4.11$, $p = .017$. However, the difference in mean scores was quite small with the effect size calculated using eta squared being 0.03. Post-hoc comparisons using the Tukey HSD test indicated significant differences ($p = .01$) between the mean score for the Educators ($M = 43.34$, $SD = 13.78$) and that of the 'Both' group ($M = 37.35$, $SD = 12.21$). The Practitioner group ($M = 40.22$, $SD = 11.01$) did not differ significantly from either the Educator ($p = .20$) or 'Both' ($p = .20$).

As the 'Both' group contains both Educators and Practitioners, independent sample t-tests were then conducted to separate out those who educate but do not practice, using the variables Educators and All-Pract. Although the magnitude in the difference of the means (mean difference = 3.97, 95% CI: .09 to 7.86) was very small (eta squared = .01), this test showed a significant difference in the scores of the Educator ($M = 43.34$, $SD = 13.79$) and All-Pract ($M = 39.37$, $SD = 11.43$; $t (77) = 2.04$, $p = .045$) confirming a difference in the CSI profile between those who specialise in education and those who are in some way involved with practice.

In order to differentiate between those who specialise in practice and are not involved in education or training, and those who are involved in education, the same test was replicated for the variables Practitioners ($M = 40.22$, $SD = 11.01$)

and All-Ed (M = 40.02, SD = 13.23). No significant differences were observed between those who specialise in practice and those who are in some way involved in education (t (248) = .14, p = .89).

These tests were then replicated to take into account gender differences. When considering the roles of Practitioner, Educator and 'Both', no statistically significant difference was observed when considering the males: F (2, 140) = 1.69, p = .19, but there was a small difference that achieved statistical significance between the groups of the females: F (2, 155) = 3.09, p = .05; eta squared = .04. Post-hoc comparisons using the Tukey HSD test again indicated that significant differences (p = .04) were observed between the mean score for the Educators (M = 45.58, SD = 11.76) and that of the 'Both' group (M = 38.26, SD = 12.40).

Independent t-tests were conducted to discern whether there are gender differences between the Practitioner and All-Ed groups, with no statistically significant differences observed for either males (p = .72) or females (p = .77).

When this test was repeated for the All-Pract and Educator groups, no difference was observed for the male professionals (p = .22), but there was a small difference between the female All-Pract (M = 39.90, SD = 11.30) and female Educators (M = 45.58, SD = 11.76; t (156) = 2.26, p = .03; eta squared = .03).

As above, these results must be approached with some caution due to the small sample size of the female Educators, but it appears that there may be a difference in the CSI profile of female professionals between those who specialise in education and those who are in some way involved with practice, but this difference is not apparent in male professionals.

4.2.5.2 OSIVQ differences

A similar process to above was conducted to investigate differences in the role of the professional and the OSIVQ profile. A one-way between-groups multivariate analysis of variance (MANOVA) was performed, using the three constructs Visual Object ability, Visual Spatial ability and Verbal ability. The independent variable was Role (Practitioner, Educator and 'Both'). Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity.

The sample was checked for univariate normality with the histogram, boxplot and Q-Q plots for all three constructs suggesting a normal distribution. No skewness or kurtosis was observed, and although the Kolmogorov-Smirnov statistic resulted in a significant result ($p<.05$) for all three constructs suggesting violation of normality, this is not uncommon with larger samples (Pallant, 2013, p. 55) and is not a cause for concern for this study as Tabachnick and Fidell (2013, p. 113) consider a sample size of 20 in each cell sufficient to ensure robustness providing that there are no outliers. Multivariate normality was assessed using Mahalanobis distance values resulting in a maximum distance of 12.86. Using a chi-square table and an alpha value of 0.001, none of the cases exceeded the critical value of 16.27 (Pallant, 2013, p. 298), and it can therefore be assumed that there are no substantial multivariate outliers in this sample. The output from matrix scatter plots showed no evidence of non-linearity, and as Box's M Sig. value is greater than 0.001 at 0.104, it can be assumed that the data does not violate the assumption of homogeneity of variance-covariance matrices.

Although no serious violations were observed when checking for normality, linearity, univariate and multivariate outliers and homogeneity of variance-covariance matrices, a very low correlation between the three dependent variables was observed when assessing the sample for multicollinearity. This was not, however, unexpected as Blazhenkova and Kozhevnikov (2008) report negative correlations between the OSIVQ object scale and spatial imagery tasks, and the OSIVQ spatial scale and verbal tasks.

No significant difference was found between the three groups, necessitating no further consideration of the univariate results for this particular test: $F (6, 592) = 2.051$, $p = .057$; Wilks' Lambda = .96; partial eta squared = .20. However, as gender differences had been observed when computing the Pearson product-moment r correlations, the test was repeated to consider gender.

There was a statistically significant difference between the roles on the combined dependent variables for the males: $F (6, 276) = 3.28$, $p = .004$; Wilks' Lambda = .87; partial eta squared = .07, but not the females: $F (6, 306) = .78$, $p = .58$; Wilks' Lambda = .97; partial eta squared = .02. When the results for the dependent variables were considered separately, the only difference to reach statistical significance using a Bonferroni adjusted alpha level of .017 was Visual Object ability: $F (2, 140) = 5.10$, $p = .007$; partial eta squared = .07. An inspection of the mean scores indicated that the male Educator scored the lowest for Visual Object ability (M = 3.02, SD = .56), and 'Both' scoring the highest (M = 3.50, SD = .70). The Practitioner Visual Object ability score fell between these two (M = 3.22, SD = .61).

No significant difference was noted for the combined dependent variables when these tests were replicated to compare All-Ed and Practitioners: F (3, 297) = 2.13, p = .10; Wilks' Lambda = .98; partial eta squared = .02, necessitating no further consideration of the univariate results.

A significant difference was noted when comparing the Educators with All-Pract: F (3, 297) = 2.67, p = .05; Wilks' Lambda = .97, partial eta squared = .03; however, when considered separately, none of the dependent variables reached statistical significance using the Benferroni adjusted alpha level of .017.

These tests were replicated to test for gender differences for All-Pract and All-Ed; again, no statistically significant differences were noted.

4.2.5.3 Summary of differences

The above sections have considered the profile of the HCI professional, with particular reference to how they differ from the general population, and how the individual roles of the HCI professional differ. In summary, the analysis of the CSI, OSIVQ and demographic data has resulted in some differences being noted between the roles, together with some gender differences. The primary differences noted were for the CSI results of the female respondents, where differences were noted between the role of Educator and ‘Both’, and Educator and All-Pract. However, as the sample size of the female Educator is very small (n=24), caution must be applied, as the findings might not be replicable. Few differences were observed when considering the OSIVQ data, although there was a difference in the Visual Object ability of the males when considering role, with the male Educator having the lowest mean score for this construct. However, as above, the sample size of the male Educator is small, and these results are treated with caution. The most important of the findings that relate to RQ1a and RQ1b are summarised below and in Figure 4-4 (see page 176) and Figure 4-5 (see page 177).

4.2.6 Key findings

4.2.6.1 CSI profile

There is a difference between the general population and both the Practitioners and All-Pract, but not between the general population and the Educators, ‘Both’ or All-Ed, perhaps suggesting a difference between those who do practice and those who are involved in education. This is confirmed by the results of the ANOVA which indicate a gender difference between both the Educator and ‘Both’, and the Educator and All-Pract, suggesting a difference between those females who both teach and practice, and those who specialise in education. These differences were not apparent in the male sample. Whilst this in is interesting, it is also noted that the sample size of female Educators is very small.

HCI professionals who are involved in practice are more likely to fall into the range of Quasi-Intuitive to Quasi-Analytical than the general population, with the profile of the Educator being most like that of the general population.

The CSI profile of the HCI Educator is closer to that of computer professionals and psychology students than that of management lecturers.

4.2.6.2 *OSIVQ profile*

The HCI professional resembles the general population of scientists and engineers in respect of their Visual Object ability, but they differ from visual artists in respect of their Visual Spatial ability, perhaps suggesting that their profile is more similar to the computer scientist than the graphic designer. This holds true for all roles of professional.

4.2.6.3 *Age and intuition*

The general population and female Practitioners evidence an association between intuition and age suggesting that intuition increases with age. This association was not apparent in male Practitioners or Educators, All-Ed or ‘Both’.

4.2.6.4 *Age and Verbal ability*

The general population evidence an association between age and increased Verbal ability suggesting that verbal skills increase with age. This was evident for all roles apart from female Educators and male ‘Both’. However, as above, the small sample size of both cohorts is noted.

4.2.6.5 Verbal and Visual Object ability

The general population and male professionals do not evidence an association between Verbal and Visual Object ability. However, female professionals display a negative association between the two.

4.2.6.6 Verbal and Visual Spatial ability

The general population and all roles apart from the Practitioner evidence a negative association between Verbal and Visual Spatial ability.

4.2.6.7 Intuition and Visual Spatial ability

There is an association between intuition and Visual Spatial ability for the female Practitioner but this is not evident for any of the other roles of professional.

4.2.6.8 Intuition and Visual Object ability

The general population and the Practitioner and Educator do not evidence an association between intuition and Visual Object ability. However, this is not the case for ‘Both’, All-Ed and All-Pract who display a negative association between the two, suggesting that the professional who specialises differs from those who are involved in both academia and practice.

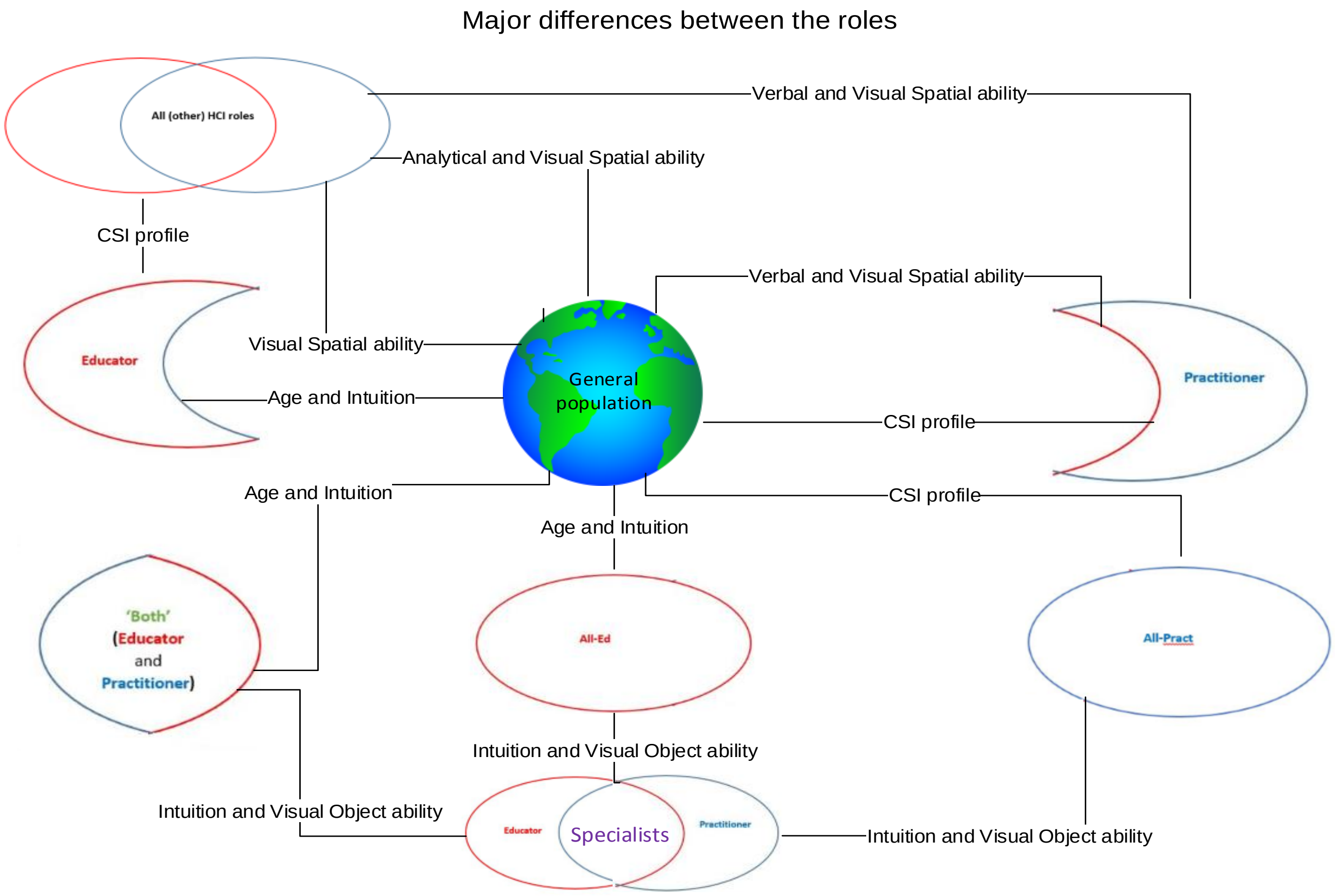


Figure 4-4: Quantitative data: Differences between the roles of professional

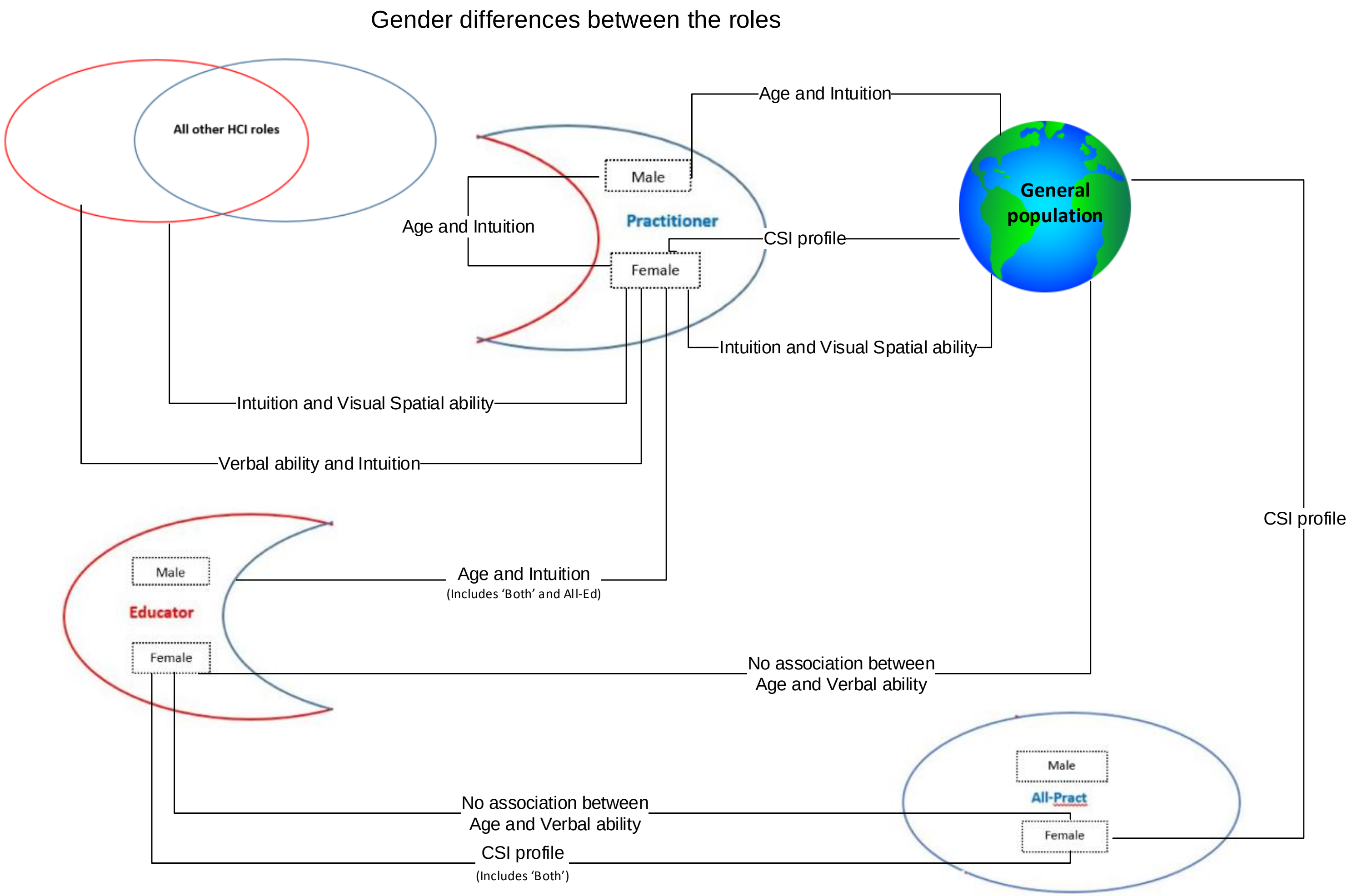


Figure 4-5: Quantitative data: Gender differences between the roles of professional

4.3 Overview of the survey data

This chapter has presented the results of the survey that was delivered between November 2012 and May 2014. The survey data has revealed that the population of the HCI professional is diverse in terms of background and employment. The majority of the respondents were from either the USA or the UK; however, a wide range of countries and nationalities were represented. Some differences in cognitive style have been identified between this sample of HCI professionals and the general population, and also between the roles of the professional. In particular, there appear to be differences between those who educate but do not practice, and those who are involved in practice. The differences were particularly apparent when considering the findings of the CSI which measures whether a subject tends more towards an intuitive or an analytical approach, and there also appear to be gender differences when considering these results; these are summarised below.

There appears to be a difference in the CSI profile of the general population and the roles of Practitioner and All-Pract, that is, those who are involved in practice. By implication, there is also a difference between those who are involved in practice, and those who specialise in education as the CSI profile of the Educators does not differ from the CSI profile of the general population.

60% of the general population fall into the middle three bands of the CSI, that is quasi intuitive, adaptive and quasi analytical. As HCI practice makes use of tools and methods that employ both an intuitive and an analytical approach, it was assumed that in excess of 60% of this sample would fall into these three categories. This was found to be the case for the Practitioners, but not the Educators confirming that the profiles of the Practitioner differs from both that of the general population and that of the Educator, whose profile resembles that of the general population.

The CSI profile of HCI lecturers differs from that of management lecturers. When comparing the results of this study with data provided from other studies, the CSI profile of the Educator is closer to that of the computing professional and psychology graduates than that of management lecturers.

A further assumption was that unlike a graphic designer, a HCI professional needs to understand the architecture and functional design of an application, and as a result they would have greater Visual Spatial ability than a visual artist; this was indeed found to be the case.

Previous studies have noted a negative association between Verbal ability and Visual Spatial ability. This was apparent for all roles of the professional apart from the Practitioner who differs from both the general population and the other roles of professional in this respect.

Above (page 178), differences were noted in the CSI profile of those who specialise in education. This observation was supported with further differences being noted between those who specialise and those who do not specialise when considering intuition and Visual Object ability. This association was only noted for those with the role of ‘Both’, which suggests that they differ both from those who specialise, and from the general population.

Age is closely related to experience, and it is expected that with there is an association between both age and increased intuition and age and verbal ability. The expected association between age and intuition was only evident for the female Practitioner, suggesting that male Practitioners and all those who are involved in education in some way differ from both the general population and female Practitioners in that they do not become more intuitive with increased age, and by implication, experience. The expected association between age and Verbal ability was present for all groups with the exception of female Educators. However, as before, this is a very small sample size, and although interesting, these findings may not be replicable.

These results from the survey data will be considered and discussed in Chapter 6 alongside the findings from the interview phase, the finding of which are detailed in the next chapter.

5 Interview results

The previous chapter describes the results of the data analysis that was undertaken in order to provide a cognitive snapshot of the profile of the professional, and to investigate differences between the professional and the general population, and between the roles of professional. These are summarised in section 4.2.6 above. This chapter describes the results of the qualitative analysis of the interview data and specifically addresses RQ2: Does the profile of the HCI professional vary from role to role in respect of their background, what is valued, and their concerns and issues?

The chapter is organised as follows:

Section 5.1 describes the role of the interviewees and derives from both the interview findings and the free text responses of the survey. Sections 5.2 and 5.3 describe the application of the technological frames and the matrix queries. Section 5.4 provides a perspective of roles of the professional. Sections 5.5, 5.6, 5.7 directly address the research question by detailing the background, what is valued, and the concerns and issues of the professionals.

Finally, section 5.8 provides an overview of the interview findings.

5.1 The roles of the professional

As described in section 3.7.1, a template analysis approach was adopted. It is not the intention to systematically describe the themes identified in the creation of the coding template, but rather to identify the similarities and the differences between the cases (King, 2004, p. 256). In this context, the cases were considered at the level of the roles of professional rather than each respondent individually, and in the context of the research question, and where consensus is noted for the roles, this is reported below. In order to facilitate the use of the coding template within the analysis, the codes were mapped to reflect areas of consideration for RQ2 (background, what is valued, concerns and issues) - see Figure 3-9 on page 128.

Before it was possible to consider differences between the roles of professional, it was necessary to assign each interview respondent to one or more roles. The role of the interviewees was extrapolated from the interview findings and confirmed by referencing the original survey response. This resulted in the following practitioner roles being identified: Designer, User Researcher[12] and UX Architect and Educator. One respondent identified himself as a software developer and did not naturally fall into any of the other categories. Due to his experience and the richness of his responses, it was decided to include additional role of Software Developer in order to analyse his contribution. However, as there is only one respondent with this job title, generalisations attributed to the practitioner role of Software Developer are treated with caution and it would be inappropriate to consider the profile of Software Developer with such limited data.

The majority of those who are involved in academic education (Educator and 'Both') are members of a computing faculty, although there was also representation from an architecture school and two communications programmes. As the analysis of the quantitative data identified differences between the non-specialist, that is 'Both', and

[12] It should be noted that the role of User Researcher is separate and distinct from that of an academic researcher. An example definition of the role can be found at https://www.gov.uk/service-manual/the-team/user-researcher

the specialist professionals, that is Educator and Practitioner, the responses of 'Both' are considered alongside the responses of the Designer, User Researcher, User Architect, Software Developer and Educator. However, it should be noted at this point that the views of the User Researcher group and the 'Both' group often coincide, as 5 of the 8 User Researchers are also members of the 'Both' group, which consists of 5 User Researchers, 2 UX Architects, and the Software Developer.

Several of the interviewees additionally identified themselves as independent practitioners rather than permanent employees, working as consultants, freelancers or contractors; this term was used interchangeably by some interviewees, and was interpreted as either working as an ad-hoc resource on a project, or as a non-permanent member of a project team. These are collectively described as Independents in this thesis.

Full details of the profile of individual interviewees are included in section 9.3 of the Appendix, and a summary of the profile of interviewees can be found in Table 5-1 below. In order to consider the interviewees' comments in the context of their professional role, individual interviewees are referred to by name, with a suffix to indicate the professional role. Where a respondent is both practitioner and educator ('Both'), the suffix further differentiates those with training or mentoring roles from those who are part time academic lecturers. This is best illustrated by means of example: Lucy [UR, Tr] is a User Researcher with training or mentoring responsibilities, Jun [D] is a Designer, and Mila [UXA, Ed] is a User Experience Architect, and also an academic educator. The full details of the suffixes used can be found below in Table 5-2.

Table 5-1: Summary of interviewees

	Professional Role						
	Designer	User Researcher	UX Architect	Software Developer	Educator	Total	Both
Interviewees	3	8	5	1	5	22	8[13]
Age group							
<30		1				1	
30 to 39	2	3	2		3	10	3
40 to 49		2	2			4	1
50 to 59		1	1	1	1	4	3
60 to 69	1	1				2	1
70+					1	1	
Gender							
M	1	3	3	1	2	10	3
F	2	5	2		3	12	5
Independent?	2	1	4	1	0	8	3
Experience							
<10 years	1	3	1		0	5	
10 to 14 years		3	1		3	7	3
15 to 19 years	1	1	3			5	3
20 to 29 years				1		1	1
30+ years	1	1			2	4	1

Table 5-2: Suffixes used to categorise interviewees

Professional role	**Suffix**
Educator	E
Designer	D
User Researcher	UR
User Experience Architect	UXA
Software Developer	SD
‘Both’ role is training or mentoring	Above + Tr
‘Both’ role is academic education	Above + Ed

[13] ‘Both’ consisted of 5 researchers, 2 UX architects, and 1 software developer.

5.2 The application of technological frames

Earlier in this thesis, it was explained how technological frames are used to support the analysis of the interview data, and to facilitate a better understanding of the perceptions of practice from the point of view of the different actors in the field (see section 3.7.4 on page 133).

To recap, a technological frame is a cognitive device which can be used to make sense of IT systems, or to describe practice (Bijker, 1987; Orlikowski and Gash, 1994). The interpretation of HCI theory and principles may vary between various groups or roles of professional, with different groups having a different perspective of a concept or an issue, but within a particular group, for the most part, the perspectives are shared, structuring their interaction, application, value and appreciation of that concept according to their degree of inclusion within that particular technological frame. For example, the perspectives of an Educator or a User Researcher may differ from each other, but the perspectives of an Educator will be similar to the perspective of another Educator. The analysis of the interview data considers the various technological frames of the different roles of the HCI professional which were identified as being Educator, Designer, User Researcher, User Architect and Software Developer.

One of the cornerstones of the theory of the Social Construction of Technology is the focus on the shared meaning given by different social groups to an artefact as this determines the level of inclusion within a particular technological frame, and structures the interaction between members of a particular social group (Pinch and Bijker, 1987). Inclusion within the same technological frame would be evidenced by a shared understanding of theory and practice, and a common approach to practice. It should be noted that it is possible for individuals to be a member of more than one social group, and indeed, this is the case for this sample which includes individuals who are involved in both education and in practice ('Both'). In order to consider those who may be a member of both social groups, where relevant, findings for the 'Both' group are included below.

Members of a social group generally share an understanding of the technology in question, but where there is a difference in the expectations, assumptions or understanding, this is referred to an incongruence (Orlikowski and Gash, 1994). Lin and Silva's (2005) discussion of the social and political construction of technological frames in the context of the adoption and acceptance of information systems propose that incongruent technological frames should be identified early in the project lifecycle, in order to reframe or influence understandings or expectations.

Those with high inclusion within a particular frame will be more sensitive to functional failure, or in the case of HCI, to follow established procedures, whereas those with low inclusion will be more likely to question the basic assumptions of that particular technological frame, for example, adapting tools and techniques to suit the needs of the task in hand. Another important element to consider is that of the dominant frame. Where there is no dominant technological frame, a dominant design does not emerge (Kaplan and Tripsas, 2008) and there tends to be a variety of problem solving approaches, or in the case of the field of HCI, tools and methods adopted or valued. Identifying the incongruent technological frames within the domain of HCI may help to explain the adoption, application and value accorded to various tools and techniques amongst the diverse members of this community and would be of value when determining which elements to include in the curriculum.

5.3 The application of matrix queries

NVivo matrix queries were used to support the comparison of the different groups of actors, separating the responses according to the role of the professional. This approach identified where there was consensus between roles and facilitated comparison of the roles, thereby contributing to the profile of each of the roles of professional. Where the output from the queries suggested consensus for a particular viewpoint, verbatim quotations were selected to illustrate this. Quotations were selected to provide illustration, to deepen understanding and to enhance readability (Corden & Sainsbury, 2006).

It should be noted that the sample size is small for some of the groups; as can be seen in Table 5-1, there was only one Software Developer, and only three Designers, and not all interviewees were represented in the data associated with each individual code. For this reason, it was not always possible to find consensus within the individual members of the groups. An example of a matrix query is shown in Figure 5-1.

	A : Respondents:Job titl...	B : Respondents:Job titl...	C : Respondents:Job titl...	D : Respondents:Job titl...	E : Respondents:Job titl...	F : Respondents:Role = ...
1 : 9.1 Job prospects	1	0	0	5	0	4
2 : 9.2.1 Formal Education	12	3	5	15	0	13
3 : 9.2.2 On the job learning	1	2	13	15	0	13
4 : 9.2.3 CPD	2	4	10	7	0	9
5 : 9.3 Lack of visibility of the field	1	0	3	4	0	3
6 : 9.4 Routes into the field	12	5	4	19	1	11
7 : 9.5 Role distinctions	1	3	17	21	2	20
8 : 9.6 Value of experience	0	3	9	2	0	4

Key: A = Educator, B = Designer, C = UX Architect, D = Researcher, E = S/W Developer, F = ‘Both’

Figure 5-1: Example of an NVivo matrix query

Some elements of the profile concern differing perspectives or perceptions of the interviewees, for example, what is valued. When considering themes that relate to perception, matrix queries supported the application of technological frames of reference as described above. Where findings highlight clear examples of incongruences between social groups, these are reported. However, it should also be noted that a lack of consensus was not always attributable to a particular social group, and this is also reported. Other elements of the profile are grounded in fact, for example, the demographics or career paths of the interviewees. In the latter case, these are described without reference to technological frames.

5.4 Perspectives of the roles

As the interviews progressed, discussion of the roles of Designer, User Researcher and Developers and Engineers emerged naturally. The roles are unsurprisingly seen to be very different, with the Designer being associated with the interface, the User Researcher role being perceived to be broader than that of the Designer, and Developers and Engineers being described in stereotypical terms with the suggestion that HCI does not come easily to them. Interestingly, although one of the principal roles of the respondents was User Experience (UX) Architect, this particular role was not a topic of discussion during the interviews. These findings are summarised below.

The role of Designer, as would be expected, is very much associated with the interface itself, and although the job titles do not necessarily differentiate, includes visual design and interaction design, with some designers specialising in one or the other, or both. Mila [UXA, Ed] tells me that they have visual designers who develop the high fidelity prototypes, but "*I'm not a visual designer …I can do some interaction design".* Roger [UR, Ed] has friends who are visual designers and "*all they do is churn out Axure prototypes day in, day out".* Jun's [D] role involves both interaction design, and visual design. Design is viewed as going beyond the immediate interface with both Delia [D] and Lotte [UR] talking of design in the context of solving a problem, and Larson [SD, Ed] reminds us that HCI design extends beyond software, posing the question "*at what point is something HCI and at what point is it product design?",* continuing "*most product design is related to physics… It's only when designers try to fight against physics we end up with objects we're not too sure how to use".*

The role of User Researcher is perceived to be broader than that of the Designer. Some User Researchers may be involved in some elements of design, and in particular, interaction design, but not implementation. Others focus solely on the research. Lotte [UR] tells me "*I don't actually design"* and neither does Roger [UR, Ed], although he tells me that this is not always the case: "*we really kind of stay away from design. [But] Most of my friends in the field do do aspects of that"*. Kenneth [UR] clearly positions his role as distinct from that of that of designer, telling me "*you get to weigh in on design challenges but don't actually have to implement the changes or come up with the solutions… I'm not expected to create [design] deliverables".* Their input into the project starts earlier in the project lifecycle, and the focus of their work may be to identify requirements, or to identify issues. Lucy [UR, Tr] emphasises the investigative element of her work, telling me that her job is to find out "*the things that they really want to do, the why they want to do it, what they want* *to do",* and Lotte [UR] confirms this, positioning her input at the start of the lifecycle, describing it as follows:

> *The work I do, what I'd say is, 'I can do research for you so you can find out either what's wrong with your product or what people actually want and need.' That's what I do.* (Lotte [UR])

As the job title suggests, the research element of the role requires an investigative and analytical approach; Lucy tells me: "*I will be very quickly processing a lot of the different factors … and we'll be working through all of those in a very systematic way".*

Larson [SD, Ed] is the only respondent with a software developer role, and he makes several references to his fellow programmers, as "*nerds"*, who "*just want to get on with the technology and see the user as this kind of irritating distraction",* and are "*very uncomfortable about doing a lot of the touchy feely stuff".* He tells me: "*if you look at typical programmers, they tend to be either very autistic or very, there are a lot of dyslexic programmers".* Larson continues with an interesting observation regarding the profile of the typical student on a computer science course, and the materials we use to deliver the HCI curriculum:

> *I think one of the problems with a lot of HCI courses is, they tend to assume that the emotional and intellectual make-up and the cognitive style of the programmers is similar to that of psychologists or the people that tend to write the interaction books.* (Larson, [SD, Ed])

If this description of a programmer is accepted, then it follows that this profile of professional will find the human interaction element of practice challenging. Delia [D] finds this to be the case with engineers, a number of whom have been allocated to her team "*to come up to speed on human-computer interaction".* She reports that they do not find that HCI methods come naturally to them: "*one of the things that I do notice is this apprehension that a lot of folks that I work with have to dealing with people".*

5.5 Background

This section will describe the background of the professionals, focussing on their career paths, their cognitive profiles and their job satisfaction.

5.5.1 Career paths

This section describes the differing routes that both academics and practitioners have taken to establish their career in HCI. Across all of the roles, the interviewees had diverse educational backgrounds, some with qualifications in a design subject such as graphic, web, interaction or information design, and others having studied subjects as computer science, psychology, engineering or architecture that had an HCI option in the course.

The multidisciplinary nature of the subject attracted some to the subject: for both Clara and Lucy it was the combination of psychology with a vocational area. For Clara [UR, Ed], *"the art and the psychology, that's where the love of interface design came from",* and Lucy [UR, Tr] *"was always interested in psychology… At the same time, since I was young I always wanted to do something with computer science" (Lucy [UR, Tr]).*

It was agreed that it was not necessary to have formally studied the subject to enter the field; as Roger [UR, Ed]) puts it: *"You don't need a degree in UX to be able to be a good UX person".*

The Educators and the Designers transitioned into the file of HCI quite naturally. Of the five Educators, Terry [E], Paul [E], Antonina [E] and Helen [E] went directly into teaching HCI after having studied the subject, and Tina [E] entered via the human factors route into research, and then into teaching. Of the Designers, Jun [D] and Dick [D] entered directly from other design roles; Delia [D], however, was previously a systems engineer.

The User Researchers had a similarly considered career path. Lotte [UR], Lisa [UR] and Kenneth [UR] all progressed into the industry after studying the subject at Master's level, although for Kenneth, this was a second career; he transitioned from the film industry when "*it struck me to think about looking at software in general and at design and ideation and try to find a way to use my imagination a little bit".* For Lucy [UR, Tr], Clara [UR, Ed], Agnete [UR, Ed] and Josephine [UR, Ed], HCI had been the subject of their PhD. Roger [UR, Ed], Lisa [UR] and Clara [UR, Ed] were all working in fields that required detailed task analysis; Clara was an instructional technologist, and both Lisa and Roger were technical writers. Roger tells me how this transition occurred:

> *I took it upon myself to actually do usability testing of the documentation that our department was writing…So I did some testing documentation, I did that for a few years, and realised that I much prefer being a usability person and helping develop and understand what the product should be, not just documenting it at the end.* (Roger [UR, Ed])

For several interviewees, however, HCI was not an obvious career path. In the words of Mila [UXA, Ed] many of the people she knows entered the field of HCI *"accidentally"*, and both Roger [UR, Ed] and Keith [UXA] tell me that they *"stumbled"* into it. Kenneth [UR] "*never imagined that this field existed",* and when I asked Antonina [E] how she got into the field, she told me: "*I liked the name. I just did not know what it was... I went to HCI thinking that it was some kind of organisational psychology, I just didn't know".*

This lack of awareness of the field was particularly apparent with the UX Architects, and resulted in HCI not being the first career for many of them. Keith [UXA] first studied aerospace engineering and then moved to a design school. He expresses, with some frustration, "*with a better career counsellor I would have figured out then that in high school this is what I should be doing".* Eli [UXA, Tr] had been considering either a career in physics or architecture when he happened upon a design school, and eventually moved from design to HCI.

The attraction to both the scientific and the 'soft' evidenced by Keith and Eli above is also shared by Mila [UXA, Ed] who sums it up as follows:

> *I just kind of fell into it but over the next few years it was absolutely the place I belonged because it combined dealing with people, dealing with technology which I was really fascinated by, building things, creating things and I never looked back.* (Mila [UXA, Ed])

5.5.2 Cognitive profile

When respondents completed the initial survey, this included the Cognitive Style Index (Allinson and Hayes, 1996), which categorises respondents as either Intuitive, Quasi Intuitive, Adaptive, Quasi Analytical or Analytical. The UX Architects were the most intuitive of the cohort, with one Adaptive, one Quasi Intuitive and three Intuitive members. They do take an analytical approach at times, because their roles demand it, and for Digby [UXA], who is Quasi Intuitive, it comes easily, but Eli [UXA], an Intuitive, *“hated every minute of it”* because it slows him down. Helga [UXA] is Intuitive, and does not find that the analytic part of her job comes naturally to her, but has learned to overcome her natural tendency in order to get the job done. She tells me “*Basically you teach yourself how to think and to take a system apart and put it back together again…I guess a lot of my job is being analytical about things but I base a lot of work on gut feelings”.*

Keith [UXA], an Adaptive, also prefers the intuitive approach, but believes that the analytical approach is more effective: “*if I do things in a formal way, and stop and think about it, it does work better than whatever feels good to me…So I try to stick to typing bullet points, drawing rectangles without UI. Stick to those, to be analytical because I know the result at the end will be better”.*

There were two Adaptive and one Quasi Analytical Designer. Dick [D] is a Quasi Analyst but tells me that *“intuition is something that’s learned… I think that I start off every project trying to be intuitive and then analyse what I’ve done”.* Having schooled himself to adopt the intuitive approach, it is now his preferred approach as he views it as more creative than the analytical, telling me, “*I feel that you come up with new concepts”,* and this concept that the intuitive approach is associated with creativity is echoed by all three Designers.

The survey respondents also completed the Object-Spatial Imagery and Verbal Questionnaire – the OSIVQ (Blazhenkova and Kozhevnikov, 2008), which measures Visual Object, Visual Spatial, and Verbal preferences. The OSIVQ suggests a three dimensional model of cognitive style – Object Imagers who prefer to construct vivid pictorial images, Spatial Imagers who prefer schematic representations and Verbalisers who prefer to use verbal-analytical tools. As this is a self-report questionnaire, and as some people are more cautious in their scoring than others, preferences, which are referred to in the instrument as abilities, were identified by comparing the scores of each of the three constructs relative to each other. In other words, as depicted in Figure 5-2, the following two sets of OSIVQ results for Visual Object ability, Visual Spatial ability and Verbal ability differ in the actual scores, but show a similar pattern of preferences, with preferences for firstly Visual Object, then Verbal and Visual Spatial the least preferred approach.

Visual object ability	Visual spatial ability	Verbal ability
5.00	**2.87**	**3.27**
4.47	**2.33**	**3.67**

Figure 5-2: Comparison of OSIVQ scores

There was less discussion when interviewees were presented with their OSIVQ results, and no clear pattern of results. As with the CSI results, some interviewees recognised elements of their preferences, and some were surprised by the findings. For example, Angete [UR, Ed], as both a psychologist and educator, was unsurprised that her greatest preference was for the Verbal, and Dick [D], who freely admits he prefers the visual to words scored lowest in the Verbal preferences. Mila [UXA, Ed] who is also an academic, scored significantly higher on the Verbal ability, and tells me "*the verbal doesn't surprise me at all. Part of that is from teaching, talking and educating and so verbal tends to be a [given]".* Josephine [UR, Ed] who scored low for both Visual Object and Visual Spatial tells me "*I don't like movies. I don't like watching them, I just don't have the concentration for it whereas I would read books or detailed descriptions. I can't follow diagrams. I can't follow maps and things very well".* Lucy [UR, Tr] who scored lowest for her Verbal ability freely admits "*I write way too much. I don't know how to concisely… you know, and it takes me many iterations, and so it takes me a long time to write a deliverable".*

It appears that these preferences are not fixed; Clara [UR, Ed] completed the survey twice over a two year period, and it was noted that the Visual Spatial score for her second attempt was a lot higher than the first attempt. It transpired that in the intervening period, she had been heavily involved with GIS systems, which she feels is a factor for the increased score.

5.5.3 Job satisfaction

All interviewees expressed high job satisfaction. However, it is also noted that this was a self-selecting sample and it may be this is not a representative view. Whilst enthusiasm for the subject was evidenced across all of the roles, a passion for the subject was particularly evident amongst the Educators and the User Researchers. Both Antonina [E] and Helen [E] describe HCI as 'beautiful', with Helen continuing "*that emphasis on the human and that humanistic set of philosophies and values… that's what I get very excited about".* Tina [E] tells me that within her institution, there are several “*people who feel passionately about it”.* Clara [UR, Ed] tells me she “*went to the British HCI in London one year as a student volunteer and I was just hooked, absolutely hooked”.* She uses the term ‘love’ in the context of HCI nine times within the interview and is almost evangelical in her approach: “*I love it! I just want to share it”.* Kenneth [UR] echoes this, telling me “*I just love it”* and Lucy [UR, Tr] describes HCI as “*that dream of always combining computer science and psychology”.* Terry, Antonina and Helen all tell of how much they enjoy teaching the subject, with Terry and Antonina mentioning some ‘fun’ aspects of the teaching.

Several practitioners describe the work as exciting, or tell me that they ‘love’ using particular tools or methods; Digby [UXA] is “*a proponent for eye tracking*... *I love Tobii. I love eye tracking.* Dick [D] tells me, “*I wouldn’t change anything. It’s great. The most exciting job I’ve got”.* Kenneth [UR] describes his work as fun, and tells me “*what I’m doing today is really rewarding”.*

5.5.4 Conclusion: background

In summary, for the majority of the roles, their career path was a straightforward progression. Designers tended to transition from other design roles and both User Researchers and Educators tended to transitions from associated courses of study. The UX Architects, in contrast, appear to have adopted a more circuitous route into their roles and this was not generally their first career path. In respect of their cognitive profiles, the User Researchers and Educators shared a range of cognitive styles, and no clear profile was apparent. However, there were cognitive similarities when considering the UX Architects who tended towards the intuitive end of the spectrum, and the Designers, who fell into the middle of the range. All roles of HCI professionals exhibit a great deal of job satisfaction. However, in the case of the Educators and the User Researchers, a passion for the subject was particularly evident. The next section moves on to consider what is valued.

5.6 What is valued

This section will describe what is valued and considers skills, tools and methods, and the curriculum focus. It moves on to describe the value placed on an analytical approach, and how success is perceived. Little variance was observed in the technological frames of the professional. Exceptions included incongruence in the technological frames of the UX Architects and the User Researchers when considering mental methods, differences in the curriculum of Educators and 'Both' when considering Agile methods and differences in how the User Researchers and the UX Architects and the Designers and the Educators view success.

5.6.1 Valued skills

When considering the skills required, there was consensus between the groups. Whilst familiarity with tools and methods is considered to be desirable, the key skills that are most valued are generic: communication, collaboration, problem solving, creative thinking, and having a flexible and open approach. The latter three skills have common attributes and therefore will be considered as a single entity in this discussion.

Effective communication is seen as key to successful practice. When asked how they know if a project is going well, both Digby [UXA] and Mila [UXA, Ed] describe this in the context of communication, reporting it respectively as *“the amount of communication between the design team, the development team, and the UX people”,* and “*the communication between the UX team and the development team is really good”.*

When Delia [D] was asked what from her education prepared her best for practice, she talked about her Master’s degree in Mental Health Counselling training rather than her Master’s in Computer Science, which is where she covered HCI; she tells me *“the most significant thing that I am using now that I’ve learned in school is my interviewing skills from my mental health counselling training… Basically being able to listen”.* She continues: “*understanding how to communicate... being able to cross the line between my users’ vernacular and then a technical vernacular and use it in different tools”.* The tools that are used to support communication are both high tech and low tech, with interviewees mentioning written notes, PowerPoint, cloud based collaborative tools, and specialist modelling tools, depending on the task, the environment and the audience.

Collaboration and teamwork were also highly valued. Within practice, one of the indicators of a successful project was evidence of collaboration. Some differences were noted between the roles when discussing collaboration: although all roles discussed some aspects of acting as an interface, the User Experience Architects and User Researchers discussed collaboration in a broader context than the Designers. The employment status of the professional can also affect collaboration, with some independent User Experience Architects and Designers reporting negative experiences. The practitioners also report that successful collaboration is considered to be a success indicator, and lack of collaboration is often a cause for project failures.

Acting as an interface is a core element of all roles. Mila [UXA, Ed] describes her role as an interface between the users and the developers: "*I have got the developers on this side. I've got the users on this side. If the developers have been listening in to the conversations of the users and we start to get a rhythm going".* Delia, Jun and Dick, who are all Designers, also discussed collaboration in the context of acting as an interface between the users and acquisitions, the users and business analysts and the users and marketing respectively.

The User Researchers and User Experience Architects, however, discuss collaboration in a wider context, which include the tools used and the involvement of industry, and some of the more abstract aspects of collaboration, such as skills sharing and the positive emotions evoked. The tools used to facilitate collaborations are digital and cloud based, and not specialist tools associated with HCI; Mila [UXA, Ed], Clara [UR, Ed] and Lucy [UR, Tr] mentioning tools such as Evernote, One Note and Google docs. There is evidence of collaboration outside of the system development team and the immediate user community, evidenced by Agnete [UR, Ed], who discusses the importance of collaboration with industry for academia: "*the relationship between industry and academia, they really help in Canada"*, and Kenneth [UR], who works with the wider business community: *"we're interested in learning about differentiations between business types, so we use interview questions to learn about how different types of businesses conduct business differently".*

It is also clear that the benefits of collaboration go beyond the obvious facilitation of the development process with several interviewees mentioning the mutual respect of colleagues and the feeling of being valued as a result of the sharing of skills. Helga [UXA] mentions that her opinion was valued by even very senior organisational members, with *"a very egalitarian structure between the different disciplines [in the organisation] and the work was very collaborative".* Kenneth [UR] also feels valued within the larger engineering team: *"I end up having folks swing by my desk all the time and have me say, 'Well, what do you think about this?'… I think I find being a creative person in an engineering environment is really rewarding".* Larson [SD, Ed] also comments on the aspect of complementary strengths; many of his colleagues are very analytical and "*tend to get very buried in the detail and they lose sight of the bigger picture, so I tend to play to my strengths".* Lisa [UR] provides an example of informal collaboration: "*in one of my technical writing jobs, just before I left for academia, I worked with a user interface designer fairly closely".*

Whilst collaboration is viewed as beneficial to a project, conversely, where it is lacking, it is often an indicator of a failing project. Lack of collaboration appears to be more apparent in circumstances that involve agile projects and those involving independent contractors or freelancers.

Alongside collaboration, multidisciplinary or interdisciplinary cooperation is recognised by several interviewees as contributing to the success. Lucy [UR, Tr] values the fact that she has *"access to a lot of different people and a lot of different groups that have a lot of knowledge…people who actually talk to the customer and can feedback in, but also looking at the technical side of things and making sure that* *the feasibility is there for what you're doing as well".* It is not just the different roles within the organisation, but also the complementary skills and perspectives that contribute to the success. Agnete [UR, Ed] sums it up as follows:

> *Then when it comes to design, yeah, you need someone who knows about architecture and navigation and the right people. And the wire framing and the prototyping. And then in the evaluation phase or the methods, all of the methods the subjective methods, that's when there's multiple performance based usability evaluation. And hopefully the design team will be multidisciplinary, you've got people from different backgrounds. Computer scientists and psychologists tend not to be the most creative people and the creative people tend not to have any rigour in their background, so we need to mix and match.* (Agnete [UR, Ed])

However, this multidisciplinary approach is not without its own set of challenges. As Helga [UXA] put it, "*as a UX person you are always an interface between all the different disciplines".* Helga continues: "*It's not easy though because I think we touch everyone else's work and I think people are very protective of their work spheres".* Digby [UXA] echoes this need to consider the sensibilities of each of the teams:

> *You have to understand that you're creating a system which everything has to have a seat at the table. So design has to have a seat at the table, content has to have a seat at the table, if there's a marketing initiative behind what you're building, that has to have a seat at the table. There are so many things that have to have a seat at the table.* (*Digby [UXA])*

Alongside effective communication and collaboration, problem solving is an integral part of the role, and this provides Kenneth [UR] with immense job satisfaction: "*what I'm doing today is really rewarding…I just get a kick out of problem solving".* As problem solving and creativity are core elements of the role, it is implicit that these skills are valued. Therefore, these will not be discussed in the context of the routine activities of the professionals to solve a design problem, but rather in the context of adopting a creative, and a flexible and open approach to the tasks. As Delia [D] points out, problem solving goes beyond providing a design solution, and includes risk management strategy: "*identifying the problem early, having a strategy to address it".*

Working in a multidisciplinary environment certainly appears to support problem solving. Kenneth [UR] explains how as a result of his film industry background, "*being a creative person in an engineering environment"* both keeps design options open, and allows him to benefit from the perspective of the engineers. He tells me:

> *Sometimes I think you might get a little stuck or you get a little bit married to some ideas...having a creative undergrad experience is really important for me because I learned …[that] you've got to be able to kill your darlings. You have to be able to work really hard on something and then totally leave it because you've learned something new"… The folks I work with have a lot of different perspectives, so sometimes it's great just to get ten people with really different perspectives in a room together.* (Kenneth [UR])

It is clear that a dominant design (Kaplan and Tripsas, 2008) has not yet emerged as the practitioners often adapt methods to suit their needs, and this practice is evident with both experienced and newly qualified practitioners. As Lucy puts it: "*every job and every project [is] slightly different anyway, and everybody's got their own ways of working".* Digby [UXA] and Mila [UXA, Ed], Josephine [UR, Ed] and Kenneth [UR] all mention developing their own, or tweaking existing heuristic sets, and Lotte [UR] tells me: "*I make up my own methods most of the time. I look at what the problem is or what the question is and then I try to find something that I already know and if it's not there I'll make it up myself".* As well as adapting or developing methods, novel uses are made of hardware and software, for example, Delia [D] uses Visio as a collaboration tool: *"if I'm on a call with someone, I'll just share out my screen and then I'll try to draw what they're saying, you know, just quick and dirty".*

Several of the practitioners highlighted the need to take a flexible approach when applying the conventional methods. As Josephine [UR, Ed] puts it, *"it's being a bit more creative outside of following exactly what the book says, I guess".* Eli [UXA, Tr] reflecting on the difference between the theory and practice confirms this opinion: "*you just need to make sure that you don't stick too hard with any of them and you leave some way for yourself to be working organically through your project keeping all those things that you learn in mind".*

Flexibility may mean taking a lean approach due to budget constraints or to meet deadlines. Keith [UXA] sums it up:

> *We use the methods we can on the time frames we can. We do things, like, do our usability research on paper without hiring a specialist. It's not perfect, but is it good enough? Are we aware of the get-outs? Sure.*

Digby [UXA] places great emphasis on "*the importance of being flexible"* and as mentioned above, has the following advice for academia:

> *If I was talking to an educator about what is going on in the field right now, that's what I'd talk about; flexibility and the importance of a holistic perspective on what it is you're doing.* (Digby [UXA])

5.6.2 Valued tools and methods

The Practitioners were asked which tools or methods they used, and how, and which were particularly valued by themselves or their employers. This section is not intended to be a systematic review of practice, but will rather summarise some of the key findings. They reported a range of tools, both hardware and software, and methods such as personas, agile practice, and mental models, all of which are discussed in more detail below. Tools and methods generally were appropriate for the particular role of the Practitioner. However, as mention in the section above, the variety of tools adopted does suggest that a dominant design does not yet exist (Kaplan and Tripsas, 2008). Some differences were also noted between the technological frames of User Researchers and User Experience Architects when discussing the use of mental models with the User Researcher considering its role to support the understanding and manage the expectations of the user, and the User Experience Architect considering its role to support the task analysis of different categories of end user and to communicate these differences.

A diverse range of tools was reported. Many of the tools employed are technology based and specifically designed for use in the profession, and the list included Axure, Optimal Workshop, OmniGraffle and usertesting.com, as well as older technologies such as Flash and Director. However, paper and pen or pencil, and sticky notes are amongst the most widely used tools, and general office tools such as PowerPoint and Excel were also mentioned on several occasions. For example, Roger [UR, Ed], Dick [D] and Mila [UXA, Ed] all report using Excel, in Roger's words, *"for nothing financial"*. Roger and Mila use it because it lends itself to tracking and recording, but Dick explains how he uses the Excel capability to link worksheets to support his multi- designs:

> *One part of the Excel table is the language translation for all the [phrases] we translate. Another sheet contains the wireframes, the wireframing diagrams*

> *and screen flow diagrams on another sheet, and then I link the cells, so I link the parts of the wireframe to the appropriate cell on the translation page so that is carries the correct text, so that every time the text is updated in the translation sheet, it automatically updates the wireframe.* (Dick [D])

What appeared to be more important than the specific tool was that the tool was used appropriately, and whether or not the tool is appropriate will depend on the circumstances that it is being used. As Lotte [UR] puts it: *"There is a lot of different problems and different types of problems and I always choose the method that fits with the problem at hand".* This is something that according to Digby [UXA], recent graduates find difficult:

> *They didn't seem to be as open to coming up with a new concept or coming up with a new way to do things. They seemed to be very married to, 'This is what I was taught in college and this is what I must do'.* (Digby [UXA])

Delia [D] provided several examples of selecting or rejecting tools dependent on her communication needs. For example, she uses the tool Visio differently, depending on who she is working with; for a screen design she will use Visio if she is talking to the software team, but may use pencil and paper instead if she is working with an end user, and if she is, as she puts it, "*cross[ing] the line between my users vernacular and then a technical vernacular",* then she will use *"different tools, like modelling and UML, and system L, for the software team",* and *"Visio or PowerPoint for my users and managers, or other people".*

The interviewees may value a tool, but they will only select it if it also adds value to the task. For example, Eli [UXA, Tr] will not use personas when he is designing for the general public *"because the persona is the entire world",* but in the "*corporate* *software business or business software environment personas are very well defined and if you know that if you're building something for an accountant versus an HR manager there's a very big difference".* Kenneth [UR] makes use of usertesting.com because *"our target market is a similar set as the people we find on UserTesting… so it's easy for us to find small business owners, or sole proprietors out of a set of folks who typically do a lot of work from home".*

One particular method that was mentioned by several interviewees is the consideration of the users' mental model. The UX Architects and the User Researchers both discussed the mental models of the end users to support effective communication, but incongruences were observed between the technological frames of these two roles. This incongruence manifested itself in the emphasis of the application. For the UX Architects, the mental model was important to support the task analysis of different categories of end user, and to communicate this; for the User Researchers the role of mental models was to understand and manage the expectations of the user.

Both Mila [UXA, Ed] and Digby [UXA] regard mental models as a tool to support task analysis and also to differentiate the roles of the end user. For example, Mila explains that the nurses use the hospital's electronic medical records system differently to the doctors:

> *There is a lot going on and things they have to watch and monitor and such. It's not the same kind of cognitive load as the kind of thing a doctor would run into.* (Mila [UXA, Ed]

Digby makes extensive use of mental models:

> *Mental models is typically how I communicate with the technology team and the design team… we talk about all of the little sub-groups and tasks that live within that architecture and things that we might need to do…and it helps me communicate with the design team when I'm actually explaining to them how they should think about communicating during steps along the way of a particularly sequential task.*
> (Digby [UXA])

The application of mental models to facilitate communication is evident elsewhere. Lotte [UR] will use the mental model of the user in an iterative development to provide feedback on the designers, using the "*mental model the user has as they're using the designs that have already been made and using that as a shorthand when explaining to the designers why this needs to change",* and Delia [D] uses them to validate her designs: "*as we developed our conceptual models, so I would go out with [the technical team], we would do observations and interviews and we would validate all of that and say 'OK well this is what we collected - is this correct?'"*

For Agnete and Kenneth, who are both user researchers, the perspective was slightly different to that of the User Experience Architects, and the mental model of the user is closely associated with the expectations that user has of the proposed system. As Agnete [UR, Ed] puts it, "*mental models are basically what's already in your head that sets your expectations for what you should have on the screen".* Difficulties arise when this mental model is not satisfied, for example, Kenneth [UR] tells me that when the development team cannot meet "*a mental model and serve expectations that, technologically speaking, we don't have the method or the means to meet, yet*", this can result in an unsuccessful project.

5.6.3 The curriculum focus

What is valued by the Educators is reflected in the focus and delivery of their curriculum. As with the Practitioners above, this section is not intended to be a systematic review, but will rather summarise some of the key findings. Although the main focus of the curriculum was agreed, some differences were noted between Educators and those who both educate and practice when considering the position of Agile methods within the curriculum.

The Educators mentioned three main areas of curriculum emphasis: cognitive psychology, interaction design, and evaluation techniques. Helen [E], Tina [E] and Terry [E] all include interaction design in their undergraduate curriculum. Antonina [E] puts "*a lot of emphasis on design, design cycle and design processes, from concept generation to implementation and evaluation. I put a lot of emphasis on evaluation, different evaluation techniques",* particularly for the undergraduate students, and this is echoed by Helen: "*I really, really try to focus on the process, the user centred design process and the importance of research and evaluation at every step of the process".*

Where HCI is taught to all years and at all levels, this is structured, but there does not appear to be consensus whether cognitive psychology should be a foundational or an advanced topic. Tina's institution delivers HCI on all four of the undergraduate years, with cognitive psychology being a third year module. Helen's foundation module "*is about the values and the process and some basic principles of usability and interaction design. It's more about psychology",* and as observed above, she also places a lot of emphasis on the importance of evaluations; although Helen has a later module that specifically targets evaluations, this is also included in the foundation module: "*Actually, I do heuristic evaluation early on, cognitive walkthrough in conceptual design".*

Understanding the concepts was seen as crucial to developing transferable skills. Helen tells me:

> *I think the process, I think that's really, really important. I think that's maybe the most important part because they can learn the tools of the process but without those foundations or values, they might skip them or use them for something different altogether.* (Helen [E])

Terry echoes this concept, providing his students with "*a mind-set, it's more a mind-set than a collection of techniques that they're going to need".*

The approach of the Educators is in contrast to those who both educate and practice; the 'Both' group front load the theory and take much more of a problem solving approach to the teaching. Mila [UXA, Ed] tells me how she focuses on the underpinning knowledge required to apply the tools and techniques: *"If you were confronted with this work problem, which methods might you use to get the research from your users to best give you the information?"* Her emphasis is very much on application to practice:

> *Everything starting from human factors and cognition, to the practical. We talk about, what is information architecture? What is user experience research? Why do we do it? What is it yielding? Some of the other tools and techniques that are out there, how you apply them, I would do exercises like, if you were confronted with this work problem, which methods might you use to get the research from your users to best give you the information?* (Mila [UXA, Ed])

Clara [UR, Ed] also delivers HCI in the context of practice, in this case it is a module in in instructional technology and instructional design. She tells me:

> *In the first part of that, they have to understand the learner and learner capabilities and then they have to design for, not just content, but the user. And then they have to focus, at the end, on the final product and have to consider all that then. It's not a typical HCI course, it's a cognitive or ergonomics course, but it embodies all of that theory. (Clara [UR, Ed]*

Roger [UR, Ed] designs his curriculum to suit the profile of student he recruits; he describes his institution as *"very much more of a polytechnic"* and his students *"are probably getting a master's degree for professional purposes, they're not going to be going on for doctorate level work".* He may have some students for just one module and explains:

> *My students have no knowledge and no background of it, so I start basically at the ground level. So, I just do one week of introduction, one thesis. So a lot of reading to them, have them read Don Norman's book, "The Design of Everyday Things". Then they go and spend a couple of weeks on heuristic evaluation and an overview of user research, give them a couple of weeks on prototyping. We do a week or two on design, and then in the last few weeks I have them put together a usability test. A small one, just two or three participants…So we cram a lot into twelve weeks, but I want to build upon giving them just the overview of all of those things.* (Roger [UR, Ed])

Although the emphasis of the curriculum may be different, the delivery approach for both groups was similar, with all interviewees mentioning practical work that complemented the theoretical approach; Helen reports "*60/40 in favour of practical hands on experience. The course is project based. They read, we discuss and they do. They do projects and they reflect on them".* In Josephine's [UR, Ed] institution the ratio is reversed, but she tells me:

> *I'd like them to have more practical work… For me as a practitioner when we were hiring people, we found that what was lacking… often they knew the theory but what was lacking was actually the experience of sitting in the room with the user and asking those questions.* (Josephine [UR, Ed]

Josephine's observations regarding the lack of experience of graduates was echoed by Agnete [UR, Ed]. Educators do attempt to address this, by making the delivery as realistic as possible, using either real life clients, or realistic case studies, and where the resources are available, the tools adopted by industry. For example, Helen mentions Axure, Morae and Balsamiq, and Larson makes use of UsabilityHub and usertesting.com. Evidencing the use of these tools will increase their chances of finding employment; Roger [UR, Ed] describes his programme as "*generally very practically based. The students might have something tangible to use as a portfolio piece, or something they can use as a work piece to try and get the next job".*

It was generally agreed that what Helen [E] describes as *"project based learning"* supports the learning process, and involving real life clients enhances the student experience; as Paul [E] puts it, "*students enjoy courses where they design for real people".* Antonina [E] agrees with Paul, telling me that she likes to see *"students working in real life settings with people from different backgrounds and people that they may not necessarily perceive as similar to them".* However, she continues that in practice, this does not happen: *"it takes quite a lot of administrative effort from my side and I'm not doing it anymore. I used to do it, but not anymore".* Although she has managed to involve local school children in participatory design, she "*would like to try to involve the industries more into the teaching. I would like to have more people visiting from industries and see real life problems and real life solutions and real life practitioners".* Tina agrees that whilst it is desirable, in practice it doesn't always happen, and sometimes they have to improvise: "*We sometimes get projects which come from real clients, less often, it's not at all often we do… [it's more likely that] I get them to evaluate something artificial or something created for the purpose".* The lack of real life clients may be unavoidable, but it does dilute the learning experience. Keith [UXA] is describing a short commercial course, rather than an academic module, where the students had to double up as the users for their practical exercises which he did not find effective: *"unfortunately [we were] using other UX practitioners as the student, as the end user, so it's a little bit messed up".*

Wherever possible real life experience is integrated into the curriculum, either as part of an internship, or in a less formal manner, for example, visiting speakers or projects set by industry partners. Agnete [UR, Ed] is a staunch supporter of students, particularly graduate students having industry experience while they are doing their degree: "*graduate students I really feel would benefit from being able to have an internship or vocation employment".* If an internship is not possible, even a short placement is beneficial, *"they're learning on the job, and I think that is so good. Many of my students have obtained jobs subsequently… because they had past industry experience".*

It is worth noting at this point that those practitioners who had the opportunity of working with industry when they were students agree with the academics. Kenneth [UR] started with his current employer "*actually as an intern while I was completing my degree, mid-way through a year when I graduated in the spring"* and he really valued the opportunities to work with real clients that his programme offered:

> *I did a lot of work during my coursework on projects on behalf of organisations in the area, so a lot of times an alumni or graduate of some sort working in a US department of one of the companies in the area would bring a project to the Master's programme for students to work on. This was really helpful because it gave you the sense that your, even though it was a learning experience, that the work you were creating was going to be used by an organisation. It also gave you a sort of portfolio example, or a real world point of reference. So I could talk about a project I had done on behalf of a company, like Verizon…I found that really helpful, and you get a lot of feedback from the third party, as well, that really, it's both relevant as well as just real work, so it feels really good to work with a company like that.* (Keith [UR])

Having benefited from the experience himself, he is taking positive action to support the practice: *"I have, myself, reached out to my master's programme to offer projects on behalf of our UX team, for their testing and assessment classes, as well".*

Variances were noted between the focus on the Educators and those who both practice and educate when discussing Agile methods. During the interviews, eight practitioners mentioned using Agile methods and tools, reflecting the increased use of this methodology in product development. Delia [D], Lucy [UR, Tr], Mila [UXA, Ed] and Digby [UXA] all expressed problems when attempting to integrate UX into the Agile development without compromising the usability of the product. Lucy tells me that the development team *"found it very difficult to…involve us from UX",* Digby found it frustrating to be *"driven by the calendar in an agile environment",* and Delia feels obliged to take a more superficial approach that she feels comfortable with, since she works in the defence field: *"using an Agile scrum process I find it very hard to do all the things I know we can do but we just don't have the time to do them, we're not given a lot of time to do them".*

Although there are clearly some difficulties integrating the two, none of the Educators mentioned UX in the context of Agile. However, those who both practice and teach, are aware of the issues and take pains to include it within their curriculum or practice. Mila [UXA, Ed], in her practitioner role, spends *"an amazing amount of my time doing teaching, how to integrate UX into an agile framework"*, and Roger [UR, Ed] covers user stories as part of his curriculum delivery.

5.6.4 The value of the analytic

As described in section 5.5.2 above, the interview respondents exhibited a range of CSI profiles which covered the spectrum from the Intuitive to the Analytical. Towards the end of interview, the interviewees were presented with their CSI results and asked to reflect on them. They were then asked to consider times they had to adopt a particularly intuitive or particularly analytical approach. These questions were included as a probing mechanism to determine whether individuals adopted methods to match their cognitive preferences; this was not found to be the case. However, what did emerge was that in the systems development environment, the analytical is highly valued, and in practice, professionals adopted a range of approaches, despite personal preferences.

Several interviewees suggested that to be analytical is a desirable quality, but this is most clearly exemplified in the comments of Helen [E]:

> *I think we live in a society that very much values, I guess, an empirical, masculine way of knowing and I think intuition is very much associated with mystery, femininity, things that are not empirically observable, and while empathy is valued, and even required in this profession, this is HCI, I don't know that's it's really necessarily acknowledged or rewarded in workplaces, especially in technology where the analytic approach is much more valued.* (Helen [E])

Agnete [UR, Ed], an Adaptive, explains why both approaches are required:

> *Every experiment, every theory starts with some intuitive, 'I have this hunch'… For some things, you use your intuition more and for others you use your analytic skills more… You can't just be analytical and you can't just be intuitive. Intuitive you will never get the rigour and if you only have rigour you will never get the other side, so you have to have both.* (Agnete [UR, Ed])

Many interviewees assumed that they were analytical because they are academics, or because they work in the software development field. Larson [SD, Ed], on being told that he falls into the category of Quasi Intuitive, is surprised, and tells me *"obviously, I'm an academic. I am fairly analytic".* He then mentions that his result may be explained by the fact that he is dyslexic, and "*dyslexics are supposedly very holistic thinkers"*. When asked which approach he prefers, he tells me *"probably leaning a bit more on the holistic. Partly because most of the people I work with are highly analytical and [I complement that]".*

Prior to me sharing the results with her, Lucy [UR, Tr], an Adaptive, is at pains to emphasise her analytical qualities. For example, she tells me, "*I have a very analytical brain, very much, kind of, a left-brain thinker",* and she later repeats this, although this time qualifying the response: "*I am definitely a geek at heart. I'm very analytical… Although, I do have a very strong creative side, as well".* When I tell her that she is Adaptive, she is initially surprised, but then she continues, "*that actually feels the way that I would describe… I mean, in that I am very analytical, and I do analyse when I work going through, and I'm very rational and logical, but at the same time, as I say, in my data I have a very strong instinct about things".* Terry's [E] CSI score puts him into the category of Intuitive, which he had not expected "*because I would consider myself as an analytical person. And many people consider me to be* *very analytical".* However, as the conversation developed, he realised that whilst he is analytical in his approach to research, when teaching, he does adopt a more intuitive or holistic approach: "*when I'm teaching, it's really immersive; you have to do it on the spot, which requires a different way of thinking".*

Conversely, Helen [E] who is a Quasi Analyst thinks of herself as *"a very intuitive person [laughter]. I think of myself as combining both. I think of myself as using both analytical ability and intuition. I'm kind of surprised because, if anything, I would have expected to be more on the side of intuition"* which she attributes to her teaching and research roles: *"There is a lot of intuition and empathy which, I think, is part of teaching and mentoring students and is also part of qualitative research".* The academics Terry, Paul, Antonina and Helen all told me that irrespective of personal preferences they were able to take the necessary analytical approach when conducting research or producing a paper, and in fact, Paul, who agrees that his categorisation as Intuitive is appropriate, when asked which approach he feels most comfortable with responds: "*In a way, I think, in the end, analytical because I know when I spend the time and the effort, I can get it right".*

5.6.5 How success is perceived

In order to understand what professionals consider to be successful practice, all interviewees were asked to reflect on how they knew if a project was going well, or not, and the reasons for success or otherwise. All of the projects resulted in some kind of 'product', whether this was documentation, designs, or a software solution, and a number of different indicators of success emerged from the discussions.

These can be separated into objective measures of success that are visible to an external party, based on metrics or identifiers, and a subjective assessment of success, which is personal to the individual, closely related to personal satisfaction and possibly not recognised by an external party. As an example, the identification of success may not be directly related to the end product itself, but rather to the process which contributed to that product development. As a result, subjective success can exist without objective success, and objective success and subjective success are not mutually exclusive distinctions; at times in the discussion, they were simultaneously evidenced.

Objective indicators of success included the product itself, the external recognition that resulted from the project, multidisciplinary collaboration, and a positive affect on the team working experience.

Differences were noted between the roles of professional: whereas the User Researchers and the UX Architects commented on both objective and subjective success indicators, the Designers and the Educators associate success only with objective success indicators.

Representatives from each of the groups of professionals mentioned the success of product, particularly in the context of commercial success, and in the case of the Designer group, this was particularly apparent, with all three interviewees making reference to the actual product. Indeed, much of Dick's [D] professional identity is integrated with both the success of his products and the resulting external recognition. He tells me: "*well, I'm normally introduced on what I've done, so my* *achievements. So it is Mr xxxx, he's responsible for…",* and he continues with the list of his products, concluding "*I've just been told that my latest product for Mobicon is the most successful product they have ever launched".*

Delia [D] offers the widest definition of the Designers, considering the not only the quality of the product, but also the affect that a successful project has on the whole of the system development team: "*Success is everyone being happily talking and struggling together with whatever crisis pops up as a team!"* The team affect is also mentioned by Mila [UXA, Ed] who describes good communication between the UX and the development team, and Digby [UXA] who also describes success in the context of communication, explaining: *"If the white noise is positive and if the white noise is optimistic and I see them inspired and laughing and cutting up together, the project is going well".* Helga [UXA] phrases it similarly and also reinforces the interdisciplinary nature of the role:

> *In terms of the team, usually you notice when you have kind of a flow or good dynamic or good discussion culture. You notice immediately when someone is not working along, as a UX person you are always an interface between all the different disciplines.* (Helga [UXA])

The User Experience Architects and the User Researchers offered more diverse definitions of success, and these included the actual product and the team affect, as discussed above. However, they widened the definition to also include the product in the context of both the complexity of the problem, and the impact of the solution, and these descriptions also provided evidence of subjective success. Subjective success indicators related to personal achievements and included problem solving, exceeding the expectation of others, and providing efficient and effective solutions.

Larson [SD, Ed] provides an example of both objective and subjective success as he describes some software he produced in the 1990s:

> *The most successful HCI project was probably Sandskew. That was written on a Mac. That, basically, was software for architects to use to evaluate space and it was successful, because it was mostly research, the architects didn't know what they wanted. They all had the technology, the mathematics required to achieve it, and they didn't know what they wanted but they knew they wanted something, and I produced all that and it became, at one point it was the software that people used. It was used worldwide and it was used, you know the [here he mentions a famous London landmark]* (Larson [SD, Ed])

Subjective success was particularly apparent in complex projects where the interviewees report pride in their personal achievement, particularly in regards to problem solving. Delia [D] tells me: "*identifying the problem early, having a strategy to address it is success".* Helga [UXA] describes one successful project where she mastered "*some e-mobility stuff where just that the technical framework was incredibly complex".* Digby [UXA], who has 18 years' experience in the industry, tells me about his first project at the start of his career; he produced a new front end to a data repository that the users were engaging with in an unorthodox manner due to an inappropriate interface, resulting in data integrity issues. It was a complex project, and he tells me

> *A number of the people, a number of the leaders, thought it was going to be way too much work. But the leader of the IT Team at the time, the Executive Leader of the IT Team actually believed in me and said, Okay, you've got six months… Eight months' later, we rolled it out and the adoption was almost instantaneous. The entire company, of 6,500 people all over the world, thought this was the most brilliant thing that had ever been created.* (Digby [UXA)

This shows evidence of both objective and subjective success; the adoption of the software can be verified, but equally, Digby considers this a personal success.

Mila [UXA, Ed] tells me about an interdisciplinary health informatics project she was involved with that required close and constant collaboration, and also resulted in a commercial product, and her account of the experience also demonstrates objective and subjective success.

> *"It was a really amazing and pretty complex programme… It was a very small team. We met every morning to figure out who was going to do what… That was a product that I saw all the way from the beginning to the very end at which point we started branding and selling. It was one of the few that I have seen so from stem to stern and everything got built. That was probably one of my personal successes. I think that was an awesome, awesome project".*
> (Mila [UXA, Ed])

However, a project did not need to be complex to be described as successful – another measure of success was efficiency and effectiveness of effort in relation to the impact of the solution, and this often reflects subjective success. Helga [UXA] describes another project as successful because it achieved external indicators of success which resulted from efficient application of methods: *"it jumped many, many points [in the J.D. Power ranking] and part of that was just because we did some very, very small navigational and wording tweaks and that's been, I would say in terms of effort and result, that has been the biggest success".* The objective success may be the rise up the rankings, but the subjective success is the rise up the rankings as a result of the efficient use of methods. Similarly, Lotte [UR] describes another project where the success is as a result of efficiency: after conducting just four interviews, she identified a mismatch between the client's perceived goal of the product, and the actual goal of the end users: *"That was a really good case study that I tell people in all my talks because it shows how useful and quick and dirty something can be".*

Of the academics, both Paul [E] and Helen [E] offered examples of objective student success. Paul tells me that some students had *"very, very good and successful projects which allowed them to get some money from people who wanted to finance new ideas".* For Helen, student success is work where the student is *"able to combine some practical aspects to apply that aspect of HCI with a lot of scholarly rigor and I think that's what makes it successful",* with the success indicators being either employment, or publications.

5.6.6 Conclusion: what is valued

In summary, although a few incongruences were noted between the groups when considering what is valued, there was much consensus. Valued skills were agreed to be communication, collaboration, problem solving, creative thinking, and having a flexible and open approach. It also emerged that the analytical is highly valued in the software development environment, and that despite personal preferences, professionals are able to adopt either approach as appropriate. Of all the roles, the UX Architects were the most intuitive of the cohort.

The methods adopted were appropriate to the role of the Practitioner, although it was observed that mental methods were perceived differently by UX Architects and User Researchers. The UX Architects found mental models useful to support and communicate the task analysis of different categories of end user, whilst the User Researchers used mental models to understand and manage the expectations of the user.

Differences were also observed in the design and delivery of the curriculum of Educators and ‘Both’, with the ‘Both’ group front loading the theory, taking more of a problem solving approach to the teaching and integrating Agile into the curriculum.

There were also differences between the roles in how success was perceived: the User Researchers and the UX Architects commented on both objective and subjective success indicators, whilst the Designers and the Educators associate success only with objective success indicators.

The next section will consider the concerns and issues raised by the professionals.

5.7 Concerns and issues

This section will describe the concerns and issues of the Practitioners and the Educators.

5.7.1 Practitioner concerns and issues

Practitioner concerns and issues were not found to be associated with any particular role of professional. The most significant concerns of the Practitioner are associated with the relative newness of the field and the speed with which it is developing. In the case of UX in particular, this has resulted in the lack of a clear identity with no common vocabulary, or standardised processes, reinforcing the lack of a dominant design discussed above. As Roger [UR,Ed] puts it “*I don’t think it’s especially linked to us but I think because of where we are and how fast we’ve grown, this has become an issue in our field”.*

Larson [SD, Ed] sums up changes to practice produced by the move to UX from HCI.

> *Well, obviously, for me user experience is one of those things that emerged over the last ten years, and clearly the early forms of HCI were very much dominated by the idea of well, usability, i.e., the notion that a computer should be usable and a lot of that was related to error rates, making mistakes, correcting errors, creating correct cognitive models. That was often in the context where a lot of technology was designed for the workplace and at that stage, your essential concern was return on an investment, but you basically could bully your staff into using whatever technology you'd invented. The concept of adoption wasn't a major issue.* (Larson (SD, Ed])

The lack of a clear identity causes particular concern. Keith [UXA] tells me "*UX can mean anything. It can mean the design; it can mean the people who gather the business requirements for an application or a project. It can mean any number of things. User Experience is so vague".* Delia [D] isn't sure how to refer to people in the field "*human systems integration folks, you, know, user experience, HCI, whatever you want to call it".*

Roger [UR, Ed] expresses a similar sentiment:

> *There really is no consensus…What is a UX person? What do we call ourselves? There's like, fifteen different terms out there, they all kind of mean the same …whether it be; user engineer, user interaction, designer, usability experience professional, user information architect.*
> (Roger [UR, Ed])

Jun [D] agrees: "*my new job title is Interaction Designer and before was UX Designer – still actually the same even the though the title is different".*

The lack of consensus is not only restricted to jobs titles, but extends to the terms used in practice which can lead to operational and communication difficulties.

For example, Keith [UXA] is describing his design outputs: "*UI specifications, is what I call them. Most people would call them wireframes but I think the specification part is a critical extra bit, or also they may call them annotated wireframes",* and talking about low fidelity prototypes, he tells me "*everybody covers [low fidelity prototypes], in my experience. They don't always call it that thing".* For clarify of communication, Lucy [UR, Tr] tells me she is "*very keen on making sure there's a shared understanding of terms",* and Mila [UXA, Ed] was sent to the Cooper Boot Camp with the express purpose of standardising the terminology used by her team.

The rate of change of technology provides both opportunities and challenges to the HCI professional. For example, it is no longer necessary for teams or users to be physically co-located; Delia [D] tells me: "*I work 100% remotely – my team is distributed all over the place, a lot of the times we're using some type of screen share and then white boarding things out that way".*

However, it was observed that the speed with which the technology changes can result in uncertainty, and unless you keep abreast of developments, there is a risk that future advances in technology could invalidate your current efforts. Larson works in the field of innovative technologies, to advise and develop *"stuff that hasn't been developed before. So, at that point, the rules haven't been written".* This need to be forward thinking is echoed by Delia [D] who designs defence systems:

> *One of the biggest things that was helpful was that our leadership on the customer side would inform us about trends that were going to influence how people interacted 5-10 years from now, so we could identify those trends now and start putting that type of flexibility into our systems so that as they evolved into that new paradigm for how they did work, our system was going to be flexible enough to accept it.* (Delia [D])

Digby [UXA] observes that the field changes so fast that even training courses are not sufficiently responsive: "*The problem I have with all the commercial stuff that I've looked at is it's so far behind what's actually happening in the field"* and Josephine [UR, Ed] also recognises this issue: *"I guess we need to educate to think beyond what currently is in interfaces and think about what could be".*

At times during the interviews, the Practitioners expressed frustration. This tended to be when they felt that the quality of their work was being compromised, or when their efforts were not implemented. Often this was due to the lack of an influential voice, but it was also caused by internal policies or funding issues. Delia [D] describes the lack of an influencing voice as *"an inability to augment the user interface sufficiently to address the needs…you don't have the ability to influence a change at the user interfacing levels that would make it better".* This frustration was not restricted to the Designers. When Helga's [UXA] specifications are not incorporated in the product "*that's usually when I'm also very, very unhappy with the end result. You put a lot of time and effort into it and it's really not at all the way you had envisaged it".* In Mila's [UXA] case, she is often removed from the project before implementation. She tells me "*I think some of that became hair on fire, where if the team gets dragged off to fix something that's broken so they get pulled away… From a whole project perspective that was frustrating because it felt like nothing ever got finished".*

Lucy [UR, Tr] identified an illogical interface design, and was told it could not be changed: *"the techs start going, 'Oh yeah, well, it's been like that so just leave it.'",* and Josephine [UR, Ed] was obliged to start user testing a finished product where she had already advised the initial designs were deficient: "*that was frustrating because then you're trying to get usability feedback from someone on something which you already know has problems".*

Sometimes the practitioners felt their professional efforts were being compromised by internal policy. Kenneth [UR] feels frustrated that in his organisation the distinction between interaction designers and visual designers is becoming indistinct, resulting in the user being involved later in the lifecycle, which is less effective as "*people are more likely to give constructive feedback when they know something is potentially less far along".* Lisa [UR] was unable to survey her users because the Marketing department was unwilling to give her list of the users "s*o that was a highly unsuccessful project".*

Lack of time, or budgetary constraints were mentioned several times, often associated with the constraints of agile practice. These manifested themselves as compromises concerning the choice or application of tools and methods, or compromises concerning time allocation. As Delia [D] puts it *"we are very schedule driven",* and Digby [UXA] agrees, telling me schedule "*is based on the calendar more than anything else. I wouldn't say I'm necessarily happy with that".* Helga [UXA] takes a pragmatic approach. If she isn't allocated the time that she feels is required for the task, "*then the work that I can do within that the phase is not the best that can ever be done, it's the best work that I can do in that timeframe".* Keith [UXA] suggests that this approach is common, telling me: "*Nobody that I know, personally, has the bunch of their time for that kind of thing. So in a sense for fifteen or twenty years we've been doing discount or lean usability".*

Keith [UXA] does "*not actually perform enough direct showing users the results of design work"* due to both time and financial constraints, and sometimes the financial constraints also affect the project. Digby [UXA] only uses Tobii "*when the client can afford it",* and Helga [UXA] tells me that sometimes her project is actually cancelled because "*the money runs out".*

Another significant concern of those who are involved in practice is the perceived lack of relevance of academic research to practice. Clearly, methods are developed and refined as research in the field continues. Keith [UXA] discusses some recent research he has come across, and he feels that some newer methods or approaches can be adopted provided they are not too complex or time consuming so that they *"can be done alongside your other processes…Therefore, you can easily apply it, immediately and you go, 'Oh, I'll do that this afternoon and apply it to my current project.' Those are helpful".* He does feel, however, that much modern research is too complex to be practicable:

> *Even today, in magazines, in conferences, people say, 'We should all be doing this' and they explain this wildly complicated process… I feel a downfall for a lot of the cool ideas people come up with, is that nobody can apply them and they won't even try and apply them because they're so complex to try to do.* (Keith [UXA])

This concept of modern research not being applicable to current practice is echoed by Agnete [UR, Ed] and Roger [UR, Ed] who are both practitioners and educators in an academic setting, and so fall into the category of 'Both'. Those two individuals are the most critical of the discipline, describing it as out of touch and not relevant, both in terms of practice and academic research. They consider that current academic research bears little relationship to practice, and that the direction that the research is taking places too much emphasis on computer science.

Roger [UR, Ed], who is an academic, a User Researcher and a consultant describes himself as feeling *“very schizophrenic and torn between a practitioner and an academic, to be perfectly honest”.* He describes *“an overlap between HCI and what we in the field as practitioners call user experience or usability”* and differentiates the academic discipline of HCI and practice as follows:

> *Where I see HCI as much smaller and always based on research, and I don’t think that’s realistic for UX as a practitioner…[People in HCI] move much slower because it’s based on research, periodicals and journals. So I think that, I think the gap is getting wider and wider and I assume it will be more over the next decade.* (Roger, UR, Ed]

Whilst Roger acknowledges the value of the academic research, he continues: *“I think it’s really not necessarily relevant to most of us that are working day to day as UX professionals”.* Roger is an active practitioner, and additionally has been involved for a number of years with the User Experience Professional Association (UXPA), which is an international professional organisation. The previous year he attended his first ACM Computer-Human Interaction (CHI) conference; this is the top international conference for HCI. He tells me of his impressions of CHI:

> *It was interesting because I consider myself pretty accomplished and pretty well-known in the field, but I felt completely uncomfortable at the CHI conference, because it was so removed from anything that I work at or even what I teach my students.* (Roger, Ur, Ed)

Agnete [UR, Ed] echoes this: "*I get disappointed with academics because they keep on coming up with fine models that nobody can use. You know, we can't apply them".* She is critical of who academics focus only on academic research with no regard for actual practice, self-perpetuating the problem, expanding on her theme:

> *In fact most of them, or very few of them, have any relationship with, or ever worked in practice. So they don't really know, but where do they get their knowledge from? From all these other papers that they read or that are written by other academics, so it's blah, blah, blah inside and it's something different outside.* (Agnete [UR, Ed])

She tells me of when she worked for a telecoms company, "*we could see that we needed the academics to bridge the gap between what our responsibilities were as practitioners and what academics could deliver",* and Roger agrees that both sides add value, but the voice of the professional is not sufficiently loud, concluding "*I've heard a lot of people talking about the academic, and the practitioners aren't really talking too much. It's unfortunate because it would be invaluable insights for both".* Agnete, however, is not so optimistic: "*I don't know what it will take for it to ever to get to be or if it will ever happen. I'm not really confident that it will".*

There was also discussion of the difference between what is taught in the classroom and the actual practice. Lisa [UR] has recently graduated. She notes that the usability tests she carries out in practice involve "*eliciting information about how the participant uses the tool and their impressions and in the usability test that we did for school, it was just come in, do the screener, do the tasks".* Josephine observes that tools she has used in academia, such as Morae, are useful and support the process, but they are also time consuming, and in the real world there are time constraints: *"in* *reality would I use them again? Probably not because I'd probably still have to deliver my reports within three days. I'd probably still do whatever was quickest".*

Roger [UR, Ed] feels the tension between his two roles keenly, wanting to provide his students with what they need for practice, but without compromising the academic side of it. He does this by concentrating on the skills in the classroom, and encouraging the students to read in their own time. He tells me:

> *This is where I feel very schizophrenic and torn between a practitioner and an academic, to be perfectly honest. Most of the things that I teach are very practical. I use the vast majority of the reading [which they have to cover in their own time]…But our programme in the class, by its nature is very practical. Because everyone on my programme is either a working professional with a family and a job, and they're juggling a lot. Or they're career changers who are trying to learn a skill to get into a job.* (Roger [UR, Ed])

Roger provides the students with his own perspective of the methods but without compromising the curriculum. For example, regarding heuristic evaluations, "*I tell my students about the pros and cons and the place it has, but personally, I think the organisation has been more UX mature, they kind of realise that heuristic evaluation has a lesser place",* and whilst he does cover GOMS he places it in its historical context: "*At least, in the work that I see today, it's less important than it was ten years ago. But it is a valuable method to tell people about and I have my students learn about it".*

Other issues included tensions between the designer groups and the developer groups which were mentioned by the Designers and the User Experience Architects, and to a lesser degree, the User Researchers. For example, Delia [D] who feels that better communication early on would avoid the developers *"writing the code, realising that something is not right and then having to go back and correct it".* Digby [UXA] mentions a conflict with "*the design person who was not really a digital person"* and Keith [UXA] refuses to hand over high fidelity representations of interface design because "*we don't want your developers slicing it up",* expressing some frustration that that the developers do not make a good job of translating his designs into implementation "*Make it this colour red. It will be in the specification. Plus if it is a raster, we'll export it because we are graphics guys, instead of your developers making it grainy and looking terrible".*

Working as an Independent provides its own set of challenges and frustrations. Eight of the practitioners worked as an Independent, categorising themselves as contractors, freelancers and consultants, and there was a definite sense that despite the experience and value that an individual can offer, or even the length of time in a role, they are outsiders. Both Helga [UXA] and Digby [UXA] are Independents, and they mention an unwillingness to collaborate which they attribute to organisational politics. Helga says "*It is usually the team, it's when people don't want to work with the UX team or don't cooperate well – it's a matter of team politics and hierarchy".* She continues with a specific example: "*I found it very hard to work with a particular designer…if I had specifications that I was very keen to include, they might just nod and then just do whatever they wanted",* and Digby agrees, and associates this lack of cooperation with being an independent contractor rather than an employee of the organisation: *"their designers really like to hold very close to the chest…their designs and they don't want people participating in the exercise of design".*

Several of the Independent interviewees felt less valued than a permanent employee. Jun [D], who has 7 years' experience as a designer, feels very much a second class citizen as a contractor, and is uncomfortable that she is expected "*to do [as instructed], that's it. But I can't ask questions if the requirements have problems there or aren't very clear",* and feels her value as a designer is dismissed. *"[They] say, this is how we want it, you do this, you do that, you do that, and I feel like, then why do you need me? You just need me to put your words in a digital format to show, that's all. You don't really need my thoughts, my insight, my experience".* Similarly, Digby [UXA] complains that the designers do not like to collaborate with freelancers. Dick [D] has been in at his current position for around 4 years, but does not feel part of the company. When I ask his job title, he responds, "*Um, long pause here, 'cause I'm not sure that I have one. I work freelance for Mobicon, and therefore I'm a contractor, so as far as they're concerned I'm a contractor".*

5.7.2 Educator concerns and issues

Just as with the Practitioner, internal policies and funding issues were sources of frustration for the Educators, and these manifested themselves as barriers to delivering the curriculum. The majority of these barriers stemmed from shortcomings related to curriculum design, with poor integration of the individual modules within the programme of study. Terry [E] tells me that it "*lacks a coherence"* across the modules of his programme. Mila [UXA, Ed] tells me that in her institution "*there is HCI 1 and HCI 2. You don't have to take them in order which I think is a bit of a problem. A lot of the time we end up teaching a set of subjects in 1, we might have to revisit them in 2, if some people didn't take 1 or took 2 before 1".* This results in duplication and wastes valuable contact time: "*I would like to see that the course is actually come one after the other so that there is a sequence. I don't mind reviewing one class to the next but ...I think we could get more in if we didn't have to repeat".*

In Larson's [SD, Ed] institution, they have to teach HCI without any implementation, as they are not permitted to assume any prior knowledge and are *"forbidden by the university to actually include any programming content… teaching HCI without allowing the students to program is also quite complicated".*

Educators felt that they weren't given sufficient time to cover the curriculum. Helen [E] mentions this issue at two different points in her interview: "*I think the biggest struggle that I always attempt to change and fail, is scheduling and trying to figure out how to make time for everything",* and Roger compromises by cutting down on the exposure to different tools: "*I only ever use one piece of software throughout the term and the classes because it's too much to do anything else".*

Other issues reported were due to timetabling issues. Helen [E] tells me that the room she was timetabled in was inappropriate suggesting that nature of HCI is not understood by those who allocate the resources: "*I taught a course that was in an old fashioned classroom where the chairs were actually linked together and they couldn't turnaround, they couldn't move them".* Additionally, she was allocated two 45 minute lectures and one longer lab session: "*we couldn't do any project work in that format, right? In 45 minutes, by the time you get started, you have to finish class and, of course, space wouldn't allow it".*

5.7.3 Conclusion: concerns and issues

In summary, the concerns and issues of the professionals were not specific to particular roles of professional. For the Practitioner, the most significant concerns are connected with the relative newness of the field and the speed with which it is developing. Other issues mentioned concerned compromises to practice due to time or financial constraints, and tensions between research and practice, and between systems development groups, and the problems of being an Independent worker rather than an employee. For the Educator, internal policies and funding issues were also sources of frustration which manifested themselves as barriers to delivering the curriculum.

5.8 Overview of the interview data

This chapter has presented a snapshot of the professionals who volunteered for interview. Some differences have been observed between the different roles of the professional. In terms of their cognitive profile, the UX Architects were found to be the most intuitive of the roles, but more interesting is the ability of the professional to adopt both approaches when warranted, and the esteem in which the analytical is held within the software development environment. In terms of curriculum delivery, those with the role of 'Both' who are involved in both education and practice are very aware of commercial application and actively incorporate their industry experience into the curriculum; evidence of commercial application is not so apparent for the Educators. In a similar vein, 'Both' use the underpinning theory to take a more problem solving approach to curriculum delivery whilst the Educators place more emphasis on the psychology element of the theory. In terms of practitioner roles, the

Designers see themselves as less involved in the software development lifecycle and the wider development team than the other roles of practitioner. .

Although there is widespread enthusiasm for HCI practice, there is also frustration at the lack of standardisation and the lack of a clear identity which is seen to be damaging to the profession.

The professionals report that within academia, HCI delivery is often interdisciplinary, with the curriculum tending to focus on cognitive psychology, interaction design, and evaluation techniques, with emphasis on practical work to support the theoretical approach. It was agreed that HCI education prepares the student for employment, but in fact, learning is a continual process, with most taking place ‘on the job’, often supported by a mentor. Within HCI practice, a wide variety of tools and techniques are adopted, and skills that are valued include communication skills, problem solving and creative thinking skills and the ability to adopt a flexible and open approach. Collaborative working is essential to success, but collaboration can be impeded where the practitioner is an independent rather than an employee.

Some differences were noted in the curriculum of those who specialise in education (Educators) and those who both educate and practice (‘Both’). Specifically, the Educators made no reference to UX in the context of Agile, whilst ‘Both’ include UX in the delivery of their HCI curriculum. ‘Both’ also front load their curriculum theory so as to allow more time for practical application, and they take more of a problem solving approach to their delivery.

Differences were also noted between the roles of Designer, User Researcher, UX Architect and Educator. These are summarised in Table 5-3 below.

Table 5-3: Differences in the roles of professional

	Designers	**User Researchers**	**UX Architects**	**Educators**
Career paths	Generally transitioned from design roles	Generally transitioned having studies the subject, or working in fields that required detailed task analysis	Not generally the first career path	Transitioned from having studied the subject
Discussion of the roles	The primary focus of the designer is the interface, extending towards problem solving.	The role of the researcher is seen to be broader than that of the designer but does not extend to implementation	The role of the UX Architect was not mentioned	
Intuitive/Analytical Cognitive profile	Fall into range of Quasi Analytical to Adaptive	No clear cognitive profile evident	Fall into the range of Adaptive to Intuitive.	No clear cognitive profile evident
Passion	Exhibit enthusiasm for HCI	Exhibit a passion for HCI	Exhibit enthusiasm for HCI	Exhibit a passion for HCI
Definitions of success	Success is associated with objective success indicators	Success is associated with both objective and subjective success indicators	Success is associated with both objective and subjective success indicators	Success is associated with objective success indicators
Mental models		The role of mental models is to understand and manage the expectations of the user	The role of mental models is to support the task analysis of different categories of end user	

The interview findings, alongside the findings from the survey data, will be discussed in the next chapter.

6 Discussion

The aim of this research is to provide a better understanding of HCI practitioners and HCI educators by identifying the differences between them, and the potential impact upon curriculum design, delivery and practice. A better understanding of this will serve to support the educational experience of the students and to strengthen the HCI curriculum.

Chapter 4 presents the results of the survey data, which includes the cognitive profile of the professionals, and Chapter 5 presents the interview results. The qualitative data (the interviews and the open questions in the survey) and the quantitative data (the demographic data and the cognitive style of the professionals) combine to contribute towards the profile of the HCI professional with elements of each of the sets of data addressing the research questions. This chapter commences with a summary of the key findings which have emerged from this study, followed by a review of the key sets of actors whose technological frames are likely to be diverse. The remainder of the chapter is organised to consider each of the research questions and presents a discussion of the key findings of the study, integrating the finding of both the quantitative and the qualitative data sources in a mixed methods convergent design (Creswell & Plano Clark, 2007).

6.1 Key findings

A number of key findings emerged from the survey and interview data regarding the differences in the profile of the HCI professional. These are summarised below together with the data sources from which they derive.

There are differences in the cognitive profile of the HCI professional and the general population (Survey)

The HCI professionals and the general population differ in their Visual Spatial ability, their Intuitive/Analytical profile and the association of age and intuition for all roles apart from the female Practitioners. Additionally, the HCI professional more resembles the computer scientist than the graphic designer.

There are differences between the roles of the HCI professional (Survey and Interview)

Whilst there are some inconsistencies in the detail, it appears that there are differences between the HCI specialist and the HCI non-specialist, that the role of the Educator differs from the other roles and that there is a difference between the Designer and the other roles of professional.

The curriculum delivered by the specialist educator differs from the curriculum delivered by those who also practice (Interview)

The curriculum emphasis of specialist educators differs from those who are also involved in practice, with the former according more importance to cognitive psychology, and the latter according more importance to commercial application.

There appear to be gender differences amongst the HCI professionals (Survey)

Female professionals, in common with the general population, are more analytical than the male professionals. Whilst this was not unexpected the female Practitioner appears to differ from the male Practitioner in respect of the association of age and intuition, and the female Practitioner also appears to differ from all other roles of professional (both male and female) in a number of associations which involve intuition. Gender differences are particularly apparent in the female Educator but as noted above, the sample size of this cohort is very small, and results are treated with caution.

These findings will be discussed with reference to the research questions, and where appropriate, technological frames.

6.2 Producers of technology, users of technology, and institutional actors

As described in section 2.6.2 above, Kaplan and Tripsas (2008) identify three key sets of actors whose technological frames of reference are likely to be diverse, namely producers of technology, users of technology, and institutional actors (stakeholders such as government bodies, user groups, standards bodies, and other organisations with influence or regulatory power).

This thesis differentiates between HCI research, which may be focussed on novel methods of interaction and developing technologies, and HCI practice with is focussed on existing technologies and practice. In the context of this thesis, the

Practitioner could be considered to be both a producer and a user of HCI tools and methods, but the Educator is more likely to be a user than a producer. The rationale for this is that if the product is considered to be HCI practice, then the HCI Practitioner can be considered to be both a producer and a user of the technology. Whenever the process is not clear or where an industry standard is not yet established, the Practitioner adopts the role of the technology producer by modifying the tool or methods with which they are already familiar, adapting proven techniques to meet the needs of the task in hand, thereby producing novel methods. However, where there is already established practice, or stakeholder preference, the Practitioner adopts these methods and thereby takes on the role of the user of technology. It should be noted at this point that stakeholder preference can influence the methods adopted, and it may be that the Practitioner is adopting a particular method to satisfy a stakeholder or institutional actor requirement.

Many Educators are likely to be involved in research as well as teaching activities, therefore it is conceivable that some may contribute towards the ‘technology production’ of HCI practice. However, the field of HCI research is broad, and examination of the proceedings of CHI indicate that only a small percentage of publications cover the use or development of tools and techniques (Liu et al., 2014). For this reason, and without wishing to diminish the activities of those Educators who are active in this area, for the purpose of this discussion the Educator is considered as a user of the technology rather than a producer as they are more likely to base their curriculum on published textbooks and more widely accepted practice, and this may go some way to explaining the incongruent technological frames that have been identified above.

6.3 RQ1: Cognitive profile differences

One of the aims of this research is to provide a better understanding of the profile of the HCI professional; this section will consider those elements which constitute the cognitive element of the profile of the HCI professional and will consider analytical and intuitive preferences, the association of age and intuition, visual ability and cognitive differences associated with role specialism and gender.

In terms of cognitive profile, it was assumed that as the HCI professional makes use of tools and techniques that require both analytical and intuitive approaches, they would be more comfortable with both approaches than the general population. Also, as they contribute towards interface design but equally need to understand the architecture and functional design of an application, they would have greater Visual Spatial skill than a visual artist, and greater Visual Object skill than a computer scientist. This resulted in two sub questions for RQ1:

- RQ1a: How does the cognitive profile of the HCI professional differ from that of the general population?
- RQ1b: What are the differences between the Educator, the Practitioner and 'Both' in terms of their analytical/intuitive preferences, and their Visual Object, Visual Spatial and Verbal abilities?

In order to probe this further, the normative data was used to make comparisons not only between the different roles of the HCI professional, but also between the profile of the HCI professional and the general population. Although the analysis for each of sub questions RQ1a and RQ1b was conducted separately, the findings will be integrated within this section of the discussion.

A number of cognitive differences were noted both between the profiles of the HCI professionals and the general population, and between the roles of Practitioner, Educator and Both. These included differences in their analytical/intuitive preferences, differences in the association between age and experience, differences associated with Visual ability, and gender differences. These are summarised in Figure 4-4 and Figure 4-5 on pages 176 and 177.

6.3.1 Analytical/intuitive preferences

As detailed in section 4.2.2 above, the Cognitive Style Index (CSI) measures whether a subject tends more towards an intuitive or an analytical approach producing five notional styles of Intuitive, Quasi-Intuitive, Adaptive, Quasi-Analytical and Analytical, with 20% of the general population fitting into each of the categories (Allinson & Hayes, 1996). This section discusses the differences in the notional styles between the HCI professional compared with that of the general population, and the differences in the notional styles between the roles of the HCI professional. These notional styles and the CSI raw scores are referred to as the CSI profile in this discussion of analytical and intuitive differences.

Differences were noted when comparing the cognitive profile of the general population with that of the HCI professionals. Whereas 20% of the general population fit into each of 5 notional styles specified above, the CSI profile of the HCI professionals differed from that of the general population, placing all roles apart from ‘Both’ into the band of the Adaptive (see Table 4-2 on page 149), with the scores for the Practitioners positioned towards the lower (intuitive) end of this boundary, and those for the Educator towards the higher (analytical) boundary. This confirms the initial expectations that as the HCI professional employs a range of tools and techniques that require both intuitive and an analytical skills that they would be happy with either approach. It also highlights a difference between the roles, as the profile of ‘Both’ is the only one that falls into the category of Quasi-intuitive. This suggests a difference between the Educator (who specialises in education), and the professional who both educates and practices: this theme of specialisation is found elsewhere and is also discussed on in section 6.3.4 on page 249.

Differences were also noted between the roles of the HCI professional. Continuing the line of enquiry above, the expectation was also that more than 60% of the population sampled would fall into the middle band of Quasi-Intuitive to Quasi-Analytical. This time additional role differences were observed as this was found to be the case for all roles except for the Educator and All-Ed (those who specialise in education combined with those who both educate and practice). This reinforces the idea expressed above that those who are involved in education in some way differ from the specialist Practitioners.

This is more clearly illustrated when considering the whole range of the CSI profiles from Intuitive to Analytical: of all of the categories of professional, the Educator has the most balanced profile, with similar representation across the whole of the spectrum, and closely resembling the profile of the general population. However, when you consider the profile of All-Ed, this balance changes, with a distinct shift towards the intuitive end of the spectrum, again suggesting that the profile of the academic who practices is different from the Educator who does not practice.

The data suggests that there are gender differences as well as role differences between the academic who practices and the Educator who does not practice: these findings are confirmed by the results of the one-way between subjects ANOVA comparing the CSI scores for each of the groups of Practitioner, Educator and Both for the female respondents, but not for the male respondents. The post-hoc comparisons using the Tukey HSD test indicated that the mean score for the female Educators was significantly different from that of the female ‘Both’ group confirming that there is some difference between the female Educator who does not practice and the female practitioner who does both. Whilst it should also be noted that the results of these tests did not indicate any significant differences between the profile of the Educator and the Practitioner, nor that of the Practitioner and those who enjoy both roles (‘Both’), taken together there does appear to be some difference in profile of those who specialise in education and those who are in some way involved in practice, but this is restricted to gender. Gender differences are discussed in more detail in section 6.3.5 on page 251.

6.3.2 Age and intuition

One of the most interesting findings is the difference in the profiles regarding the association of age and intuition. The literature suggests that there is a correlation between age and intuition, and by implication, age and experience, suggesting that people become more intuitive as they grow older (Allinson & Hayes, 1996; Hedden & Gabrieli, 2004). However, it appears that this tenet holds true for the female who practices, but not for any of the other roles of HCI professional, which suggests that the HCI professional, with the exception of the female who practices who has a profile which differs from that of the general population. This begs two questions:

why do the other HCI professionals differ from the general population, and what is it about the female who practices that differs from the other HCI professionals?

One explanation to explain why some HCI professionals do not become more intuitive with age may be that although the field of software engineering generally requires an analytical skillset, as the data from this study shows, those who are attracted to the sub field of HCI have a naturally more balanced profile and are comfortable with both an analytical or an intuitive approach to tasks. It may be that these skills are naturally innate in those involved in HCI practice, and as a result, the effect of age and experience is less pronounced than for other roles.

This explanation is less likely to apply to the role of the Educator as it is unlikely that that HCI is the only area of the curriculum that is covered. In the case of the Educator, it may be that this difference can be explained by the different skillset required: the Educator needs to exhibit teaching skills as well as subject knowledge, and also to be active in academic research. This view is supported by the interview findings which suggest that the Educators override their natural tendencies in order to adopt intuitive or the analytical approaches as required to support research and teaching activities (see section 5.5.2 on page 193) which would minimise the effect of experience on intuition.

It is also interesting to note that in this lack of an association between age and intuition, the Educator differs from the general population, whereas in respect of their general CSI profile, no differences were observed. There is insufficient data in this study to compare the profile of the HCI Educator with other academic roles but it would be interesting to determine whether the lack of an association between age and intuition is a general characteristic of educators or whether it is specific to HCI Educators.

It is more difficult to deduce why this should not hold true for female Practitioners. The data indicates that the general CSI profile of Practitioner does not differ from that of the general population, and no gender differences were noted. The data does indicate that for each of the roles, the females are more analytical than the males, which is supported by the findings of Hayes and Allinson (1996). However, unlike all of the other roles of HCI professional, it appears that the female Practitioner becomes more intuitive with age, or possibly, experience. Once possible explanation for this may be that the field of software engineering is traditionally a male dominated area. Assuming that cognitive style is to some extent malleable (Zhang, 2013) this perhaps suggests that the naturally more analytical female Practitioners (see page 150 above) develop particular strategies over time in order to adopt intuitive approaches which come more naturally to the male professionals. However, more research is needed in this area and it is not possible to come to any firm conclusion at this point.

6.3.3 Visual ability

It was assumed that as HCI professionals, unlike computer scientists, routinely contribute towards interface design, and as they also need to understand the architecture and functional design of the application, unlike graphic or interface designers, that they would have greater Visual Object ability than a computer scientist or an engineer, and greater Visual Spatial ability than a visual artist. The former was not found to be the case, which was unexpected, and this may be an indication that consideration of aesthetics plays only a minor part in the job function of HCI professionals. In contrast, all roles of HCI professional were found to have greater Visual Spatial ability than the general population of visual artists. This may indicate that they are closer in profile to the more technical roles of those involved in the software development process, for example, the programmer, than to the profile of the graphic designer.

Blazhenkova and Kozhevnikov (2008) also observed a negative association between Verbal and Visual Spatial ability, suggesting that the more comfortable an individual is with Visual Spatial approaches to problem solving, the lower their Verbal ability. This was found to be the case for all roles of professional apart from the Practitioner, which suggests that the Practitioner differs from both the general population and those involved in education. The reason for this difference might be attributed to their role of acting as the interface between the user and the software development team; not only does the Practitioner needs to understand the functionality of the system in question, but they also require excellent communication skills in order to communicate effectively with both the non-technical users and the technical developers.

6.3.4 Cognitive differences: role specialism

It is interesting to note that when considering cognition, whether or not the professional is a role specialist appears to be a factor which determines their profile. The difference between those who specialise in education and those who both educate and practice is discussed in section 6.3.1, and the data also reveals differences between the specialist and the non-specialist when considering the association of intuition and Visual ability. The profiles of the specialists (the Educator and the Practitioner) resemble that of the general population in that there is no association between their intuition and Visual Object ability. In contrast, this association is present in all those who combine education and practice (‘Both’, All-Ed and All-Pract). When considering the association between intuition and Visual Spatial ability, the association is only present for the specialist female Practitioners. The reason for this difference or why the male Practitioners, who are also specialists, should differ from the female Practitioners is not clear, and this gender difference is an area that would warrant further investigation.

As discussed above, it is noted that the female Practitioner differs from all of the other roles exhibiting an association between age and intuition. Female Practitioners also differ from the other roles with an association between intuition and Visual Spatial ability, and Practitioners (specialists) and All-Practs (which includes both specialists and non-specialists) also differ from the other professionals by exhibiting an association between intuition and Verbal ability. With the exception of the association between intuition and Visual Spatial ability that is also evident in the All-Pract group, these differences are apparent in those females who specialise in practice. Whilst it is not clear why this should be the case, it does suggest that the female professional who specialises in practice is dissimilar to the other roles of professional.

There is other evidence of differences between those groups who specialise, for example, the difference in the CSI profile between those who specialise in education and those who combine practice and education; this is discussed in section 6.3.1 on page 244 and differences between the female Educator and non-specialist female Practitioner in section 6.3.5 on page 251.

6.3.5 Cognitive differences: gender

A number of cognitive gender differences were noted between the roles of the professional and these are summarised in Figure 4-5 on page 177. What is immediately apparent is that there are several differences associated with the roles of both the female Practitioner and the female Educator.

Some of these gender differences have already been discussed elsewhere. The differing CSI profile of the female Educator and female 'Both' is discussed in section 6.3.1 on page 244, the difference between the female Practitioner and other roles in the association of age and intuition are discussed in section 6.3.2, and differences in the association of intuition and Visual Object ability in section 6.3.3. There are also several gender differences associated with the female Educator which will be discussed in more detail below following a general discussion of the CSI and gender differences.

No significant gender differences were noted when comparing any of the CSI profiles of the HCI professional with the CSI profile of the general population. However, the mean score was higher for the females of the sample of HCI professionals (M=40.76, SD=11.52, n=158) than for the males (M=39.45, SD=12.51, n=143) suggesting that they are more analytical than males. This is consistent with the original findings of the CSI which showed that females consistently scored higher than males (Allinson and Hayes, 1996). However in more recent studies, where a significant difference has been noted, the majority of the results are from student samples with the remainder being managerial or professional samples, suggesting that the gender differences may be attributed to other contributing factors such as organisational culture or conformance to norms (Allinson and Hayes, 2012). This is particularly relevant when considering the findings of this study where the respondents are also professionals in an industry that attracts the naturally analytical.

The discussion now moves on to consider the profile of the female Educator. As mentioned above, a number of differences were also noted between the female Educator and both the general population and other roles. It is, however, also noted that the sample size of female educators is small (n=24) and these results therefore need to be interpreted with caution. For example, the female Educator appears to differ from the general population and from the majority of all other roles of professional by exhibiting no association between age and increased verbal skills, perhaps suggesting the Verbal ability of female Educators in this sample is naturally greater than that of both male Educators and of the other roles. Whilst it may be tempting to draw conclusions regarding verbal skills of both females and Educators, this quality is also evident with male 'Both' professionals. Whilst this trend is interesting, with such a small sample of female Educators, it is not possible to draw any firm conclusions from this data.

6.3.6 Conclusion: RQ1

Some of the findings from the analysis of the survey data have been inconclusive or even contradictory. However, three main themes have emerged from the discussion of the cognitive style findings: there are differences between the HCI professional and the general population in terms of their cognitive profile, there are differences in the profile of the specialist/non-specialist, in particular the Educator, and there are gender differences, particularly when considering intuition. Another area for additional research has been identified in order to probe gender differences and differences between computer science lecturers and lecturers from other disciplines. The discussion shall now consider RQ2: Does the profile of the HCI professional vary from role to role in respect of their background, what is valued, and their concerns and issues?

6.4 RQ2: Background, what is valued, concerns and issues

The previous section considered the cognitive elements of the profile of the HCI professional and identified some differences between the roles of Educator, Practitioner and 'Both'. This section will now move on to consider how the elements of background, what is valued, and concerns and issues vary from role to role in the profile of the HCI professional.

6.4.1 Background

The initial survey asked for brief details of their employment situation and this was supplemented with some interview questions. Unlike the findings of Gulliksen (2004), who suggests that many respondents are likely to have moved into usability from an engineering or software developer background, the interview respondents came from a range of backgrounds. Qualifications included design subjects such as graphic, web, interaction or information design, as well as computer science, psychology, engineering or architecture courses which include an HCI option, suggesting that HCI is embedded in many more areas than previously. Even those with the longest careers who would have been practicing at the time of Gulliksen's survey came from a variety of fields, including psychology. It should, however, be noted that Gulliksen's survey specifically requested this information, and whilst detailed background information was elicited at the interview phase of this study, this was not included in the survey. This resulted in a much smaller sample for analysis which may not be representative of the entire population of respondents.

What is apparent, however, is that the roles of the Practitioner are diverse and the routes into the field are equally varied. In a number of cases, this was a second or even a third career, and as a result, several of the new entrants to the field were not recent graduates but had already developed transferable skills from their previous roles.

Interestingly, when the respondents provided their perceptions of both their own and other roles within practice, these included observations concerning the roles of Designer, User Researcher and Developers and Engineers, but the role of the UX Architect was not discussed, suggesting that this particular role does not have a clear identity and therefore may not be recognised as a career option by careers advisors. This may go some way to explain the diverse career paths of the UX Architects for whom this tended not to be their first career, and indeed, they mention a lack of awareness of HCI before stumbling into the field. The other roles of professional in contrast transitioned quite naturally into their HCI roles, with the

Designers moving from other design roles, and the User Researchers and the Educators transitioning from associated courses of study.

Unsurprisingly, the role of Designer is mainly associated with the interface and the role of the User Researcher is seen to be broader than the role of designer, but can include some design; they are involved earlier in the lifecycle.

When providing perceptions of practice, differences were noted between the roles. In particular, the technological frame of the Designer appears to be at variance with that of the UX Architect in that they consider their involvement in HCI to be confined to the early stages of the development process, and they do not consider themselves to be part of the development team. This is in direct contrast to the viewpoints of the UX Architects, who consider the design process as part of the development process. This may in some way be explained by the emphasis of the roles – the Designers are primarily visual artists, whereas the UX Architects spend a significant amount of time interacting with other members of the development team, or with users, which requires a completely different skills set.

When reflecting on their skillset, the UX Architects note that they do not necessarily have specialist skills, whereas the Designers are most certainly specialists. That is not to say that the Designers do not enjoy their roles, but rather the opposite; they expressed a great deal of job satisfaction as HCI professionals. The concern is, however, that these mismatched technological frames could possibly lead to conflict between Designers and other members of the development team.

6.4.2 What is valued

Although some differences were noted when considering success indicators, the technological frames of the professionals were broadly aligned with considering their values and their priorities. A number of core skills were identified, and it also emerged from the discussion that the analytical skillset is highly valued.

6.4.2.1.1 Valued skills

The attributes that were identified as desirable qualities for an HCI professional include communication skills, team working, problem solving and creative thinking skills, and the ability to adopt a flexible and open approach. This list reflects those skills that have long been recognised as key employability skills and they are in fact relevant to all professions. When a UK university course is validated, graduate attributes which closely resemble this list are embedded within the course design documentation, no matter which the discipline, but that is not to say that the delivery of these subjects is seamless (Green, Hammer, & Star, 2009). As discussed above academics are already having to prioritise topics to include within the curriculum, and this is no doubt true of all disciplines. In some institutions the academic specialist may feel that generic skills should not be delivered alongside disciplinary skills, and particularly where there is a modular delivery of the curriculum, graduate attributes are delivered as a stand-alone module (Bath, Smith, Stein, & Swann, 2004; Yorke & Harvey, 2005). However, this need not be the case with the HCI curriculum as the core skills identified above are integral to HCI practice and it will be easy for both the student and the academic to see the relevance of activities which embed group work or communication skills that can easily be contextualised within the discipline (Jones, 2013).

6.4.2.1.2 The value of the analytical

What was particularly interesting was the extent to which the analytical is valued within the field of software engineering (see section 6.4.2.1.2 on page 257). Irrespective of their survey responses, respondents were eager to categorise themselves as analytical and initially expressed surprise if their CSI profile indicated that they preferred intuitive approaches. The fact that the analytical is highly valued is no doubt due to the fact that the respondent often works as part of a software development team and is likely to be working in close conjunction with developers and software engineers. As a result, they are working in an environment where to be an analytical thinker is the norm which correlates with Zhang and Sternberg's assertion that an intellectual style is in part sociological, and affected by the preferences of the society in question (Zhang & Sternberg, 2005). Whilst all interviewees were able to adopt either approach depending on the needs of the task in hand, it appears that this came easier to those with an Intuitive profile who were Educators than those with an Intuitive profile who were in practice, with the suggestion that this is a direct consequence of being involved in academic research. Whether this is a direct consequence of being an Intuitive Educator in a field dominated by the analytical is not clear; it would be interesting to probe this further with academic practitioners who are involved in subjects that normally require a more intuitive approach such as those in the humanities.

6.4.2.1.3 Differences in success indicators

It is interesting to note that when the interviewees were asked what constituted success, the Educators offered only objective indicators of success. Above (see section 5.6.5 on page 217) success indicators were categorised as either objective measures of success (visible to an external party and based on metrics or identifiers, for example, a successful product, recognition, or effective collaboration efforts) or subjective assessments of success (possibly not recognised by an external party and a source of personal satisfaction to the individual, for example efficient use of resources or effective problem solving approaches).

That is not to suggest that the Educator does not experience job satisfaction from their role; as noted in section 5.5.3, the Educators exhibited a particular passion for the subject. The reason for this difference in the definition of success indicators may be more to do with the academic environment where success is very much measured by objective measures such as journal publications and citations, and retention and achievement figures.

The Designer also differed from the User Researcher and the UX Architect in their definitions of what constitutes success. The accounts of each of the Designers refer only to objective success indicators. However, the User Researchers and UX Architects discuss both objective success indicators which are associated with the product and a positive team working experience, and subjective success indicators which are associated with personal efficacy. Although the Designer expresses pride in their HCI outputs, it appears that the User Researcher and the UX Architect additionally experience a great deal of personal satisfaction in their roles mentioning their personal achievement and growth as a professional.

6.4.2.1.4 What is valued in education and practice

As discussed in section 6.4.2.1.3 above, incongruences were noted between the roles of the Educator and those involved in practice, and these were also evident when discussing academic practice. Within education, the curriculum is delivered by both specialists, that is Educators, and non-specialists, that is ‘Both’. Some notable differences were observed in the responses of these two groups of professional.

In terms of curriculum delivery, the Educators report that their HCI curriculum includes cognitive psychology, interaction design, and evaluation techniques, but the most apparent difference between the Educators’ curriculum and that of ‘Both’ is the lack of commercial application; for example, those who are involved in both practice and education include agile methodologies within their HCI curriculum. Whilst those who specialise in education are doubtless familiar with agile practice, it was not mentioned when discussing HCI curriculum delivery. Similarly, whilst ‘Both’ place significant emphasis on tools and techniques that support practice, reference to these problem solving approaches is not so apparent in the accounts of the Educators.

That is not to say that the Educators do not recognise the value of an authentic learning experience. For both the Educators and ‘Both’, the use of real life clients is recognised as good practice and wherever possible is embedded into the course delivery so that students are prepared for uncertainties of the real world. What is lacking is the practical application of HCI methods reflecting the real world problem solving activities of practice. This is hardly surprising as the career path of the specialist Educator suggests that they are unlikely to have had exposure to these tools and techniques, and as discussed above in section 5.6.2, the tools and techniques that are adopted by practitioners may not have been originally designed to support HCI activities. As a result, the Educator may well signpost personas or software such as Axure to support the problem solving process, but they may not think to include tools such as Excel or GoToMeeting.

This is clearly an example of an incongruent technological frame and this incongruence may go some way to explaining the mismatch between what is valued in education and what is valued in practice.

6.4.3 Concerns and issues

Educator issues were for the main part common to academia rather than specific to the field of HCI, and the Practitioners mentioned a number of issues, many of which would apply to any industry, and these are not explored in this thesis. The issues most relevant to this discussion are the tension between practice and research the lack of a dominant technological frame which manifests itself in the lack of consensus regarding terminology and methods, and which is seen as being particularly damaging to the profession (see section 5.7.1 on page 223).

These two topics are discussed in some depth below.

6.4.3.1 The relevance of academic research

The lack of a dominant design noted in the section above is particularly apparent in the criticisms raised by the Practitioners that current academic research bears little relationship to practice, and that the direction that the research is taking places too much emphasis on computer science.

Kaplan and Tripsas (2008) discuss three key sets of actors, the producer of technology, the user of technology and the institutional actor. The Practitioner and the Educator have already been discussed above in the context of producers and users of technology (see section 6.2). The institutional actor includes stakeholders such as government bodies, user groups, standards bodies, and other organisations with influence or regulatory power, and these bodies are likely to influence the production of technology. They will include commercial organisations such as Google, Facebook and Microsoft who conduct academic research alongside research and development and other commercial activity, government agencies such as the UK's Engineering and Physical Sciences Research Council [14](EPSRC), and special interest groups such as the Association of Computer Machinery (ACM) Special Interest Group on Computer Human Interaction (SIGCHI) which sponsors the CHI conference, and the User Experience Professionals' Association (UXPA).

Kaplan and Tripsas suggest that the institutions can provide an arena for producers, users and other institutions to come to a common understanding and to thereby stabilise divergent frames, and whilst events such as the CHI and UXPA conferences go some way to meeting the 'focused set of institutional arenas' (2008, p. 796), the gap between the academic and the practitioner research is still wide. This gap is nothing new, and does not solely apply to HCI research in novel technologies. For example, Gulliksen (2004) discusses the variance between the

[14] https://www.epsrc.ac.uk/

long established research participatory design methods and its lack of adoption into practice.

It seems that the pragmatic desires of the practitioner are still not being addressed by the researchers who are seen as out of touch. This raises the question, who should drive the change, the practitioner or the academic/researcher? Clearly, as with any other field, practice should be informed by research. However, the research also needs to be seen by the practitioner as being relevant, and this was not always seen to be the case by the interview respondents who criticise academic research as being out of touch with the reality experienced by practice.

One reason for this might be quite simply that the researcher is attracted to novel technologies because the technology in the ‘era of ferment’ is more exciting than current practice. Another reason may be that the slow pace with which research progresses is at variance with the speed of technological advances. If a researcher were to focus on established technology, that is ‘convergence on a dominant design’ (Kaplan & Tripsas, 2008), by the time a research paper was published in a journal, the technology may have progressed in a different direction. Equally, researchers who focus on emerging technologies which characterise the ‘era of ferment’ lay themselves open to the accusation that their research lacks relevance to practice should they become a victim of the ‘era of ferment’ and choose a technology that is subsequently superseded.

Some of the responsibility for these divergent technological frames may lie with the institutional actors themselves, and it may be that they are partially responsible for the conflict within the field of HCI. For example, some of the institutional actors who fund the research are commercial competitors with competing technology. As an example, both Samsung and Apple fund research into emerging technologies, but each will have a vested interest in promoting technologies that are compatible with their own operating systems (Android and iOS respectively), and their own strategic plans. In this particular instance, two different technological frames have emerged with one subset of producers, users and institutional actors championing the Android operating system, and the other championing iOS, each. It is difficult at this moment in time to imagine which of the two will emerge to become the dominant design, but it is likely that as Kaplan and Tripsas predict, should one design become dominant, small peripheral groups which champion the alternative technology will persist (Kaplan & Tripsas, 2008).

6.4.3.2 The lack of consensus regarding terminology and methods

As described in section 5.7.1, the most significant concerns of the Practitioner are associated with the relative newness of the field and the speed with which it is developing. This has manifested itself in the lack of a clear identity with no common vocabulary, or standardised processes.

Above in section 2.6.2 this thesis discusses the discipline of HCI in the context of the technology life cycle (Kaplan & Tripsas, 2008). Their application of a cognitive lens to explain changes in technology that cannot be predicted by economic or organisational factors is particularly pertinent to this discussion as the discipline of HCI is relatively young and whilst there is no physical artefact, the state of the industry in relation to the processes and terminology bears some resemblance to the ‘era of ferment’, with variation in practice both amongst practitioners, and variations between what practice and education value. The ambiguity and lack of agreement regarding the terminology has resulted in the lack of a common vocabulary, and the variety of tools and techniques currently used reflect both the diversity of practice, and the adaptive nature of a fast moving field. In the words of Kaplan and Tripsas (2008, p. 796) “actors must make sense of the new technologies, yet technological frames in the new domain are still being created”.

The phase following the ‘era of ferment’ is described as ‘convergence on a dominant design’ – during this phase, the producers often adopt the role of ‘sense makers’ of the technology, and in the process of endorsing the dominant design, thereby consolidating the position of the dominant technical frames. However, prior to the adoption of a dominant design – in the case of this thesis, accepted tools and techniques and a common vocabulary – conflicting frames need to be resolved, and the differing roles and job titles that proliferate within practice, as well as the variety of tools and techniques that are employed indicate that this stage has not yet been reached.

6.4.4 Conclusion: RQ2

A number of key points that emerge from the discussion of RQ2. Firstly, the background of the HCI professional is increasingly diverse and for many it is not the first career choice. More interestingly, differences were again noted between the specialist Educator and the non-specialist ‘Both’ with the curriculum of the latter exhibiting far more commercial application, and between the Designer and other roles of Practitioner in the scope of the role, which is restricted to early in the project lifecycle and appears to be more insular than the other roles.

One key point to emerge from the discussion of what is valued is that delivery of HCI skills would naturally satisfy the requirement to deliver employability skills without the need for a stand-alone module, resulting in a more efficient curriculum, and two more differences emerged regarding the profile of the Educator have emerged: their success indicators differ from most of the other roles, and the Intuitive Educator is comfortable taking an analytical approach when required, but the same cannot be said for the Intuitive Practitioner. This again suggests more research into the profile of the academic, this time to probe whether the Intuitive Educator in a field dominated by the analytical differs from an Intuitive Educator in a field dominated by intuitivists.

The key issues considered were the lack of a dominant frame which was discussed in the context of the technology life cycle, and the gap between research and practice which concluded that institutional actors also have a role to play in resolving these issues.

6.5 RQ3: What are the implications for the curriculum?

The final research question considers the implication for the curriculum in respect of all of the above with particular reference to implications for curriculum design, curriculum delivery and course recruitment.

Both the quantitative survey data and the qualitative interview data indicated differences in the profile of the specialist Educator and the 'Both' group, with the cognitive styles tests indicating differences in the cognitive profile, and the interview data indicating incongruent technological frames which were particularly apparent when considering curriculum emphasis. The interview data also indicated differences between the role of between the Designer and the other roles of Practitioner. The implication of these differences is discussed below.

6.5.1 Implications for curriculum design

The variance in the technological frames of the Educator and Both when considering the curriculum focus may suggest that the HCI curriculum does not fully meet the needs of practice. There are a number of reasons why this could be the case and these are explored in more detail below.

One reason may be that HCI is rarely the primary focus of the course: as discussed above, HCI modules often form part of a larger programme of study, for example, computer science, and as such HCI is not the major consideration when validating a programme of study. However, if HCI education is to meet the requirements of HCI practice, then HCI employers need to play an active part earlier in the curriculum design process of the parent course. In other words, academic course designers need to consider the HCI employer as one of the beneficiaries of their product (the course), and just as it is good practice to involve the end user from the very start and throughout the lifecycle of a software development project, so the HCI employer needs to be considered from the earliest stages of design and development of the curriculum, and throughout the lifetime of the course. In the words of Gulliksen et al., *“usability professionals need to get a seat at the decision making table”* (2006, p. 586).

It is already standard practice in the UK to involve employers throughout the design, development and approval of new programmes[15], and most universities will have an employer advisory panel which provides advice on programme design and delivery. It is more likely that the needs of HCI practice would be met if one of the advisors were to represent HCI interests. Of course, if the course does not have HCI as its central focus, then it is unlikely that the academic advisor will be an HCI specialist. If, however, close links already exist between HCI practitioners and the institution then it may be that this practitioner can influence the curriculum design process.

Possibly those with the role of ‘Both’ would add most value to an advisory board. The interviews reflected a sense of frustration amongst those who both practice and educate, perhaps reflecting the divergence between practice and the curriculum, and the constraints of the education system. This group were the most critical of academia, and are the best placed to view the perspectives of both education and practice. As such, they may be better positioned to advise on curriculum design than the specialist practitioner, and to guide changes to the curriculum which would benefit both education and practice.

Another reason why the HCI curriculum may not fully meet the needs of practice may be that the course designers do not see HCI as adding value to a course that does

[15] http://www.qaa.ac.uk/publications/information-and-guidance/uk-quality-code-for-higher-education-chapter-b1-programme-design-development-and-approval#.WbfYS7KGPb0

not have HCI as its primary focus, for example, a computer science course. In this instance, HCI will be competing with other computing subjects for representation within the curriculum. It follows then that if HCI is to enjoy a greater presence in the wider curriculum, it needs to appear both attractive and relevant to those responsible for curriculum design, particularly if the course designers are not HCI champions.

Whilst the value of topics such as cognitive psychology is not disputed, there may be an advantage in according HCI skills more prominence in the curriculum in order to make the courses more relevant to practice and produce graduates who are better prepared for employment in the field of HCI. Whilst course designers who are not HCI champions are unlikely to be swayed by this argument, what may attract them is that delivering HCI skills alongside the theory would address the employability skills that need to be embedded within the curriculum without the necessity of having a standalone module, thereby saving on teaching resources (See section 6.4.2.1.1on page 256). Quite simply, in order to make the subject of HCI more attractive to course designers who are not HCI specialists, the subject needs to be viewed as adding value. As the skills required in HCI practice are broadly equivalent to the employability skills that are considered when developing a course, this could be an opportunity to highlight the value of including HCI within the curriculum as the institution would be delivering a single module that simultaneously evidences both employability and subject specific skills.

It may be that this requires a shift in the mind-set of the HCI course designer. For example, it is common practice to include computing skills such as SQL, Java, and the use of GitHub alongside theory in the computer science curriculum, and it may be that we need to consider HCI skills in the same way and include both skills and methods alongside the HCI theory. This would require close collaboration with those in practice to determine which skills or methods should be included; for example, a local employer may have a specific software suite that they use extensively, or a preferred methodology. Providing that use of the skills and methods are closely mapped to HCI theory this should not dilute the academic value of the module but will have the advantage of adding additional skills to the CV of the student who often does not see the relevance of generic employability modules. These activities will be more relevant even for students who are not considering a career in HCI as they will evidence transferable skills such as communication, teamwork and problem solving; these can be referenced in a job application, hence increasing the employment prospects of all students.

6.5.2 Implications for curriculum delivery

As discussed above, differences were noted in the curriculum delivery of the specialist Educator and those who both practice and educate. The curriculum as delivered by ‘Both’ with its commercial focus and problem solving approach appears to be more relevant to practice than the curriculum as delivered by Educators. This suggests that the HCI curriculum would benefit from more delivery by those with experience in practice, and it follows from this that the Educator would benefit from exposure to practice. However, it seems that Practitioners are more likely to move into academia than Educators are to move into practice.

The lack of mobility of the Educator into practice may be explained by the design of the curriculum, where very often an HCI module is delivered as part of a computer science or a design course. HCI is normally covered by a small number of modules within the larger programme, and very often the modules are optional. It may be that the Educator who delivers the curriculum is a specialist in the academic field of computer science or design with an interest in the specialist area of HCI rather than an HCI specialist who has found employment in the faculty, and whilst the Educator would be well equipped to deliver the curriculum, they are less likely to have practical hands on experience of working with clients and end users within an academic environment.

In contrast, it may be easier for the Practitioner to move into education as they have acquired a set of transferrable skills in the field which potentially equip them for educating, and whilst they may initially be unfamiliar with the underpinning theory, they are immediately able to use context specific examples of theoretical application in order to deliver the curriculum.

The lack of exposure to practice manifests itself in the difference in curriculum emphasis. One of the key differences between the curriculum of the Educator and 'Both' was the lack of commercial application applied by the specialist Educators. This may be a reflection of the current literature upon which the Educators draw, or on the importance that the Educators assign to the psychological element of the theory. However, the fact that those with the status of 'Both' emphasise the commercial application suggests that it may be this may be a weakness in the curriculum delivery that needs to be addressed. If the links with practice advocated in section 6.5.1 are indeed present for the lifetime of the course, this would go some way to addressing this weakness.

Whilst it may not always be possible for the Educator to gain experience in the field, there was evidence of attempts to address this gap between practice and academia. For example, wherever possible students are provided with a real life client for assignments and guest speakers from industry provide an alternative perspective of the discipline. Closer links with industry as discussed in the previous section may also go some way to addressing this issue.

Not all academics can be practitioners but that is not to say that commercial awareness cannot be introduced into the curriculum. This sample of Educators is small and it would be unwise to generalise the issues presented. However, in this sample, it appears that agile methods are not given sufficient prominence within the HCI curriculum, and it was not clear from the interview data to what extent the underpinning theory of cognitive psychology is combined with practical application.

That is not to say that the responsibility for these shortcomings lie solely with academia. If the requirements of practice are not being satisfied, then practice also has a responsibility to communicate those concerns, and to involve themselves more in both education and research. A possible approach to address these issues would be for the specialist Educator to work with 'Both' in order to identify areas where the HCI theory can be more closely mapped to current practice. This approach would, however, require support from both practice and educational institutional senior management or it would be unlikely to succeed due to the financial burden of such an initiative. A successful partnership would have the benefit of providing internships, work experience and guest speakers, and would also develop local links between practice and educational institutions.

6.5.3 Implications for course recruitment

The differences in the role of Practitioner were most notable when comparing the profile of the Designer with other roles, and whilst this has implications for practice which are outside the scope of this thesis, there are also implications for course recruitment. Previous research by the University of West London's Sociotechnical Centre for Innovation and User Experience into the cognitive profile of HCI students has identified differences between HCI design students and HCI engineering students who study at institutions with an entrance examination (Abdelnour-Nocera, Austin, Modi, & Oyugi, 2013). As differences have been noted in both design students and design practitioners, this may suggest that differences between the Designers and the other roles are inherent.

If it is accepted that there are differences in the profile of the Designer and other Practitioner roles, then it is not unreasonable to suppose that the prospective Designer will also differ from other prospective roles of Practitioner. This is particularly pertinent when recruiting students for a programme of study that does not filter students with an entrance exam, particularly where there may be a number of HCI options, and where there are pathways or options which may be design oriented. In these circumstances it may be beneficial to counsel or to profile the student in order to offer sound academic advice before selecting areas of specialism.

6.5.4 Conclusion: RQ3

A number of key points emerged from the discussion of RQ3. It is vital that there is input from HCI practice during the design and development of new courses in order to ensure their relevance and currency, but also that this continues throughout the lifetime of the course delivery to ensure the currency of the curriculum. This may involve improving links with industry, and in particular those who are already involved in both education and practice. In terms of the curriculum content, it may be that course designers would be more open to including HCI content if they were made aware of the graduate attributes that are addressed alongside delivery of the HCI content. Secondly, as it is important that those responsible for course admissions are aware of the difference between the Designer and the other roles so that appropriate academic advice can be offered when recruiting students to courses.

This chapter has discussed the differences in the profiles of the HCI professional, and the implication of these differences to the HCI curriculum. The next chapter will consider the contribution to knowledge of this study, areas for further research, and the limitations of this study.

7 Conclusion

The previous chapter discussed the findings in the context of the research questions. This chapter concludes the thesis by providing a brief review of the initial aims of the study, the contribution to knowledge, the limitations of this study and areas that merit further research.

7.1 Review of the aims of this study

The stated aim of this research was to provide a better understanding of HCI professionals by examining the different roles in order to identify the differences between them and the potential impact of these differences on curriculum design and delivery. Whilst there have been many studies which focus on education or practice, there has been little research to identify differences in the profile of professional in terms of cognitive preferences, what is valued, and their concerns and issues. This study set out to address this gap in order to provide a better understanding of the different profiles of the HCI professional. The following research questions were formulated and used as a basis to structure the analysis of the data and discussion of the findings:

- RQ1: What are the differences in the cognitive profile of the HCI Practitioner, the HCI Educator and the general population?

- RQ2: Does the profile of the HCI professional vary from role to role in respect of their background, what is valued, and their concerns and issues?

- RQ3: What are the implications for the HCI curriculum?

RQ1 examined the differences between Practitioners, Educators, and those who both practice and educate ('Both'), and revealed a number of cognitive differences between the professionals and the general population. It has emerged that for all roles apart from female Practitioners, the profile of the HCI professionals differs from the profile of the general population in their Visual Spatial ability, their Intuitive/Analytical profile and the association of age and intuition. Some gender differences were also observed between the profiles of the Professional, particularly when considering intuition. Differences were also noted between the specialist Educator and other roles of professional, and these differences were confirmed when considering RQ2.

The roles of professional that were considered for RQ2 were Designer, User Researcher, UX Architect and Educator, together with those who are involved with both practice and education ('Both'). Although there was much consensus, some differences were noted between the specialist Educators and 'Both'. These were particularly apparent in what is valued by the Educator and what is valued by those who both educate and practice, with the curriculum of 'Both' showing far more commercial application. Differences were also noted between the role of Designer and the other roles of Practitioner, with the Designer role being perceived to be more restricted in scope than the other roles.

The implications for the curriculum, addressed by RQ3, emerged as a result of the discussion of the first two research questions, and in particular, discussion of what is valued and the concerns and issues of the professionals. The differences evidenced between the Educator and 'Both' suggest that a closer relationship between practice and academia would be beneficial when designing and delivering the HCI curriculum in order to ensure that the needs of practice are satisfied. There was, however, consensus when discussing desirable qualities for an HCI professional. These included communication skills, team working, problem solving and creative thinking skills, and the ability to adopt a flexible and open approach, qualities which are very similar to the required graduate attributes for all disciplines. It was suggested that course designers may be more open to including HCI content if they were made aware that the graduate attributes could be addressed alongside delivery of the HCI content. Finally, it was suggested that the differences noted between the Designer role and the other role of professionals may extend to differences amongst students, and that appropriate guidance should be offered to applicants who are considering areas of specialism.

These findings are particularly pertinent when considering the second part of the aims stated at the very start of Chapter 1 which assert that a better understanding of the differences in the profiles of the HCI professional will serve to support the educational experience of the students and to strengthen the HCI curriculum. The assumption is that an awareness and understanding of the differences between the profile and what is valued by the Educator and the profile and what is valued by the Practitioner will achieve the balance between what practice requires and what academia requires when considering curriculum design and delivery. This thesis has highlighted some of the differences between the various roles.

7.2 Contribution to knowledge

The contribution to knowledge of this study is two-fold. The primary contribution has been to provide an alternative perspective of HCI Education, complementing previous work in this area. However, this study also extends the application of technological frames of reference to include perceptions of practice. Both elements are discussed in more detail below.

7.2.1 Contribution to the study of HCI education

This study complements previous studies into HCI Education such as the SIGCHI Education project (Churchill et al., 2015) by adding additional dimensions to their findings and provides a threefold contribution to knowledge.

Firstly, and most importantly, this study provides the additional perspective of those who are involved in both education and practice. Although Churchill and colleagues surveyed students as well as practitioners and educators, they did not incorporate the role of 'Both' in their findings. As discussed above, the difference between those who both educate and practice and those who specialise in education has been central to the discussion.

Secondly, whilst there is some overlap in the areas of investigation, and some commonality in the findings, this thesis also differs from the SIGCHI project in that its emphasis is on the different profiles of the HCI professional rather than on the position of HCI Education and the requirements of the curriculum, thereby providing a fuller picture of the HCI Education landscape. This study includes the concept of cognitive differences and identifies differences between the profile of the HCI professional and the general population, and also differences between the roles of the HCI professional.

Thirdly, the emphasis on Practitioners differs in this study. Churchill et al.’s (2015) interviews were with hiring managers and they concentrate on five large companies. In contrast, the majority of the Practitioners in this sample are from small to medium sized enterprises and a range of roles is represented, thereby providing an alternative view of the HCI commercial landscape.

Additionally, the present study both confirms and extends the previous findings of HCI Education and Culture project led by the University of West London’s Sociotechnical Centre for Innovation and User Experience. That project explored cultural differences and the cognitive styles of students at universities in the UK, India, Namibia, Mexico and China, observing a relationship between predominant cognitive styles and student performance in HCI relevant tasks (e.g. Abdelnour-Nocera et al., 2013). That study noted particular differences between HCI students on design courses and HCI students on engineering courses, and this study highlights additional differences between the Designer and other roles.

7.2.2 Contribution to the study of technological frames of reference

Previous studies have adopted the concept of technological frames to explain attitudes towards IT such as user acceptance, usability and usefulness of systems (Abdelnour-Nocera et al., 2007; Karsten & Laine, 2007; Shaw et al., 1997) or the integration of IT systems (Davidson, 2002, 2006; Lin & Silva, 2005; Olesen, 2014;

Orlikowski & Gash, 1994). This study, in contrast, has adapted the framework to consider instead the socially constructed interpretation of practice by probing the implicit understanding, the assumptions and the expectations of professionals, and then by positioning practice within the context of the technology lifecycle (Kaplan & Tripsas, 2008).

In the case of this particular study, the revised framework has been applied to HCI practice and HCI professionals, and identification of the shared and incongruent frames has resulted in the conclusion that the current state of HCI practice resembles the 'era of ferment'. The framework is sufficiently adaptable, however, that it could equally be applied to other domains and may provide value within an organisational setting. For example, the identification of divergent or incongruent frames would be beneficial when managing organisational change, both at the start of the process when it could inform the strategy, and during the latter stages of a project to determine the success of the initiative.

7.3 Limitations of the research

There are a number of acknowledged limitations to this research which relate to the survey, the interviews, and the research method adopted.

7.3.1 Limitations of the survey

The survey included the two cognitive style instruments as well as the demographic data, and in view of this, a deliberate decision was made to restrict the amount of additional data collected in order to avoid cognitive fatigue. With hindsight, however, the survey design could have been improved with additional fields to capture fuller detail of the professional roles. As discussed in section 3.4.2.2, it was difficult to analyse and quantify the job roles, and to distinguish between roles such as UX designer and interaction designer, and the survey would have benefitted from a complementary selection list to capture this information.

Similarly, the role of ‘Both’ could have been more clearly defined. Those who categorised themselves as Educators are for the main part employed as a lecturer or as a researcher. However, whilst the majority of those who categorise themselves as ‘Both’ teach in an academic institution, it is clear from the responses of the questionnaire that education is taken in its broadest sense by those in practice, and it includes mentoring and in-house training as well as having a formal lecturing position in an educational establishment. These findings were borne out by the interviews when the respondents provided detail of their practice, and the interviewee role classification was accordingly extended to also include training and mentoring.

Likewise, it would have resulted in a richer profile of the Educator had Faculty data been requested. The data revealed that those who categorised themselves as purely Educator tend to be employed in an academic setting. Some respondents did offer information regarding the Faculty in which they sit and it appears that many teach on computer science, psychology or design courses which was confirmed by the interview data. However, this information was not specifically requested, so it was not possible to draw any firm conclusions from this data.

Finally, although there were 301 records retained for analysis, the sample size of the Educators was small, and as a result any findings relating to gender differences need to be treated with caution.

7.3.2 Limitations of the interviews

Although twenty two interviews were conducted, again this was a relatively small sample size and some roles were under represented. This was particularly apparent for the roles of Designer (n=3) and the Software Developer (n=1).

Access to the interviewees was constrained by geography, and whilst it was possible to conduct some interviews face to face, the majority were conducted by means of video interview, or if the network connection was poor, a telephone interview. In the latter cases, it was not possible to benefit from non-verbal communication such as body language.

Whilst every care was taken in both the transcription and in listening to the audio, it is noted that English is not the first language for some respondents, and it may be that not all questions were fully understood. There is also the possibility that some interviewees may have responded to present themselves in the best light rather than responding honestly which may have misrepresented the accounts of practice.

7.3.3 Limitations of the research method

A mixed methods approach was adopted for this study, and this resulted in a large amount of qualitative data that was analysed using the template analysis approach.

Ideally a team of researchers would code the interview data in order to validate the template and to minimise the effect of bias. However, this was a solo project and resources were not available to support this process. Although every attempt was made to validate the codes and the resulting template by means of review and discussion during supervisor meetings, the final coding template has originated from one single researcher rather than a team, and as a result will have been constrained by my own subjective experience.

The bias of the researcher is also acknowledged at this point. It was important to remain neutral when conducting the interviews and to be consciously objective when analysing the results. However, some bias is inevitable: for example, what constitutes good practice is particularly subjective, and as an educator who has never been in practice, my interpretation may differ from a researcher who has also practiced.

7.4 Areas for further study

Although this study has contributed towards a better understanding of the HCI professional and the field of HCI, two areas were identified that would further enhance our understanding. Specifically, these include further research into the profile of teaching academics, and further research into the profile of computing and engineering students.

7.4.1 Research into the profile of teaching academics

Although some findings were inconclusive, some interesting trends were noted during the course of this study regarding both gender and intuition, and these were particularly apparent when considering the role of Educator. However, the sample size of Educators in this study is somewhat constrained by size and the fact that it includes only HCI Educators. Therefore, it would be interesting to investigate the profiles of teaching academics covering a wider range of subject specialisms and to explore both gender differences and differences in their intuitive/analytical preferences.

It is also noted that in this study there has been fairly even representation between the genders for all roles suggesting that there is not a gender imbalance within the community of HCI professionals. However, this is not the case when considering the environment in which HCI professionals perform their role, that is, the field of computing. Computing is a male dominated industry with women making up only 17% of the workforce (Diversity UK, 2016) and in 2015-16 making up only 18% of the full time engineering and technology academic workforce (HESA, 2017), but it would appear that more females are attracted to the field of HCI.

In terms of their intuitive/analytical preferences, all interviewees were able to adopt either an analytical or an intuitive approach depending on the needs of the task in hand. However, this came easiest to those with an Intuitive profile who were involved in education. The majority of these are members of a computing faculty, a field which typically demands an analytical skillset. This again suggests research into the profile of the academic to probe whether the Intuitive Educator in a field dominated by the analytical differs from an Intuitive Educator in a field dominated by intuitivists, for example, an academic in the field of humanities.

A more extensive study which probes both gender differences and differences in intuitive/analytical preferences between HCI lecturers, computer science lecturers and lecturers from other disciplines may go some way to extending the profile of the HCI Educator presented in this study.

7.4.2 Research into the profile of computing and engineering students

Following on from the suggestion above, it also may be fruitful to better understand the profile of students who enrol onto computing and engineering courses. In section 5.4 there was discussion regarding the stereotypical depiction of Developers and Engineers as ‘nerds’. However, as technology is far more accessible that it was in the early days of computing, it may that that this view is outdated and students now entering the field of computing and engineering have a different profile than in previous years. If this is the case, then it may be that recruitment process for such programmes should be reviewed in order to offer appropriate academic advice.

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9 Appendix

9.1 Final template and mapping of research questions

Final Template	Background	Values and priorities	Concerns and Issues
1 HCI			
1.1 Definition			
1.1.1 What is HCI	x		
1.1.2 Human factors	x		
1.1.2 What is UX	x		
1.2 Perception of the discipline	x		x
2 The Curriculum			
2.1 Curriculum emphasis	x	x	
2.2 Teaching resources		x	x
2.3 Delivering the curriculum	x	x	x
2.4 Good practice			
2.4.1 Real projects for students		x	
2.4.2 Application to practice		x	
2.5 Problem areas			
2.5.1 Student perspective of issues			x
2.5.2 Staffing			x
2.5.3 Constraints of the education system			x
2.5.4 Interdisciplinary issues			x
2.5.5 Problems of delivering the curriculum			x
2.5.6 Students leaving without skills			x
2.5.7 Practice v academia			x
3 Practice			
3.1 Tools and methods			
3.1.1 Tools and methods used		x	
3.1.2 Tools can be adapted		x	
3.1.3 Pick the right tool for the job		x	
3.1.4 Technology to support the method		x	
3.1.5 Agile and lean		x	
3.2 The face of success		x	
3.3 Skills			
3.3.1 Communication		x	
3.3.2 Flexible open approach		x	
3.3.3 Problem Solving		x	
3.3.4 Creative thinking		x	

Final Template	Background	Values and priorities	Concerns and Issues
3.4 Good Practice			
3.4.1 Rigour and a disciplined approach			
3.4.1.1 Following process		x	
3.4.1.2 Establishing requirements		x	
3.4.1.3 Iterations		x	
3.4.1.4 Testing		x	
3.4.1.5 Information architecture		x	
3.4.1.6 Risk assessment		x	
3.4.2 Being reactive		x	
3.4.3 Active participation of users			
3.4.3.1 Mental models		x	
3.4.3.2 Managing expectations		x	
3.4.3.3 The user as a consumer		x	
3.4.3.4 Involving the user		x	
3.5 Practice issues			
3.5.1 Financial considerations			x
3.5.2 Cultural issues			x
3.5.3 Lack of communication			x
3.5.4 Application of theory to practice	x		x
3.5.5 HCI as an emergent field			
3.5.5.1 Lack of a clear identity	x		x
3.5.5.2 Lack of common terminology	x		x
3.5.5.3 Lack of set procedures	x		x
3.5.5.4 Changing face of technology			x
3.5.5.5 Plethora of roles and titles	x		x
3.5.5.6 Demand for skilled professionals ou	x		x
4 Working with others			
4.1 Subject matter experts		x	
4.2 Collaboration			
4.2.1 + Collaboration		x	
4.2.2 - Collaboration			x
4.2.3 Multidisciplinary		x	
4.3 Mentoring		x	
5 Attributes			
5.1 Analytical	x		
5.2 Intuitive	x		
5.3 Visual object	x		
5.4 Visual spatial	x		
5.5 Verbaliser	x		
5.6 Gender awareness	x		

Final Template	Background	Values and priorities	Concerns and Issues
5.7 Attitudes			
5.7.1 Passion	x	x	
5.7.2 Frustration	x		x
5.7.3 Enthusiasm	x	x	
5.8 Overriding natural preferences	x	x	
6 Tensions and concerns			
6.1 Development v design			x
6.2 Practice v client desire			x
6.3 Outdated technology and tools			x
6.4 Time, work and budget			x
6.5 Contractor v Employee			x
6.6 Practice v Academic research			x
6.7 Internal politics			x
6.8 External politics			x
7 Perceptions of...			
7.1 Academics	x		
7.1.1 View of academics	x		
7.1.2 Out of touch			x
7.1.3 Govenerned by research interests		x	x
7.2 Practitioners	x		
7.2.1 Designers	x		
7.2.2 Programmers	x		
7.2.3 Researchers	x		
7.2.4 Engineers	x		
7.3 Students	x		
7.3.1 Academic view of students	x		
7.3.2 Practice view of students	x		
7.3.3 Not valued by students			x
7.3.4 Valued by students		x	
7.3.5 Diversity of student body	x		
7.3.6 Student weakness			x
7.3.7 Student growth and development		x	
7.4 HCI and disciplines			
7.4.1 HCI and design	x		
7.4.2 HCI and marketing	x		
7.4.3 HCI and computer science	x		
7.4.4 HCI and business	x		
7.4.6 HCI and psychology	x		
7.4.7 HCI and engineering	x		

Final Template	Background	Values and priorities	Concerns and Issues
7.5 Research			
7.5.1 Scientific approach		x	
7.5.2 Relevance to practice			x
7.5.3 Dissemination		x	
7.5.4 Data and results		x	
7.6 Client	x		
8 Valued or not valued			
8.3 Valued by academia		x	
8.4 Not valued by academia			x
8.5 Valued by practice		x	
8.6 Not valued by practice			x
9 Career			
9.1 Job prospects	x		
9.2 Education			
9.2.1 Formal Education	x	x	
9.2.2 On the job learning	x	x	
9.2.3 CPD	x	x	
9.3 Lack of visibility of the field			x
9.4 Routes into the field	x		
9.5 Role distinctions	x		
9.6 Value of experience	x	x	

9.2 Interview questions

9.2.1 Educator questions:

Initial chat, pleasantries, check still okay to be interviewed, check they have sufficient free time now, etc.

Background information

1. What is your name?
2. The date today is xxx . Can I just confirm that you happy for this interview to be recorded?
3. What is your teaching job title?
4. What is the highest level educational qualification?
5. What was degree subject did you study?
6. Did you study HCI at university or on a commercial training course?
7. Can you tell me about your current role as an educator?
8. How did you get into this field of work?
9. How long have you been teaching HCI
10. How many years of HCI (or ID, or UX) experience do you have in total?
11. What does the term HCI actually mean to you?
12. What about UX?

A bit about your teaching

13. What sort of course and levels are you teaching HCI at?
14. Are HCI/UID core or optional subjects?
15. Which courses are HCI/UID available on?
16. How is HCI perceived in your institution in relation to other subjects such as software development/programming? Less important or more important? Explain your answer
17. When you teach HCI, which topics are prioritised?
18. Can you tell me about the balance between the theory and the practical hands on experience?

19. What changes would you like to implement in the delivery of HCI in your courses?
20. Why are HCI subjects taught in your institution?
21. Do you influence curriculum design?
22. Which are the recommended texts?

Tools and techniques

I'm going to list some different methods and techniques that are used within the industry. Can you tell me which you teach?

a) Focus groups
b) Observations
c) Interviews
d) Participatory design
e) Remote usability testing
f) Eye tracking – taught
g) Low fidelity prototyping
    - Paper?
h) Wireframing
i) Personas
j) Scenarios
k) Card sorting
l) Discount usability
    - Heuristic evaluation?
    - Walkthroughs
m) Wizard of Oz?
n) Mental models
o) Model based evaluation
    - Task network models
    - Cognitive architecture models
    - GOMS

23. What do the students think about the value of HCI?
24. Which of the subjects that you teach do think are particularly relevant to current practice?

25. Can you describe to me the topic that you most enjoy teaching? How do you deliver it? Why do you find it so satisfactory?
26. Which topic do you least like teaching?
27. Which topic do the students most enjoy?
28. Which topic do they find most useful?
29. Which topics do they really not see the point of?
30. Which s\w packages or h\w tools do you expect the students to use?

31. Can you think of a successful student HCI project. What is it that makes an HCI project a success?
32. Can you think of a HCI project that did not go well?

    a) What were the major problems?
    b) What do you think caused the problems?
    c) How could the problems have been corrected or avoided?
    d) If that didn't happen, why do you think it didn't happen?

33. If you were to produce a student persona, what would it look like?

34. Have you taught in more than one country?
    a) Which ones?
    b) What differences have you noticed in either the tools/techniques or the approaches

35. If you could change anything in the way you do your work, what would that be and why?

Your cognitive profile

OSIVQ

For comparison

	Scientists and engineers	Visual artists	Linguists and historians	General population
Visual-object ability	3.28	4.14	3.28	3.59
Visual-spatial ability	3.28	2.84	2.81	2.93
Verbal ability	2.81	2.69	3.48	2.90

- **Visual Object xxx**
- **Visual Spatial xxx**
- **Verbal ability xxx**

36. Do these results surprise you in any way?

CSI xxx

37. Do these results surprise you in any way?
38. Tell me about some of the times when you have to take a more analytical approach in your work? Which analytical tools do you use?
39. What about times when you have to be more intuitive or 'see the whole picture'
40. Which do you feel more comfortable with?

Thank you for your time

9.2.2 Practitioner questions:

Initial chat, pleasantries, check still okay to be interviewed, check they have sufficient free time now, etc.

Background information

Q1: What is your name?

Q2: The date today is xxx. Can I just confirm that you happy for this interview to be recorded?

Q3: What is your job title?

Q4: What is the highest level educational qualification?

Q5: How did you get into this field of work?

Q6: How long have you been working in this particular position?

Q7: How many years of HCI (or ID, or UX) experience do you have?

A bit about your role in the field

Q8: What does the term HCI actually mean to you?

Q9: What about UX?

Q10: Not applicable

Q11: Did you study this subject at university?

Q12: What was the title of your course?

Q13: Any commercial training courses?

How is it different?

Areas of practice

Q14: I’m going to list some different methods and techniques that are used within the industry. Can you tell me which you have formally studied, and which you ones you use in practice (just yes/no responses at this stage)?

a) Focus groups – studied? – used in practice?
b) Observations – studied? – used in practice?
c) Interviews – studied? – used in practice?
d) Participatory design – studied? – used in practice?
e) Remote usability testing – studied? – used in practice?
f) Eye tracking – studied? – used in practice?
g) Low fidelity prototyping – studied? – used in practice?
    - Paper?
h) Wireframing – studied? – used in practice?
i) Personas – studied? – used in practice?
j) scenarios
k) Card sorting – studied? – used in practice?
l) Discount usability – studied? – used in practice?
    - Heuristic evaluation?
m) Mental models – studied? – used in practice?
n) Model based evaluation – studied? – used in practice?
    - Task network models
    - Cognitive architecture models
    - GOMS

Q15: Thinking back, which parts of any training or formal education did you find particularly useful in preparing you for your current role?

Your current practice

Q16: How do you elicit requirements?

Q17: Which tools do you use?

Q18: Which tools do you prefer (and why?)

Q19: Which tools do you adapt (and how)?

Q20: Which tools don’t you use that you “should”? why don’t you use them?

Q21: Which tools does your employer/client particularly value?

Q22: How do you know whether your project is going well?

Q23: How do you know when to move from one phase and on to the next? Or back again?

Q24: Tell me about the most successful HCI project that you were part of?

Q25: Tell me about project you were part of that did not go well.

a) What were the major problems?
b) What do you think caused the problems?
c) How could the problems have been corrected or avoided?
d) If that didn't happen, why do you think it didn't happen?

Q25a: Have you practiced in more than one country?

a) Which ones?
b) What differences have you noticed in either the tools/techniques or the approaches

Q26: If you could change anything in the way you do your work, what would that be and why?

9.2.3 ‘Both’ questions

Initial chat, pleasantries, check still okay to be interviewed, check they have sufficient free time now, etc.

Background information

1. What is your name?
2. The date today is xxxx. Can I just confirm that you happy for this interview to be recorded?

3. You categorised yourself as both –which are you more, educator or practitioner?
4. What is your teaching job title?
5. What is your practitioner job title?
6. What is the highest level educational qualification?
7. What was degree subject did you study?
8. Did you study HCI at university or on a commercial training course?
9. Can you tell me about your current role?
    a. As a practitioner
    b. As an educator?
10. How did you get into this field of work?
11. How long have you been teaching HCI
12. How long have you been working in HCI?
13. How many years of HCI (or ID, or UX) experience do you have in total?
14. What does the term HCI actually mean to you?
15. What about UX?

A bit about your teaching

16. What sort of course and levels are you teaching HCI at?
17. Are HCI/UID core or optional subjects?
18. Which courses are HCI/UID available on?
19. How is HCI perceived in your institution in relation to other subjects such as software development/programming? Less important or more important? Explain your answer
20. When you teach HCI, which topics are prioritised?
21. Can you tell me about the balance between the theory and the practical hands on experience?
22. What changes would you like to implement in the delivery of HCI in your courses?
23. Why are HCI subjects taught in your institution?
24. Do you influence curriculum design?
25. Which are the recommended texts?

Tools and techniques

I'm going to list some different methods and techniques that are used within the industry. Can you tell me which you teach, and which you ones you use in practice

a) Focus groups – taught? – used in practice?
b) Observations – taught? – used in practice?
c) Interviews – taught? – used in practice?
d) Participatory design – taught? – used in practice?
e) Remote usability testing – taught? – used in practice?
f) Eye tracking – taught? – used in practice?
g) Low fidelity prototyping – taught? – used in practice?
    - Paper?
h) Wireframing – taught? – used in practice?
i) Personas – taught? – used in practice?
j) Scenarios
k) Wizard of Oz
l) Card sorting – taught? – used in practice?
m) Discount usability – taught? – used in practice?
    - Heuristic evaluation?
    - Walkthroughs
n) Mental models – taught? – used in practice?
o) Model based evaluation – taught? – used in practice?
    - Task network models
    - Cognitive architecture models
    - GOMS

26. Which of the subjects that you teach do find particularly relevant to your current practice?
27. Can you tell me about some of the sessions that you particularly enjoy teaching? What is the topic, and how do you deliver it?
28. Can you tell me about some of the sessions that the students find most beneficial?

Your current practice

29. How do you elicit requirements?
30. Which tools do you use?
31. Which tools do you prefer (and why?)
32. Which tools do you adapt (and how)?
33. Which tools don't you use that you "should"? why don't you use them?
34. Which tools does your employer/client particularly value?
35. How do you know whether your project is going well?
36. How do you know when to move from one phase and on to the next? Or back again?
37. Tell me about the most successful HCI project that you were part of?
38. Tell me about project you were part of that did not go well.

    a) What were the major problems?
    b) What do you think caused the problems?
    c) How could the problems have been corrected or avoided?
    d) If that didn't happen, why do you think it didn't happen?

39. Have you practiced or taught in more than one country?

a) Which ones?
b) What differences have you noticed in either the tools/techniques or the approaches

40. What are the major differences between the theory and the practice?

41. If you could change anything in the way you do your work, what would that be and why?

Your cognitive profile

OSIVQ

For comparison

	Scientists and engineers	Visual artists	Linguists and historians	General population
Visual-object ability	3.28	4.14	3.28	3.59
Visual-spatial ability	3.28	2.84	2.81	2.93
Verbal ability	2.81	2.69	3.48	2.90

- **Visual Object xxx**
- **Visual Spatial   xxx**

- **Verbal ability xxx**

CSI xxxx

42. Do these results surprise you in any way?
43. Tell me about some of the times when you have to take a more analytical approach in your work? Which analytical tools do you use?
44. What about times when you have to be more intuitive or ‘see the whole picture’
45. Which do you feel more comfortable with?

Thank you for your time

9.3 Profile of the interviewees

Name	Gender	Age	Experience in HCI	Independent?	Employment background	CSI categorisation	OSIVQ scores		
							Visual Object	Visual Spatial	Verbal
Agnete [UR, Ed]	Female	67	31	No	Professor Only PhD supervision [Extensive industry experience some years previously]	Adaptive	3.33	2.87	3.87
Antonina [E]	Female	39	10	No	Lecturer	Quasi-Intuitive	2.07	2.93	4.53
Clara [UR, Ed]	Female	53	17	No	Associate professor Instructional technologist	Intuitive	4.93	2.80	2.93
Delia [D]	Female	37	15	No	Senior systems engineer	Adaptive	2.33	2.00	3.40
Dick [D]	Male	64	35	Yes	Contractor (doesn't label himself) In practice, is designer or design architect	Quasi-Analytic	3.67	3.40	2.33
Digby [UXA]	Male	46	18	Yes	Director of UX Involved in both research and design	Quasi-Intuitive	4.27	3.53	3.53
Eli [UXA, Tr]	Male	39	12	Yes	Product user experience expert Volunteer tutor for young people (high school) Team training	Intuitive	4.20	3.47	3.60
Helen [E]	Female	37	10	No	Assistant professor	Quasi-Analytic	5.00	2.87	3.27
Helga [UXA]	Female	35	7	Yes	UX strategist UX architect	Intuitive	4.47	2.33	3.67
Josephine [UR, Ed]	Female	34	13	No	Practitioner for 7 years Fully educator for last 1 year Teaching fellow Games User Researcher	Analytic	1.67	2.13	3.93
Jun [D]	Female	38	7	Yes	Interaction designer/UX designer	Adaptive	4.60	3.73	3.47
Keith [UXA]	Male	44	19	Yes	President of Design Chief Experience Officer In practice, design	Adaptive	3.47	3.80	2.53
Kenneth [UR]	Male	26	2	No	UX researcher	Adaptive	3.00	2.80	3.53
Larson [SD, Ed]	Male	51	29	Yes	Mostly educator Lecturer No title for practitioner role (development and consultancy)	Quasi-Intuitive	3.33	4.53	2.07
Lisa [UR]	Female	43	3	No	User Experience Researcher intern	Analytic	2.33	3.13	3.07
Lotte [UR]	Female	34	6	No	UX researcher	Intuitive	3.33	2.93	3.93

Name	Gender	Age	Experience in HCI	Independent?	Employment background	CSI categorisation	OSIVQ scores		
							Visual Object	Visual Spatial	Verbal
Lucy [UR, Tr]	Female	34	10	Yes	Experience research consultant Not involved in academia, but does team training	Adaptive	3.20	3.53	2.87
Mila [UXA, Ed]	Female	57	19	No	Senior User Experience Architect	Intuitive	3.40	2.93	4.20
Paul [E]	Male	73	35	No	Professor	Intuitive	3.27	3.80	3.67
Roger [UR, Ed]	Male	48	14	No	Senior adjunct lecturer User Experience consultant	Quasi-Intuitive	2.93	2.60	3.20
Terry [E]	Male	38	10	No	Lecturer Researcher Formerly physics teacher	Intuitive	2.13	4.07	3.07
Tina [E]	Female	59	30	No	Lecturer and subject group leader	Analytic	3.20	2.33	3.33

Key

Professional role	Suffix
Educator	E
Designer	D
User Researcher	UR
User Experience Architect	UXA
Software Developer	SD
‘Both’ role is training or mentoring	Above + Tr
‘Both’ role is academic education	Above + Ed