Chapter One

Background

1.1 The research context

This study is about competence and confidence in student nurses as computer users. In higher education and health care practice, student nurses will spend time using and working with computers and the broader contexts of ICT. The opening discussion sets out the origins of the research idea and how my interest emerged. The ubiquitous range of interpretations, functions and activities requires some unpacking of the definitions for ICT, computers and computing. These definitions have been chosen to reflect the kinds of circumstances that student nurses will encounter. I include a rationale for the selection of the computer as an established and contemporary technology, and its context for my research title.

The following section discusses learning about ICT and learning using ICT. These two areas have distinct and overlapping features. They are important because they underpin undergraduate theoretical and clinical experiences. This precedes how these experiences support the development of computing competence and confidence. As student nurses have clinical placements, the discussion on this area explores some aspects of ICT in healthcare and nursing. I then justify why I have chosen not to look at registered nurses as computer users. Factors in support of my study are unearthed from literature showing the state of ICT in nurse education and its influence on student nurses as computer users. The following discussion sets out the distinct differences between registered nurses and their undergraduate counterparts as computer users. A review of other professional groups gives some contrasting insight into how ICT, computers and computing activity have been introduced and incorporated elsewhere. I then present the case for study about student nurses as computer users and show why this group is unique. The final section identifies why research about competence and confidence in student nurses as computer users is important.

1.2 The origins of the research idea

The research idea stemmed from curiosity about a group of registered nurses' mixed reactions as computer users, some of whom were recently qualified (Todhunter and Kershaw, 2005; Todhunter, 2006). I wondered if this might be the case for student nurses. At that time only 30% of adults in the United Kingdom had received formal ICT education. I thought about what might affect student nurses' competence and confidence as computer users (Office of National Statistics (ONS), 2006). First thoughts about the relationship between age and ICT coined the portrayal of digital residents and digital visitors, with varying levels of experiences and abilities (Prensky, 2001; White and Le Cornu, 2011). Digital residents are those individuals who would have received formal ICT activity in school. The following statistics reflect ICT in pre-16 years' education in England. At the millennium there were 13 computers per 100 pupils (Information Age Partnership, 2002), compared to 1.9 pupils to 1 computer in primary education and 0.7 pupils per 1 computer in 2007 (Royal Society, 2012).

OFSTED data collected between 2008 and 2011 shows an average of 2 pupils to 1 computer as an average across 167 primary, secondary and special schools in the United Kingdom (OFSTED, 2011). A recent European Union (EU) study into ICT and formative education shows the shift from this narrow focus to questions asked about schools' quality of broadband access, types of online learning resources, virtual learning environments, contractual maintenance support and school websites (EU, 2013). Concerns about the quality of ICT teaching practices in the pre-16 years' curricula, is cited as a key influence on the decreasing numbers choosing to study this subject at GCSE and A level (British Educational and Communications Technology Agency, 2010; Royal Society, 2012).

Worryingly the ICT curriculum in some schools does not support the modern workplace or post-16 years' education (Royal Society, 2012). 89% of 16-24 year olds see themselves as digital residents, but still require specialized ICT education and training for employment and career plans (GOW, 2014).

Digital visitors are those for whom access and computing skills would have been post-education, such as learning by personal computer and exploration of the internet. In 1998, 33% of households owned a personal computer and just 10% had internet access (ONS, 2007). By 2011, 77% of UK households had domestic access to the internet, of which 45% used a mobile phone for connection (ONS, 2011c). However by the first quarter of 2012, 8.12 million (16.1%) adults in the UK had never used the internet (ONS, 2012). A third of the poorest children in the United Kingdom do not have internet and computer access at home (ONS, 2013).

Together these figures give initial insight into the human response to a complex environment. Significantly, they also reflect a digital divide, with sections of the UK population being clearly disadvantaged through lack of access and opportunity. In the material reviewed ICT, computers and computing appear to be used interchangeably, not least because they represent a broad range of circumstances for their use. Experiences appear to be determined by the type of artefact, the nature of its use, access, and teaching and learning.

1.3 Definitions of ICT, computers and computing

For the purpose of clarity and consistency this section sets out and discusses some definitions for ICT, computers and computing. The definitions have been chosen to reflect the characteristics of the intended study and the kinds of experiences relative to student nurses.

1.3.1 ICT

ICT as the synonym for Information and Communication Technology is applicable to a range of products, reactions and circumstances. The problems with this degree of diversity are discussed by Grudin (2013), who in showing how ICT can be organized across three areas recognizes the difficulties of assigning distinct boundaries. The three areas defined by Grudin are: managing information, social and societal factors, and computer science linked to design, manufacture and programming. ICT appears as a prefix before: behaviours and social engagement (Punamäki, Wallenius, Hölttö, Nygård and Rimpelä, 2009; Salanova, Llorens and Cifre, 2013), user and use (Manca and Ranierit 2013; Pearce and Rice,2013), games to motivate learning (Hapgood and Ainsworth, 2011), digital communication (Rye, 2010; Belk, 2013), strategic guidelines (European Parliament, 2003; OECD, 2009; Department of Health, 2011) and societal improvements (Akpan-Obong, 2010). These discussions and viewpoints have been chosen from a wide range of applications, because they reflect and influence ICT in nurse education and student nurses' lives in University and beyond. All of the above relate to the first two interpretations determined by Grudin (2013), because they are about social interaction and managing and using information for professional learning.

The examples cited for strategic guidelines have been chosen for two reasons. The first reason is because student nurses will use ICT in local and global contexts for their studies; for example, to find out about health in other countries. The links with the second reason lies in the way that teaching and learning are organized. For example, ICT is used to support constructivist and experimental methods in teaching and learning. Its different presentational textures and characteristics have been shown to be invaluable for those who struggle with traditional approaches (Starcic and Begon, 2013) As a prefix to literacy ICT reflects the evolution of traditional teaching and learning approaches associated with reading construction, interpretation and communication, to the creation of graphics, text and managing data (Hsu and Wang, 2010;

Twining, Raffaghelli, Albion and Knezek, 2013). These papers show the digitalization of traditional teaching and learning skills, and the inevitability and pervasive nature of ICT in education.

The following papers discuss ICT as digital communication and societal responses. Rye (2010) discusses the powerful influence of internet access as a deciding factor on home, study and leisure locations. Belk (2013) identifies the impact of digital communication on the dematerialization of visible objects that remain invisible until required. For example, the swapping of playlists has replaced CD and LP lending. Text books can be downloaded as e-books. Student nurses may do this to access study materials. Belk warns of the negative consequences of the steep rise in online communities and increasing isolation. For student nurses (and other groups) ICT skills used in a social context are transferable to work and study-related environments. Shah (2013) in presenting a positive view of cyber solitariness sets out the mutual gains to be had from remote membership and participation. Student nurses are expected to access an information-intensive environment and seek out opportunities for online collaborative working, across a range of locations. Solitariness is quiet thinking time and opportunity to learn through experimenting and problem solving.

The following examples discuss behaviour and the effects of isolated and intensive computer use. In their exploration of the effects on peers and family, Punamäki et al (2009) identify an association between intensive use and poor communication skills. Salanova et al (2013) coin the terms 'technofatigue' and 'technostress' as a result of intensive and compulsive use. Their subjects reported behavioural symptoms of anxiety, poor self-esteem and fatigue, breakdown in relationships and poor social engagement. These papers reflect the positive and negative consequences of ICT.

The attachment of ICT to use and user is ubiquitous as in effect it involves all of the above. The two papers selected from this broad perspective have been chosen because they identify some barriers and reasons for ICT adoption by computer users. For student nurses this is important as a number of influences will determine ICT access, extent and type of use. Pearce and Rice (2013) in their discussion of digital inequity, consider the familiar context of ICT learning opportunities linked to social class and access. They consider how these variables co-exist with the decreased likelihood of computer use for capital enhancing benefits such as work and education. In contrast, Manca and Ranierit (2013) show how the rise of inexpensive and easy-access social media sites such as Facebook has addressed some inequity obstacles. The authors discuss the opportunities for collaborative learning created by social media. These papers give useful insight into the personal environments, information seeking and the behaviours of ICT users.

In sum ICT is ubiquitous in its meaning and application so the following definition is based on Coward's work (Coward, 2010). For this study ICT refers to computer-based technologies that support nurse education and health care. This is because health care practitioners are held accountable and responsible for their ICT actions and nurse education provides teaching and learning resources to support the development of the relevant expertise.

1.3.2 The computer

All of the above papers show the influence of location and reasons for computer use. Rapid changes and diffusion in product innovations have brought about new language and descriptions for the computer. Increasingly, their descriptions do not include the noun 'computer' in titles, acronyms or promotional material. The term is reflective of old and inferior technology (Latzer, 2009) and associated with its pioneering and development period (Lee and Sawyer, 2010). However ICT products still use computer-origin interactive and inter-connective components (Hoffman, 2010). This is significant for this study because student nurses will be using resources that are related to computers and computing, but may be called something else. Therefore the definition and justification for the study title is the computer relates to any device that houses software, connections, keyboard and monitor structures, irrespective of age, size and appearance, mobile or fixed, wireless or otherwise, that student nurses will use for their studies. For example, the computer is the tool used to access ICT functions such as the internet.

The connection between the components of a traditional fixed computer; the monitor, keyboard, mouse and hard drive have been superseded with mobile technologies such as smartphones and tablets (Agosto and Abbas, 2011; Dede, 2011; Jung, 2013). For this study of student nurses, the convenience features from both fixed and mobile technologies are related to the social, collaborative and emotional dimensions of learning. This is because the decisions and actions for these dimensions rest with the user and not the device.

1.3.3 Computing

Computing is the practical activity that student nurses and other groups undertake when using computers and other ICT products. A number of discussions show how computer use and computing ability are synonymous with job and career opportunities (Lagesen, 2008; Lemieux, Bentley-Macleod and Parent, 2009; Clark, 2011; Lee, 2013). Skills are organized as essential and / or desirable as a basis for recruitment. "Computing will be one of the fastest job growing markets through 2018." (Hoffman, 2010, page 19). All of these studies were conducted in organizations where ICT skills were crucial and decisions for employment were in influenced by ability. All discuss how different levels of computing competence can impact on career trajectories. The citations reflect the links between ICT and computing skills, and employment terms and conditions. Traditionally, computing skills have not been a priority for nursing employers. The use of the practice-based electronic health care record requires computing competency as an essential employment skill (Lluch, 2011, Sheikh et al, 2011).

1.4 Learning about ICT and learning using ICT

Learning using ICT is about the products used to store, manage and retrieve information for the development of professional knowledge and skills. This is distinguishable from learning about ICT as the merits of different artefacts to support participation, understanding and application. A number of studies discuss the importance of assessing abilities in both contexts. For this study, their shared purpose lies in the preparation of student nurses for current academic and eventual workplace activities.

1.4.1 Learning about ICT

In nurse education it is important that student nurses are given opportunities to learn about the ICT tools used in theory and practice. This is because they need to understand the importance of ICT to house functions such as the internet and programmes such as PowerPoint, Word and Excel. These kinds of functions will influence how and when a computer is used. (Koivusilta, Lintonen and Rimpelä, 2007). ICT tools are used to house e-learning activities that all undergraduates including student nurses will encounter. Formal learning about ICT is likely to commence in primary school. Informal learning about is likely to commence in the home at any age but the experience is dependent on factors such as family attitudes, cost, access and type of equipment (Carneiro and Gordon, 2013). A review of some of the early years' studies on education show that young children quickly learn to appreciate and handle ICT tools that are play-based, colourful and related to their surroundings (Higgins, 2005; Siraj-Blatchford and Morgan, 2009; Learner, 2013). These findings underpin research showing how ICT skills acquisition at a young age supports later digital literacy (Falloon, 2013).

In secondary education years, teens have been shown as skilled in the use of mobile technologies not related to their studies (Agosto and Abbas, 2011; Lai, Khaddage and Knezek, 2013), for texting, listening and talking. These studies show how ICT has become embedded in and beyond the learning environment across different age groups. Skues and Cunningham (2012) discuss the collaborative role of the e-learning coach to help students transfer their social ICT skills to an educational context. Their examples of hard and software used by all age groups include the interactive whiteboard and mobile technologies, digital portfolios, photo-stories and animation activities. In addition to the benefits of using different kinds of ICT, the authors conclude that collaboration through arms-length support, experimental and informal conditions enhance learning. These papers show that learning about ICT can be summarised as: variety in approach, opportunities for students to learn how to use tools at their own pace, formal and informal activities, individual and group work, problem solving and involving the student in their own assessment.

1.4.2 Learning using ICT

Unsurprisingly a search of the literature on learning using ICT gave a high number of returns. A selection of papers were chosen on the basis of their relevance to this study and represent: e-learning and emotional support (Feng, Chang, Chang et al, 2013), different approaches toward learning such as opportunities for students to learn how to use tools at their own pace (Bennet and Maton, 2010; Giannakos and Vlamos, 2012), e-learning using ICT (Cant and Cooper, 2010; Windle, McCormick, Dandrea and Wharrad, 2011), formal and informal activities (Cox, 2012) and the characteristics of the learners who learn using ICT (Kennedy, Judd, Delgarno and Waycott, 2010).

These discussions identify the importance of students being able to use the ICT in order to learn through it. For example, the systematic review by Feng, Chang et al (2013) is useful because it gives a wide informed judgment about the massive area of e-learning. The outcome is that e-learning is an invaluable resource as it offers choice in location and access time. However the authors offer a salutary caution about the implications for learners who are not comfortable in this environment. These students require emotional support such as words of encouragement. The recommendation is for a blended approach of direct support, informal learning through experimenting and the use of small tasks or exercises. The purpose of these papers is to show the supportive function of ICT products to help student nurses' and others access, manage, comprehend and make an informed judgement about theory in practice. In addition all discuss the importance of evaluating both ICT effectiveness and the students' abilities.

In educational technology literature, the term Computer Assisted Learning (CAL), reflects e-learning using ICT. Examples of nurse education literature presented as 'Computer Assisted Learning' are: the value of a simulated environment for student nurses to learn how to make practice decisions (Cant and Cooper, 2010), skill development (Chambers, 2010) assessment and treatment (Morente, Morales-Asencio and Veredas, 2013), subject-based CALs (Sheridan, Gorman and Claffey, 2008) and Re-usable Learning Objects (RLOs) (Windle et al., 2011). The advantages of CALs and RLOs are that they can be stand-alone activities and / or local network packages that are not necessarily reliant on good bandwidths. The discussions on CALs and RLOs report how the cited packages have been designed to accommodate both professional learning needs and the use of computer-based products. Reusable Learning Objects (RLOs) are professional and academic components whose content can be accessed through the mobile and fixed technologies described above. They can be customized to reflect contemporary health and social care learning.

Windle, McCormick, Dandrea et al. (2011, p.811) describe Re-usable Learning Objects (RLOs) as "small interactive, visual.... using a range of multimedia elements." The analogy is a trail of breadcrumbs as information points that are followed and picked up. These small activities promote deep and curiosity-driven learning.

The social interface for RLOs is thoughtful with no pressure and opportunity for learners to work at their own pace and anywhere, honing skills prior to clinical activity. For student nurses the benefits of CALs and RLOs are both academic and technical, learning about ICT and learning using ICT plus, transferring mobile technology skills between personal and professional settings.

Lai and Wu (2006) present findings from a study into handheld technologies used by student nurses for the first time. Their key discussion points are the reactive behaviours through watching, listening and talking, the novelty of using an unfamiliar technology for learning and familiarity through frequent use. The later work of Giannakos and Vlamos (2012) on educational webcast acceptance supports these established findings. Their key recommendations are that frequent access and small, but continual successes will influence learning where the ICT is unfamiliar.

Reime, Harris, Aksnes and Mikkelsen (2008) reflect on the move away from the novelty of learning using ICT. They conclude that irrespective of established tools, students will still need to be ICT competent to work through and understand, for example an e-learning package. This and more recent papers show the shift from the uniqueness of learning using ICT to studies evaluating and justifying the conditions for its use (Voogt, Knezek, Cox, Knezek, and Brummelhuis, 2011; Beacham and McIntosh, 2013). These points appear in the US report *Learning Science Through Computer Games and Simulation* (National Research Council, 2011). The report justifies and recommends the use of ICT for gaming and simulation to recreate work-like conditions in a safe environment. Examples are the creation of projects that stimulate interest and support knowledge and skill acquisition. Li, Cheng and Liu (2012) discuss the benefits of gaming for students with low ICT knowledge, skills and self-belief in their abilities. Importantly the authors say that this kind of experience reduces the challenge perception. In support Jia, Chen, Ding, Bai, Yang, Lit and Qit, (2013) identify that the important issues are the learning experience per se followed by the subject matter using ICT. The authors cite the benefits of this experience as the transferability of knowledge and theory-related ICT skills into the workplace.

Kennedy et al (2010) offer an alternative perspective on the digital residents and visitors' dialogue (Prensky, 2001; White and Le Cornu, 2011). Whilst product development advances, gaps in knowledge and skills between expert and basic users exist, Kennedy et al show that some long term computer users still struggle to learn with ICT and learn using ICT even at basic level. These papers do show the supportive function of ICT for e-learning. They also identify the importance of transferring skills and knowledge between different kinds of ICT experiences.

1.5 How do these experiences support the development of computing competence and confidence?

The previous sections show that in reality society has become so immersed in and engaged with ICT, that it is now difficult not to have some kind of interaction with it. This reflects the earlier statistical data showing the impact and timeless nature of ICT. Most student nurses will have had some computer-based experiences before and beyond their professional learning. However, it is also possible that a number will not have had any experiences as computer users. Importantly the early experiences expose learners to activities that are transferable to later study and work. Clearly popular, gaming and social computer-based activities offer a recreational approach whilst fostering higher-level abilities of assessment, decision making and problem solving. These kinds of projects show the benefits of a safe learning environment with supervision, opportunity to rectify common errors, feedback and feed-forward. All of these experiences support the development of computing competence and confidence because they can be unique to the individual; they offer different opportunities through a vast range of experiences at different times.

1.6 ICT in health care and nursing

In healthcare, computer related technology has been used in England for circa forty years, but in a supportive administrative and database function. Examples are the storage of patient biographical data and correspondence (Willmer, 2005; Bond and Procter, 2009). The inclusion of practitioner related activities required nurses and doctors to be brought up to speed with the ICT infrastructure. A number of organizations set out the importance of embedding informatics into practitioner education and providing support for early pilot site e-projects. This was training on how to use computers in the National Health Service. The purpose was to improve information capture and communication within and between professional care services and individuals (Department of Health (DH), 1997; 1998; English National Board for Nursing Midwifery and Health Visiting, 1998).

The advent of the National Programme for Information Technology (DH, 2002) brought about the interactive electronic health care record (EHCR) and related communication systems. Its related policy 'Connecting for Health' (DH, 2005) contained an extensive range of computer based projects and activities. This required workforce education for their uptake and implementation. Projects within the 'Connecting for Health' site reflect a shift from the retrieval of local inert information to interprofessional knowledge management. For example, nurses have a role in medication management through electronic prescribing.

The collaboration between the DH and Higher Education reflects joint initiatives in the development of ICT teaching and learning programmes (DH, 2011; Higher Education Funding Council for England (HEFCE), 2011). The *Framework for Technology Enhanced Learning* (DH, 2011), sets out the parameters of ICT and the requirement for continuous education and training to support safe and effective health care. A key recommendation is the combination of classroom technologies with traditional approaches to learning.

This recommendation is repeated in *The Power of Information – putting all of us in control of the health and social care information we need* (DH, 2012). Both strategies acknowledge diversity across the healthcare workforce, recognizing age-related exposure and the importance of formal and informal learning. Informal approaches enable individuals to work at their own pace with support, in the circumstances of their choice. The use of combined or blended learning approaches enable an incremental shift towards the unfamiliar, whilst maintaining some links with traditional education (Bond, 2009; Holley and Oliver, 2010). Underpinned by the NHS

Information Technology Skills Pathway (NHS, 2012), healthcare workforce education is incremental, from basic to advanced ICT study with certification for each level of learning and product used in the clinical area. The effectiveness of a number of ICT projects and their subsequent influence on commissioning and provider services are documented in a report by PricewaterhouseCoopers (PricewaterhouseCoopers, 2013), commissioned by the DH.

In the late 1990s in the United Kingdom the emergence of healthcare ICT initiatives for professions, was typical of the emergence of public sector workplace transformations and technical changes (DH, 1998; Organization for Economic Co-operation and Development, 1999). A comparison of ICT in health care with the wider workplace shows that at the millennium, 63% of businesses in the UK were using e-commerce with the internet to support their operations. That figure rose to 86.5% by 2010 (ONS, 2011a). However, over a decade after the National Programme for Information Technology (DH, 2002), paper copy is still being gradually replaced by, or being used in the NHS in tandem with clinical computer systems. Implementation appears to have been slow (Sheikh, Cornford, Barber et al 2011). This is nothing new. Hughes (2003) identified that in spite of its size and ambitions, the National Health Service (NHS) trailed behind other large scale organizations in developing the ICT infrastructure.

Sheikh et al (2011) confirm Hughes' (2003) earlier findings. Commenting on implementation and staff education associated with the EHCR, they identify inconsistencies across the UK. Some areas are still not using the EHCR beyond an administrative function. Cheng (2012) shows the continuing existence of these problems. She explores the dichotomy between the provision of e-learning resources and their actual use by practitioners continuing their education as registered nurses. Hellesø, Sorenson and Lorenson (2005) investigated nurses' varied and often incorrect practices with identical electronic health care systems. Together these findings reflect long standing strategic and operational discrepancies, with implications for the quality of patient care.

In contrast to the above findings, there is a body of evidence showing that nurses are using computers effectively in practice. Examples are: the management of clinical information and communication using a web-based environment (Ammenwerth, Brender, Nykanen et al., 2006), using ICT as part of a multidisciplinary team in integrated care (Pirnejad, Niazkhani, van der Sijs et al., 2008; Collins, Bakken, Vawdrey et al., 2011), using different kinds of ICT tools such as information retrieval for diagnosis (Berglund, Nilssen, Réyvay et al., 2007; Garrat and Klein, 2008) supporting patients in their use of ICT tools as a point of communication (van den Brink, Moorman, de Boer et al., 2005;

Kuosmanen, Jakobsson, Hytinnen et al., 2010) and being able to work across a range of healthcare communication systems (Hellesø et al., 2005). These papers reflect the moves towards establishing EHCR integration within nursing programmes of care and professional involvement in patient-related ICT. All identify gains such as efficiency in the protection, retrieval and interrogation of data.

Other examples of good practice are interactive hands-free audio- and visually responsive technologies, used by both carers and patients as part of a programme of care (Fejtová, Figueiredo, Novák et al., 2009; MacKenzie and Ashtiani, 2011). In their discussion on hands free technology for wheelchair user groups Fejtová et al. (2009) set out the importance of health-care support, patience and time to practise the activity, in order to develop confidence. MacKenzie and Ashtiani (2011) describe a blink-write system for text entry as a discussion board for people with extreme motor challenges such as locked-in syndrome. Eye tracking is used for communication and the collaborative processes with practitioners involve transposition and typing by the respondent.

Van den Brink et al. (2005) positively evaluate an electronic health information system jointly used by nurses and patients. This system detects complications caused by the potential spread of head and neck cancers. The activity is reliant on practitioners' extending their computing skills to the provision of patient-related ICT teaching and learning. Hung, Conrad, Hong, Chen, Franklin and Tang (2013) show the benefits of joint provider-patient use of EHCRs. Their findings report an increase in patients' engagement with their conditions and interest in health management. In showing the impact on service users' quality of life, these discussions offer persuasive evidence for student nurses to develop competence and confidence as computer users. Inconsistencies across practice show that opportunities for student nurses to become competent and confident as computer users are variable.

1.7 Why not look at qualified nurses as computer users?

The above papers reflect the broad parameters of ICT focussed research in health care and nursing. The decision not to conduct research into registered nurses as computer users was influenced by my occupation as a lecturer in nursing and predominantly working student nurses in a higher education setting. The cited papers show that research into registered nurses as computer users would be likely to involve a workplace study. A further review of the more recent studies in this area reflect concerns about computing competence and confidence and are about: resisting change, varying degrees of computing efficiency, losing that which is familiar, deficits in supports systems and previous negative experiences with computers and computing (Kunz, 2010; Asah, 2011; Chow, Chin, Lee, Leung and Tang, 2012; Hårland, 2012;). Therefore the research would possibly include an examination of competence and confidence in activities where computers are likely to be used by student nurses. However given the previous cited studies, as a researcher I was faced with some complex issues. These are related to the multi-layered nature of nursing and different technological proficiencies within health and social care organizations.

My decisions would have been based on: which nursing workplace and group warrants investigation, how this specific professional group within nursing compares to other nurses as computer users, the selection of practice hardware and software applications to study competence and confidence and, what value such a study would give back to the health care organization (Walton, 2013). The objective would be to produce research that makes recommendations for mainly for workplace practice and not undergraduate nurse education.

1.8 ICT in nurse education

Similar to other higher education disciplines, ICT in nurse education activity is underpinned by a quality assurance framework. For computer-based activities this would include: making sure that local strategies and resources are in place to ensure information literacy, recognizing and responding to the ICT needs of staff that facilitate classroom and laboratory work and finding out about the student experience. (Quality Assurance Agency (QAA), 2010; 2011). ICT is also an academic discipline and the subject of research (Department for Education and Employment, 1997; Department for Education and Skills, 1998; 2002). These frameworks underpin the professional ICT standards for nurse education theory and practice. Key areas are: the quality of the academic and practice learning experiences, the different types of support provided, assessment of theory in practice and proficiency and accreditation towards registration (Nursing and Midwifery Council (NMC), 2001; 2010). For pre-registration students in the United Kingdom, professional accreditation and proficiency in the clinical area now include abilities related to ICT knowledge and skills (NMC, 2002; 2007).

The NMC's interpretation of fluency with technology has seen a shift from procedural rules and order, "Can use a variety of technological applications to record, store, retrieve and utilize information, while being alert to considerations of confidentiality and security." (NMC, 2002, p.18) to being able to "Interpret and utilise data and technology, taking account of legal, ethical and safety considerations in the delivery and enhancement of care." (NMC, 2007,p.8). This latter statement appears to recognize that students will interact with the range of ICT products and environments identified above. The following papers reflect the NMC's language showing a change from explicit rules and order satisfactory for observable task and its repetition, to asking about the student's ability to make an informed judgement using skills such as reasoning and deduction.

Ammenwerth et al. (2004) recommend an evidence-based health informatics profession and practice. The purpose of which is to formalize learning about the specific language and applications of computer-based products such as mobile technologies. Moule, Ward and Lockyer (2011, p.78) discuss nomenclature, citing informatics' definitions relative to teaching and learning. These include "e-learning as any learning that uses ICT, mobile or M learning using technologies such as mobile phones and social network learning through the internet." Given the increase in mobile phone ownership from 64% in 2001 to 80% in 2010 (ONS, 2011d), these discussions show the emergence of an educational identity for products and activities that are in the public domain.

For example, Berglund et al. (2007) found that student nurses' already familiar with Personal Digital Assistants, quickly recognized the similarities between this device and the EHCR.

Kuosmanen et al. (2010) reinforce the value of ICT learning prior to professional practice. Reporting on ICT for patient education in a mental health setting, their work shows student nurses as a critical user group supporting patients and others with ICT equipment. Todhunter, Hallawell and Pittaway (2012) blend social and academic activities alongside the development of ICT skills and knowledge. These papers reflect the successful integration of ICT into nurse education and practice and the importance for student nurses to have positive experiences as computer users.

The following section reports on studies showing the challenges of introducing ICT into nurse education and practice. Sinclair and Gardner (1999, p.1447) asked student nurses about their 'knowledge of computers'. Extracts from the results show that in two cohorts of students (n=361 and n=384) less than five in each identified as having expertise in computer use. For the combined cohorts 59% and 24% of the combined cohorts stated they had medium competence for word processing. Significantly 95% had received previous training for word processing. 81% of the combined cohorts identified themselves as having low expertise in

Internet use. Only 15% and 14% in each group had received previous training to use the internet.

Willmer (2005) found that student nurses in a busy acute ward were reluctant to engage with computing activities to support care, irrespective of the NMC (2004) proficiency requirements. Similar findings in a much earlier study by Tetley (1999) show the unwillingness of qualified staff and student nurses to acquire new ICT knowledge and skills. More recent evidence provided by Sheikh et al. (2011) confirms that some practitioners and learners have an aversion to learning and working with ICT. These studies span over a decade, but reflect comparable problems.

Ragneskog and Gerdner (2006), make the link between sporadic implementation of ICT in nurse education and student nurses' computing abilities. Significantly 71% of students stated that were ICT proficient for their studies. This high figure reflects the over-estimation problems associated with self-assessment (Ballantine, Larres and Oyelere, 2007; Field, 2009). Their teachers' assessment was that only 29% of students were ICT proficient, showing a difference of 42% in opinion. Only 41% of the lecturers surveyed said that they had sufficient ICT knowledge and skills to effectively work with student nurses. Other observations about the effectiveness of nurse lecturers to support students using ICT are variable. For example, Moule (2006) states that nurse education have developed flexible and innovative approaches towards ICT. In contrast Willmer (2005) and Bond (2009) identify that nurse education does not adequately prepare students, or practitioners as Mentors, for ICT learning.

Farrell, Cubit, Bobrowski et al. (2007) in their study of using the worldwide web for online learning, found that some student nurses resorted to working in small groups around a single computer. This finding clearly shows that not all student nurses will be happy working in isolation. Similar findings by Koch, Andrew, Salamonson et al. (2010), about first year student nurses' web-based learning needs, caution on the overuse of virtual environments and the loss of invaluable face-to-face contact. Farrell et al. (2007) claim that online teacher presence and technical support are crucial for module success. Student nurses value the human computer interaction with their teachers. However, Moule, Ward and Lockyer (2010), report on the problems of passive human computer interaction and student nurses' preferences for a tutor-led instructive approach. Together these papers reflect uncertainty about the ICT environment and a dichotomy between strategic intentions and reality. They offer insight into students' preferences for blended learning approaches (Bond, 2009; Holley and Oliver, 2010). These conclusions are comparable to the earlier negative findings for registered nurses.

1.9 What is different about the computing competence and confidence of student nurses compared to registered nurses?

There are a number of differences between student and registered nurses as computer users. These are how they are prepared for their levels of computing activity and reflect the expected level of application, access, use and skills. Dobrota, Jeremic and Markovic's discussion identifies not only the differences, but why they are important (Dobrota, Jeremic and Markovic, 2012). Access is the authorized level of entry to a network. For example, registered nurses will have access to health and social care intranet structures. Students may be granted guest access under supervision as part of their experiential learning. This shows the differing levels of accountability and responsibility. Practitioners' computer use reflects the professional activities and patient care. Student nurses' computer use will be for their academic and clinical learning with some exposure to patient-related ICT.

Skill reflects the level of efficient and effective use for the required activity. Therefore student nurses need to be competent and confident for their studies whilst working towards registration.

Practitioners need to be competent and confident as a result of their studies and during their professional activities. These interpretations do not account for more complex activity, such as professional practitioners undertaking post-graduate study involving the use of ICT. Likewise for students, the boundaries between academic and clinical computer use overlap in the journey towards registration. Nevertheless they do show some core expectations for each group. In sum computer use in clinical practice is primarily concerned with patient related activity and information. Its main focus in undergraduate nurse education is to support academic outcomes. The key differences are the context for application, decisions, actions, and expectations for registered and student nurses as computer users. The location of these technologies in health and academic settings is significant. This is because of expectations that students will adapt to the computers and the computing activity (Bosak, Pozehl and Yates, 2012). The range of computer-related technical skills that registered nurses must possess broadly reflects two areas. At strategic level senior nurses will be involved in the decisions related to the effective use of ICT and computers in the workplace. For example, Bruylands, Paan, Hediger and Müller-Staub's three point data collection gave nurse leaders a conclusive evaluation about the training needs required to implement an electronic nursing documentation system (Bruylands, et al., 2013).

The following citations are examples of nursing studies about computer-based tools used to manage electronic healthcare records (EHCRs) and to access online health information (Urquhart, Currell, Grant and Hardiker, 2009; Gilmore, Huntingdon, Broadbent, Strong and Hawkins, 2012). Together these papers report on the computing knowledge and skill base required in this environment. Johnson, Sanchez, Suominen et al (2013) examined how information from the EHCR was delivered at nursing handover. Their descriptive study reports on the use of speech recognition technology available within some EHCR structures. Importantly the findings reflect on the use of non-technical knowledge and skills in order to use the EHCR. These were related to language, clinical reasoning and the use of clinical terminology, making an informed judgement and voice dynamics. Together these papers show the key differences between what registered nurses will be expected to do and what student nurses will be expected to learn. Johnson et al's (2013) paper shows how the nursing use of the EHCR is being developed. Significantly their findings show other essential competences that student nurses will need as computer users. Student nurses therefore need to have experiences where they can develop the technical and non-technical competences associated with computers. These competencies are: being able to use computer-based tools and ICT products such as EHCRs and online resources to support a programme of care. In addition the non-technical competences are critical reasoning, evaluation and decision making. Under supervision, student nurses will be expected to mirror these roles and work activities as computer users.

1.10 Is this the picture for other computer user groups?

A review of papers from the literature about other professional computer user groups shows the serious attention given to the emergence of ICT in the 1990s (Postle, 1993 Schoenecker and Cooper, 1998; Lamb, King and Kling, 2002). These papers identify the proactive global investment to skill up the workforce. The foci beyond the first decade of the millennium is on: evaluation and return on investment, changes in work practices, the re-location of the workplace to the home and essential versus desirable workplace knowledge and skills as the changing nature of employability (Gillaizeau, Chan, Trinquart, Colombet, Walton et al 2013; Grudin, 2013; Sayah 2013; Sung, Ng, Loke and Ramos, 2013). The cited papers are examples of the investment in mobile technologies to accommodate learning and working in different locations (Agosto and Abbas, 2011; Fuller and Joynes, 2014). These discussions represent the human context of ICT.

Sung, Ng, Loke and Ramos (2013) discuss employability skills and the essential criteria to work effectively. The changing nature of work practices now requires individuals to be multi-skilled with a range of ICT products. Halford (2005) predicted the impact of global ICT and the internet on work location. These findings have come to fruition. Home and work life is blurred by the connectivity of ICT as the "dislocation of work through cyberspace and the relocation of work into domestic territory" (Halford, 2005, page 19). Sayah (2013) picks up this theme, reporting on the hazy boundaries between the workplace and work time created by ICT. For professional learner groups the 24/7 access to University ICT gives them a taste of these experiences as students.

The following two papers report on how computers have change information management practices. Grudin (2013) discusses changes in the working practices of librarians. He cites the influence of the computer on the departure from manual indexing and classification. Contemporary librarianship requires knowledge and skill sets in computing and a command of complex information repositories underpinned by ICT. In their study of changes in GP prescribing practices, Gillaizeau, Chan, Trinquart, Colombet, Walton et al (2013) show the benefits of using specific computer software to manage therapeutic dosages.

The following citations present changes in academic practices. In their study of changes in examinations and the introduction of software, Inuwa, Taranikanti and Habbal (2011) found no differences between student performance and results in online and traditional practical assessments in anatomy. Medical students were competent in the use of Moodle learning management software. Lee (2013) discusses the importance of faculty and student computing skills to complete the online component of a counselling course. Together these discussions represent the shift from desirable to essential ICT skills in education and the workplace.

In the aftermath of large-scale failed investments and financial misdeeds, actuarial science has implemented forensic computer-based systems within its professional infrastructure. Reliant on the computing skill of the user, the ensuing audit trail maps human judgement, self-regulation, decisions, risk management and consequences (Gunz and Jennings, 2011). In a similar parallel, medicine has also embedded computer-based systems to support expert practice (Håland 2012). The similarity here is the substantial use of computer-based technologies to protect and accelerate different professional environments.

Computing competence and confidence is an employment characteristic in the skilling up of the BRIC economies. A number of papers discuss the plans for the integration of computer-based systems in the BRIC (Brazil, India, China) economies and the required education and training (Davila, Foster and Jia, 2010; Simon, 2011; de Villiers, Johnson and Cremer, 2012, Wang, Myers and Sunderam, 2012). All identify the shortage of ICT and computing skills and the widening digital divide between developed and developing countries. Low levels of ICT and computing skills result in underperformance, errors, market losses and damage limitation activity.

Two similar workplace studies investigated assessment of individual skill and learning need using self-efficacy tools (Downey and Zeltman (2009) and personal assessment of competence and confidence (Saldaňa-Ramos, Sanz-Estaban, Garcia and Amescua, 2013). Both comment on the related problems of false positive and negative portrayal and the requirement by individuals to declare their real ICT learning needs. Significantly Downey and Zeltman (2009), state that early skill development will influence self-efficacy. These papers reflect the cited work in early years' education (Learner, 2013; Siraj-Blatchford and Morgan, 2009; Higgins, 2005). High competence and confidence equate to individual efficiency and increased production. There are some parallels between the state of computing skills in BRIC countries and those in UK health care (Sheikh, Cornford, Barber et al 2011).

1.11 Why am I interested in student nurses as computer users?

Together these mixed findings and my own observations sparked an interest in this subject and student nurses as computer users. I recognized that student nurses need to have positive experiences as computer users. They need to beneficiaries of this environment in order to work effectively before and after registration. The discussions on computers, computing, ICT and competence and confidence apply to all learners in higher education. This is because of the ubiquitous presence of ICT during and after studies.

In contrast to other learner groups, student nurses are late recipients of teaching and learning for ICT, computers and computing. Collaboration between industry and higher education for workforce preparation commenced in the early 1980s (David and Foray, 1994; Dummort and Dryden, 1997). Similar investment between healthcare and higher education appeared much later (DH, 2002; DH, 2005; DH, 2011). Compared to others student nurses have been disadvantaged as computer users. The need to address this issue is imperative given the ambitions of health care and the wide implementation of ICT. The Department of Health's aim for a paperless environment by 2018 (Gov.uk, 2013) heightens the importance of student nurses to be competent and confident in this environment. Albeit obvious, the best opportunity to focus a study into student nurses as computer users in order to find out about their competence and confidence is prior to registration. Locating this study in undergraduate nurse education is an opportunity to investigate the experiences of student nurses against previous findings.

1.12 What is unique about this group of learners?

1. Student nurses were not widely included in ICT developments in the 1990s.
2. They are being caught up in the aftermath showing that parts of the modern health care workface are underprepared for ICT.
3. Student nurses will therefore witness and be part of the ICT experience of their mentors who themselves may not be competent and confident.
4. Student nurses will use a range of ICT products in their academic and clinical learning. This means that computing competence and confidence are essential rather than desirable requirements for study.

5. These experiences will count towards achievement of the NMC proficiency for ICT.
6. Student nurses are required to work towards a level of ICT skills and knowledge that reflect professional registration status.
7. Multi-agency and inter-professional work using ICT is the norm. Student nurses will need to develop competence and confidence for collaboration through internet and intranet communication links.
8. ICT health products are being increasingly used by patients and carers. Registered nurses are likely to be the first point of contact. Student nurses need to develop their ICT prowess to work with these groups.

1.13 Why does this research matter?

1. The guidance for Information and Communication Technology from the NMC (2002; 2007) sets out the important statutory requirement for student nurses to demonstrate a level of ability as computer users.

2. Some student nurses may not be competent and confident in the use of computer-based activities. This has implications for achievement of proficiencies and registration status.

3. It is important for student nurses to have positive ICT experiences in order to be competent and confident as registered practitioners.

4. The evidence reviewed has shown some weaknesses in how ICT theory and practice are delivered in nurse education.

5. Health care failures related specifically to ICT have not yet been cited by the NMC. However given the above evidence, it can only be a matter of time before nurses are asked to account for their direct and vicarious actions in the use of ICT.

6. There are a limited number of studies that specifically explore computing competence and confidence in student nurses.

The literature has shown that student nurses might have poor quality ICT experiences at every significant point of their learning journey. All of which have the potential to affect their competence and confidence as computer users. These poor quality ICT experiences can be summarized as: poor quality ICT teaching and learning experiences during school years, poor quality ICT workplace training, contrasts in the quality of links between ICT in schools, workplaces and higher education, contrasts in the quality of experiences in nurse education and practice. It may also be possible that some have no previous experiences as computer users. All of which cast doubt on the simple divides characterized by White and Le Cornu (2011) and Prensky (2001) because it assumes that everything is in place for individuals to be digital residents and digital visitors. Therefore it is not known if student nurses are competent and confident computer users because of, or in spite of, their experiences. Preliminary exploration of the literature suggests that competence and confidence may affect computing ability, but do not explain their influence and characteristics beyond descriptors such as reluctance or enthusiasm. Moule et al. (2010) identify that there is a limited number of studies exploring student nurses' reactions and responses to the computer-based environment.

1.14 Organisation of the thesis

Chapter two will report on literature that deals with the appearance of computing competence and confidence in student nurses and other learner groups. The emerging research questions offer an opportunity to explore and explain perspectives not previously covered. Chapter three explores and selects the best ways to answer the research questions. The decisions to use mixed methods with two sequential studies using quantitative exploratory and qualitative explanatory methods will be explained. Chapter four reports the results from the two studies. Chapter five discusses the findings from each study. The ensuing synthesis precedes a number of recommendations for nurse education.

1.15 Conclusion

The all pervasive presence of ICT, computers and computing means that most people will have had some form of interaction with this environment. My experiences and the literature have shown that student nurses have varying degrees of competence and confidence as computer users. Both student and registered nurses have a critical presence in the deployment of numerous activities underpinned by ICT. However rapid emergence and societal adoption of digital technologies does not automatically equate to being competent and confident in their use. Examination of their adoption in the workplace, education, domestic, health care and nurse education settings revealed mixed outcomes and significant contrasts to policy intentions. It is important that student nurses are adequately prepared to work with ICT both for their studies and in the health care environment as future registered nurses. The decision to explore the experiences of student nurses as computer users was influenced by uncertainty about their readiness as the future workforce using ICT.

Chapter Two

The Literature Review

2.1 Introduction

The aim of this chapter is to appraise and present literature about competence and confidence and their application in an ICT environment. The previous chapter highlighted a range of issues facing student nurses as computer users. The discussion revealed conflicting views about their learning experiences and the development of computing competence and confidence. The opening section presents the search strategy and literature on the dimensions of competence and confidence. A review of their interpretation in an ICT environment for student nurses and other computer user groups offers comparative and contrasting insights. This is to ascertain any similarities and differences in characteristics, compare the types of studies undertaken, the methods used and to identify gaps in the established information.

2.2 Search strategy and the inclusion criteria

The behaviours of the practitioners and the broad range of evidence presented in chapter one intimated the influence of competence and confidence in a computing environment. However this body of work did not reveal any precise information about their characteristics. Therefore I used a broad range of search words to find literature about competence and confidence. These were: competence, performance, ability, proficiency, prowess, skill, confidence, belief, attitude, opinion, computers, computing, human computer interaction, social technology and information and communication technology. Filters were then added to find literature about competence and confidence specifically for behavioural sciences. Studies about ICT products designed to enhance competence and confidence in patient care were considered, but only included in the review if they reported on students' behavioural experiences. Studies about integrating informatics into nursing theory and practice with just a fleeting reference to competence and confidence were discounted.

The method used was a hand and online search of peer reviewed journals and books. The electronic databases explored were: Cambridge, CINAHL, EBSCO, Emerald, Ingentaconnect, JStor, Sage, Springer, Swetswise / Wiley, Synergy and Taylor Francis. To reflect the emergence of professional ICT activity retrieval dates were set between 1990 and 2012. For definitions and interpretations of competence and confidence, the dates were widened. The search parameters were then redefined to studies conducted in the United Kingdom and beyond, specifically examining the experiences of undergraduate student nurses. Studies on other learner groups using ICT were explored.

Systematic reviews were included as this literature summarized the strengths and limitations of the different methods used. The discussions gave invaluable insight into the validity and reliability of different measures used to assess competence and confidence and how these structures influenced the results. The cited examples reflect the numerous discussions citing the varying validity and reliability findings (Watson, Stimpson, Topping et al., 2002; Gozu, Beach, Price et al., 2007; Walsh, Bailey and Koren, 2009). Challenges related to content validity, questioned to what extent the scales used captured the relevant features of competence and confidence (Dorman, Byrne and Edwards, 2007). For construct validity, the key issue was how well the scale was related to other measures in the same construct. In their review of construct validity for the assessment of doctors' performance using peer review, Overeem, Faber, Arah Elwyn et al. (2007) comment on the usefulness of factor analysis and how it will discriminate items within the instrument.

For reliability, self assessment using survey by questionnaire is common. However, the discussions show questionable test and retest reliability related to over or under-estimation by the respondents and problems with recall (Walsh et al., 2009; Schichtel, 2010). Reviews discussing how closely different items were related on a scale cited different interpretations of the acceptable range for Cronbach's Alpha and item consistency (Skirton, Murakami, Tsujino et al., 2010; Sulosaari, Suhonen and Leini-Kilpi, 2011). Together these discussions indicated the methodological influences on the strength of the evidence.

Unsurprisingly literature covering computing competence and confidence in professional learner groups appeared in related specialist journals and generic educational journals with a focus on technology. For example, literature about student nurses' computing competence and confidence appeared in nurse education publications. I found that UK-based studies and discussions about ICT and student nurses, tended to be on a parallel with the NMC (2002) outcomes for technical application and interpretation and the utilization of data and technology (NMC, 2008), rather than the journey towards becoming competent and confident.

2.3 Competence

The literature reviewed for competence gave a wide range of interpretations and contexts. The emerging interpretations were competence as capability (Savolainen, 2002; Mulder, 2007; Lum, 2009; Lozano, Boni, Peris et al., 2012), competence as performance (Rummler and Brache, 1995; Gilbert, 1996) competence as expertise (Dreyfus and Dreyfus, 1986; Swanson, 1994; Benner, 2001) and competence as a combination of visual and hidden attributes that surface when required (Slatter, 1990; Keen 1992; Parry, 1996).

The adjective competent emerges from the Latin *competere,* translating as emerging together and becoming suitable or capable (Savolainen, 2002). This suggests two interpretations of competence. Firstly competence as an adjective or description of transformation witnessed through performance and second, competence as a noun, the finished product or final result. Competence is inferred from observation of whatever has been completed.

Swanson (1994) identifies competence as an optimum level of expertise, recognizable through actions and performance and the possession of optimum skills and knowledge. Dreyfus and Dreyfus

(1986) elaborate the incremental conditions required for expertise, in their original model of five and later seven stages. Their model (See Figure 1, page 52) shows the transition from novice to expert (Dreyfus and Dreyfus, 1986; Dreyfus, 1994; Dreyfus, 2001; Benner, 2001). Eraut (1994, p.166) offers a view of competence and expertise based on the intentions for its use, "defined in ways which best suit the existing expertise of the colonizing profession." Together these discussions depict competence as part of a single-direction hierarchical framework, emerging through knowledge, incremental experience and wisdom. All of which imply infinite time, slow growth and maturity. This seems to be a deliberate strategy to polarize extremes and extend recognition to experts as accredited to deal with issues within their remit.

Mulder's (2007) historical overview of the 16th century definition of competence identifies a period in time where recognition of capability was underpinned by statute and the law. Competence comparisons can be made here with contemporary practice-driven professions whose acts are legitimated by law. Proof of competence as capability with authority to act is underpinned by professional accreditation, formal qualifications and actions, also recognized through statute (Lum, 2009). The behavioural aspect of competence as lawful acts is embodied not only by professions but also by others with preconceived expectations as recipients of a level of competent behaviour. Lozano et al. (2012) also discuss competence as capability, but offer broader perspectives and possibilities that also have behavioural considerations. Here capability is the capacity to become competent, implying preceding phenomena and a journey towards competence. This broader context of competence includes the capacity for self-examination at every stage of learning and reflection on progress. It also implies a progressive improvement towards becoming competent.

These discussions from the literature reflect conflicting contrasts for competence as capability, as both an inert and a changeable structure. Competence as capability through formal assessment is prescribed and recognizable, whereas the latter interpretation is flexible and personal. A blend of the two has connotations of autonomous competence, paraphrased as the practice of an expert by Dreyfus and Dreyfus (1986). Although comparisons can also be made between the Dreyfus and Dreyfus (1986) model and the changeable attributes of competence as capability (Lozano et al., 2012), the Dreyfus and Dreyfus (1986) model does not portray the characteristics of experts faced with unfamiliar circumstances. The differences in the descriptions show competence at the midpoint in the novice to expert structure (Dreyfus and Dreyfus, 1986) and as a pinnacle point elsewhere (Mulder, 2007; Lum, 2009). Together these discussions reflect the subjective nature of determining where competence is situated in the context of knowing and being able.

Figure 1

Seven Stages of Learning (Dreyfus and Dreyfus, 1986; Dreyfus, 2001)

Description 7 stages
7. Practical Wisdom – ***Skilled perception following the grasp of relevant features of particular situations. Unconscious competence.***
6. Mastery - ***Increasing self awareness and personal coherence – consistency. Fluid and smooth performance.***
5. Expert – ***Demonstrates*** **a** ***flexible range of responses and the range of possibilities. Skilful behaviour rooted in experience.***
4. Proficient – ***Able to perceive situations as a whole. Demonstrates intuitive behaviour. Sees what needs to be done through contemplation.***
3. Competent – ***Activity is on the basis of conscious and deliberate planning.***
2. Advanced Beginner – ***Evidence of recognition.***
1. Novice – ***Works using*** **a** ***simple rule of instruction*** **related to aspects of a situation.** ***Exercises no judgement. Tends to act slowly.***

Rummler and Brache (1995) link improvement with competence through the measurement of performance. This interpretation is suggestive of assessed actions, as a series of incremental stages, not unlike the Dreyfus and Dreyfus (1986) model. In contrast, Gilbert (1996) identifies competent behaviour as the outcome of worthy performance, the range of current knowledge, behaviours and skills that an individual draws on to show accomplishment. This is suggestive of competence as an end status, rather than incremental change. These interpretations of competence reflect different immovable and variable phenomena. Both have comparable theatrical connotations where testimony of competence is the actor's overall performance of the task. Sen (1985) and Nussbaum (2006) both reject competence as performing an isolated event, in favour of competence as adaptability and flexibility in performance, such as being able to resolve familiar problems in unfamiliar contexts. Whilst these views go some way to address the flaws in the Dreyfus and Dreyfus (1986) single-direction model, at best they can only confirm competence through witnessed acts. However the key strength of these two models is that adaptability and flexibility are identified as ongoing processes, applicable at any level of learning and understanding.

Keen (1992) identifies competence as the interaction between skills, understanding, values and experiential wisdom, witnessed through appropriate reaction. Parry (1996) makes the distinction between hard competence, relating to occupational knowledge and skills and soft competence, relating to personality characteristics, beliefs and styles. Parry (1996) stops short of stating the alignment of gender to hard and soft personality characteristics of competence, but this is implied in the text. Slatter (1990) defines competence as consisting of explicit and implicit factors. Explicit competence applies to specialist knowledge and skills that can be seen. Implicit competence is the hidden and often unspoken wisdom emerging from incremental exposure and experiential learning. From this combination emerges the expert who, according to Slatter (1990), switches effortlessly between thinking and doing. Here Slatter (1990) seems to be hinting that the pragmatic aspects of competence share some ground with knowing what should happen. In order for competence to work effectively, one draws on background knowledge and ways of knowing how to think and how to do.

Winterton, Delamare-Le Deist and Stringfellow (2006) also offer a broader definition using a combination of adjectives such as cognitive competence (understanding), functional competence (being able to) and personal competence (awareness). This interpretation of competence as a set of objects assumes commensurability and equal co-existence. Such idealization does not recognize the possibility of imbalance. Moreover the desirable characteristics of competence are (not unreasonably) what one should expect to see, for example in a professional environment such as healthcare. Here is evidence of Mulder's (2007) interpretation of competence as capability and authority, comparable with the NMC's (2008, p.3) definition, "A bringing together of general attributes – knowledge, skills and attitudes. Skill without knowledge, understanding and attitude does not equate with competent practice. This competence is the skills and ability to practise safely and effectively without the need for direct supervision."

Although these definitions and interpretations of competence reflect unconformity, there are suggestions of overlaps and different adjectives for similar meanings. Some do have their own distinctive features, possibly designed for a specific function, often pragmatic in nature and representing different kinds of organizational, professional and individual competence. Complexity arises in the indistinct combination of visual and hidden factors and where competence is either a static or moveable facet. Individually these definitions at best are advisory, often reflecting the demands of work activity. In their defence they were designed to reflect the acquisition of ability. The missing element in most discussions appears to be an underpinning link between pragmatic know- how-to and theoretical know-why characteristics, as observable and hidden phenomena. This is well defined by Short (1984, p.201) who states "Mastering particular things is not the same as possessing certain qualities." Together these interpretations show the characteristics of competence: as useful and good to have, about being able to do something well, can be seen and admired by others, sometimes need to be learnt and accredited and often require review or refinement. These discussions also show that competence is more than just technical ability. They reflect competence as having the social abilities and humanistic skills required for interaction, demonstration and receiving. All of the above influenced my own definition of competence which is: A level of ability that can be strengthened by exposure to related knowledge, and skills, working with others and then becoming accredited through demonstration of action and subject language.

2.4 Confidence

Confidence as a behavioural entity implies feeling able to deal with something. In nursing, feeling able to deal with something and the ability to act and then make accurate judgements and decisions with confidence is important for patient care. Certainty and its antonym, uncertainty are the behavioural actions of confidence. In the literature reviewed, the vocabulary for describing confidence and behaviour appears to reflect two areas. These are self belief and item specific confidence. Confidence as self belief is personal in nature and associated with inner feelings such as feeling positive or negative (Koriat, Lichtenstein and Fischhoff, 1980; Bandura, 1986; Bowman, 1999; Berman, 2006). Item specific confidence is the term used to describe the interaction between two factors that influence confidence. These are what is believed to be correct and how confident an individual is about that belief (Gigerenzer, Hoffrage and Kleinbolting, 1991; Kruger and Dunning, 1999; Butterfield and Metcalfe, 2001; Whitehouse, O'Neill and Dornan, 2002). The following section sets out interpretations of self-confidence and item specific confidence.

2.4.1 Self confidence

For self confidence, Bandura's (1986, p.2) influential work posits confidence as "beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations". This interpretation suggests knowing the shape and features of confidence before being confident. Alternative views of self confidence show a link with pragmatic qualities of being and doing (Bowman, 1999; Berman, 2006). Berman (2006) relates confidence and self belief to having the courage to take action. Her interpretation reflects two themes; the courage to attempt change and the courage to deal effectively with errors whilst maintaining presence of mind. Courage as the confidence to face and address errors head on, suggests reactive confidence and capability.

Bowman's (1999) conceptual representation of confidence is not unlike the Dreyfus and Dreyfus (1986) model structure for competence. Positive one-directional change and the emergence of incremental self belief appear to be based on a series of small actions that equate to positive progress. Together these interpretations reflect a before, during and after structure for confidence. All appear to show confidence as grounded in thinking and wisdom, which in turn influence behaviour. Alternative permutations composed of setbacks, failure, lack of courage and deterioration in self belief are not considered.

Koriat et al. (1980) determine confidence as certainty of recall and faith in personal judgement. Confidence as judgement is the belief of being correct. However confident judgement based entirely on a history of repeated successes, leads to behavioural influences rather than cognitive deduction. An example of a behavioural influence is the euphoria from being right. Confidence in what is believed to be correct exceeds competence. This interpretation appears to be a blend of self-confidence and item-specific confidence.

2.4.2 Item specific confidence

Item specific confidence is when a specific experience triggers a reaction. Characteristics related to item-specific confidence tend to feature in studies where confidence has been shown to exceed competence. Here the focus is on the divergence between over-confidence and under-confidence. Butterfield and Metcalfe (2001) attribute over-confidence to memory and rapid recall. Under-confidence is associated with doubts about skill level such as working through a task and problem solving. Kruger and Dunning (1999) found that over-confidence was more likely to manifest in unskilled rather than expert participants. Gigerenzer et al. (1991) similarly report over-confidence in novices working on challenging problems. Whitehouse et al. (2002), studied post-registration house officers' behaviours in surgical placements. Their findings link over-confidence with the hard-easy effect, such as being dismissive of challenging situations and taking credit for simple activity. Together these papers reflect over-confident behaviour as a self indulgence. Characteristics such as enjoying feeling confident and acting with confidence seemed to be at the expense of cognitive thought processes. Contrasts between the desirable models (Bandura, 1986; Bowman, 1999; Berman, 2006) and the structural imperfections (Gigerenzer et al., 1991; Kruger and Dunning, 1999; Butterfield and Metcalfe, 2001; Whitehouse et al., 2002) portray idealism and realism. However this literature offers the conditions for knowing different formations of confidence and confident behaviours.

An alternative view is of item-specific confidence as deliberate performance (Eva, Armson, Holmboe et al., 2012). The discussion shows how subjects felt obliged to project confident behaviour, irrespective of their abilities. The findings show confidence and confident behaviour in health students (medicine and midwifery) as an interaction between experience, knowledge and fear (Eva et al., 2012). Significantly, the subjects felt they had to project high confidence, irrespective of ability, self-appraisal and feedback about errors.

In contrast, Butterfield and Metcalfe (2006) state that errors are part of the human condition. They challenge the notion of avoidance of mistakes as a good learning experience. Fear antagonizes thinking and action. These findings distinguish between errors committed with high confidence and errors committed with low confidence. Errors endorsed with high confidence are more likely to be resolved than those committed with hesitation and uncertainty. Butterfield and Metcalfe's (2001) work shows that it is possible to have knowledge or a pre-understanding of sets of probabilities for confidence; the different kinds of confidence that individuals might display or the likely outcomes for confidence and confident behaviour.

Overall the literature shows difficulties in assigning confidence a single descriptive statement, with a tendency for interpretation of a range of circumstances rather than a succinct definition. Given the breadth of contexts this is not unreasonable. In the literature reviewed interpretations are broadly organized into categories of self belief and item-specific confidence. There do not appear to be any upper or lower limits or middle ground for these structures, creating difficulty in assigning values to confidence.

Although this body of work offers insight into observable and unseen phenomena, the behavioural entity reflects confidence as an outcome, rather than knowing the structure of its components and how it actually surfaces. As with competence the missing element appears to be the hazy latent area between thinking with confidence and acting confidently. Together these discussions show confidence: as influenced by emotions, has observable behavioural features, is linked to movement adjectives such as hesitantly or swiftly, may be influenced by previous experiences and is internalized as self-belief. Having reviewed some interpretations of confidence my definition for this study is: Confidence is being able to perform without introspection of self belief irrespective of fluid performance, uncertainty or error. This is because in clinical practice it is expected that nurses will be composed and conduct themselves in a confident professional manner.

2.5 Computing competence and confidence in student nurses

This section reviews literature on studies about competence and /or confidence in student nurses as computer users (Cartwright and Menkens, 2002; Cotton and Gresty, 2006; Ragneskog and Gerdner, 2006; Bond, 2009; Bond, 2010; Moule et al., 2010; Brettle and Raynor, 2012). These discussions recognize the significance of student nurses being able to use computer in the classroom and practice. Table 1 (See pages 70-71) summarizes the literature reviewed.

A number of discussions indirectly report on and measure some aspects of competence and confidence and although cited as highly relevant, are secondary constructs to another focus (Gresty and Cotton, 2003; Fetter, 2009; Kelly, Lyng, McGrath et al., 2009; Bogossian and Kellett, 2010). These studies refer to the importance but do not unpack the features of computing competence and confidence. They have been included because they make a reference to the significance of competence and confidence. The first section reports on how competence and confidence are interpreted within the studies. This is followed by a review of the type of measurement used to assess competence and confidence in student nurses as computer users. Table 1 (See pages 70-71) summarizes the literature reviewed related to student nurses.

Brettle and Raynor (2012) set out their criteria for competence in student nurses as skills in the cognitive and affective domains. Their discussion distinguishes between knowledge and the ability to demonstrate ICT in practice. Confidence is interpreted as students' confidently working with ICT and getting on with it, rather than relying on instructions. Moule et al.'s (2010) critical examination of factors affecting student nurses' use of computers show asymmetry between competence and confidence. Their findings highlight fear and a contrasting reliance on supportive instruction. Feelings of inability to work with technical aspects of a computer were predominant in mature students, unable to explore software beyond retrieving information.

Together these findings show disparities between high and low levels of confidence, but do contain similarities in repeating patterns of behaviours and reactions. In sum, this body of literature shows some pre-inclinations or disposition either to be confident or otherwise, implying that these reactions might be ingrained within the persona. Moule et al.'s (2010) work confirms a number of factors. These are the likely presence of imperfections within models of competence and confidence, a dichotomy between reality and the NMC's desirable competence characteristics and a possible correlation between competence and confidence. Their work reflects a realistic picture of confidence as a series of structural imperfections (Gigerenzer et al., 1991; Kruger and Dunning, 1999; Butterfield and Metcalfe, 2001; Whitehouse et al., 2002) and a pre-knowledge of different behaviours for confidence (Butterfield and Metcalfe, 2006). All of which are likely to manifest in their subjects, student nurses faced with a computing activity.

In her two papers representing a longitudinal study, Bond's (2009; 2010) focus for competence is student nurses' abilities to work with the internet. Bond (2009) comments on a range of issues surrogate to competence and confidence, such as a supportive environment, encouragement and students' willingness to use ICT. Bond (2010) identifies a link between a supportive environment and students' self beliefs in their abilities as computer users. Here confidence is portrayed through ICT scenarios offering a visual picture of learners either coping or otherwise. Cotton and Gresty (2006, p.50) discuss interface usability and ask the question "Is it easy to use?" In Cartwright and Menkens' (2002) study, students were asked to comment on their level of competence with e-mail, editing functions and word processing. Competence is assessed against pragmatic skills and interpreted as "comfortable using a computer." (Cartwright and Menkens, 2002, p.147). Kelly et al. (2009) also assess competence through specific actions, even though their findings allude to, but do not specifically state competence. For example "I was able to download the videos to my home computer"

(Kelly et al., 2009, p.297) and “difficulties in adapting to e-learning” are indicative of the level of competence (Kelly et al., 2009, p.298).

These combined findings reflect the application of computing competence across a diverse range of products and locations, in academic and domestic settings. Significantly they reflect a synthesis between specific theoretical frameworks of competence (Dreyfus and Dreyfus, 1986; Winterton et al., 2006) and confidence (Bandura, 1986). Self belief underpins the Dreyfus and Dreyfus (1986) stage “Skilled perception following the grasp of relevant features of particular situations” (See Figure 1, page 51), using cognitive, functional and personal competencies.

Gresty and Cotton (2003) show the blurred boundaries between competence and confidence. Competence is inferred through discussion about the importance of access and supporting student nurses for online learning. Their confidence survey, albeit subject focussed, includes computer-related questions about students’ previous experience and inexperience, level of ability, nerves and willingness. Ragneskog and Gerdner (2006) relate competence to the skills required for computer use in the classroom and in patient care. Confidence is referred to as feelings about using computers. Fetter (2009) identifies competency as the emergence of ICT skills from critical reasoning and problem solving. Bogossian and Kellett

(2010) discuss competence and confidence as ability and level of comfort. Similarly Hoffman, Dempsey, Levett-Jones et al. (2011) allude to problems experienced by student nurses using ICT, but do not specifically mention competence. Ward and Moule (2007) report on students' comments about the need for skill development and the influence of home ICT access on confidence, but do not refer to specific interpretations. Together these findings reflect flexibility in the application of competence and confidence and the absence of distinct boundaries between the two areas.

Students' recognition of skill development in Ward and Moule (2007) is evidence of their anticipatory recognition of its existence. Prediction implies some prior understanding and knowledge of competence, as what needs to be done in order to become competent. The significant issue here is that students seem to be considering competence in order to become competent as ICT users. These papers show the interest in student nurses as computer users and offer a range of interpretations for competence and confidence.

2.6 Instruments and measures used to assess computing competence and confidence in student nurses

This section identifies the instruments and measures used to assess competence and confidence in student nurses in the studies reviewed. Brettle and Raynor (2012) developed a tool to assess online literature searching skills with scores assigned to activities such as truncation and being able to use Boolean operators. Subjects were asked to rate their confidence from 1 (= confident) to 5 (= no confidence) in the use of a number of personal computer applications. Mann-Whitney U Tests were used to compare differences between groups of subjects.

Ragneskog and Gerdner (2006) also used a five point scale from strongly agree to strongly disagree, with uncertain as the midpoint in a non-randomized convenience sample. Data was analyzed using descriptive statistics. Moule et al. (2010) used a two phase mixed methods approach of survey by questionnaire followed by case study analysis. The results and findings from the exploratory survey influenced the explanatory design of the second study.

Bond (2009) in one section of her three-phase data collection asked student nurses to rate their skills to computing tasks as: excellent, good, basic, or not used. Other questions reflecting type of use and opinions about the ICT environment required a response to a four point Likert scale from strongly agree to strongly disagree. Descriptive and non-parametric statistics (Chi-square) were used for data analysis. This was followed by a qualitative study, using group interviews with registered nurses, followed by thematic analysis. Similar to Moule et al. (2010), Bond's (2009) discussion shows how her initial findings influenced the structure and method of the subsequent study.

Kelly et al. (2009) conducted a multimethod study, the first of which was a survey by questionnaire (n=204), followed by a post-test outcomes evaluation (n=14). Using a four point Likert scale, from strongly agree through to strongly disagree, the purpose was to show if there was a measurable change in knowledge and skills before and after the intervention. Mann-Whitney U Test was used for analysis of data from randomly assigned groups. Although the results show significant differences between the groups, the discussion has not reported on the methodological decisions and connections.

Also using a 4 point scale, Fetter's (2009) survey (n=27) measured student nurses' inabilities when trying to access to practice information systems. Gresty and Cotton (2003) used a combination of questionnaire and open ended questions to find out specifically about student nurses' previous and current use of computers, including if online learning appealed to them. Their work shows the influences and decisions linking survey opinion and the open ended responses.

Bogossian and Kellett's (2010) survey through questionnaire on barriers to e-portfolios used a four point scale with prefix adjectives to assess feeling comfortable when working with computers. Student nurses were asked to select from: extremely comfortable, very comfortable, somewhat comfortable and not comfortable. Data was analyzed using descriptive statistics. Hoffman et al. (2011) asked students to rate the technical aspects of computing activity with free text narratives, for example "...too time consuming and frustrating with technical difficulties". Similarly, Cartwright and Menkens (2002) used a combination of survey with open and closed questions and focus group activity. Data was analyzed using descriptive statistics whilst qualitative evidence was categorized from the emerging themes. Their mixed findings show strengths and challenges facing distance learners from a computer-user perspective.

Ward and Moule (2007) used a mixed focus group of healthcare students (n=16), of which 8 were student nurses. Their comments about the use of transcript analysis are positive. This is a good method, to directly explore peoples' experiences as computer users. Cotton and Gresty (2006) used think-aloud method and protocol analysis to evaluate e-learning approaches and aspects of competence and confidence. Commenting on the rich vein of evidence from think-aloud, Cotton and Gresty (2006) provide positive feedback about think-aloud and protocol analysis to ascertain student nurses' computing experiences. The phenomena investigated can be summarized as differences between groups of ICT users, specific technical aspects, using a computer for academic activity, distance learning and opinions about the ICT environment. The range of methods used to examine them is diverse. This highlights the importance of careful decisions about the type of measure and instrument that will give the best outcome.

Table 1 Summary of the studies reviewed related to student nurses

Study	Compet-ence	Confidence	Context	Instrument and Cohort details	Measures	Surrogate measures eg. Attitudes Access Acceptance Motivation
Bogossian and Kellet (2010)	Implied but not stated Ability and feeling comfort-table	Implied but not stated Feeling comfortable	Exploration of barriers to e-portfolio access	Survey Questionnaire (administered to year 3 student nurses)	Four point Likert type scale using adjectives	Access Time Attitudes of staff to ICT
Bond (2009) and Bond (2010)	Ability	Belief in ability	Student nurses' internet skills	Survey questionnaire (initially administered to year 1 student nurses)	Competence rated by the use of adjectives Four point Likert type scale for confidence	n/a
Brettle and Raynor (2012)	Skills in the cognitive domain. Skills in the affective domain	Confident behaviour	Effectiveness of an online literacy tutorial	Survey questionnaire (administered to year 1 student nurses)	5 point scale for confidence	n/a
Cartwright and Menkens (2002)	Comfortable with using a computer	Not stated	Using ICT for distance learning	Survey questionnaire and end of year focus group discussion (administered to nursing students on a Masters) programme	Open ended survey responses. NUD*IST software to categorize themes from focus groups	Reliability of technology Productive use of time
Cotton and Gresty (2006)	"Is it easy to use?"	Not discussed	Using the think-aloud method to evaluate e-learning	Observation by Think-aloud (with pre-nursing and year 1 student nurses)	Protocol Analysis	Computer-based learning
Fetter (2009)	Relates to ability	Not discussed	Promotion of ICT in nursing curriculum	Survey questionnaire (administered to student nurses – academic year of cohort unknown)	4 point Likert scale	Computer user training
Gresty and Cotton (2003)	Discussed in relation to access and support-	Emotional reactions Likes and dislikes Nerves	Development of an online biology resource	Survey by questionnaire (administered to student nurses –	Interpretation of free text comments	Willingness to work online

	ing online learning	Inexper-ience		academic year of cohort unknown)		
Hoffman et al. (2011)	Relates to technical difficulties and ability to access technical help	Related to patient care only	Computer-ized case studies to support clinical reasoning skills	Survey questionnaire (administered to nursing students – year not stated)	Free text comments	Problem solving Motivation
Kelly et al. (2009)	No definition	Discussed but no definition	Effectiveness of and attitudes to online instructional videos	Survey questionnaire (administered to year 1 nursing students)	4 point Likert scale	Attitudes Opinions Motivation
Moule et al. (2010)	Computer literacy	Low confidence discussed as feelings of inability	Nursing students' experiences and e-learning in HE	Two phase mixed methods 1)questionnaire 2)case study visits (cohort included a range of nursing students undertaking different levels and types of study)	Thematic analysis	Motivation Organization infrastructure
Ragnes-kog and Gerdner (2006)	Computer literacy	Feelings about working with ICT	Computing competence in nurse teachers and nursing students	Survey Questionnaire (administered to 242 nursing students from an overall sample of 299– year not stated)	5 point Likert scale	n/a
Ward and Moule (2007)	Issues with computer skills as a barrier to ICT use	Not discussed	Nursing students' use of ICT to support learning and care delivery	Focus groups (with year two and year three student nurses)	Thematic analysis	Factors compounding ICT access and use. Attitudes Cultural shifts for ICT use

2.7 Computing competence and confidence in other groups

This section is a snapshot of the vast literature about competence and confidence in other computer user groups. The purpose of which is to ascertain if there are any similar or contrasting features in interpretations and the research methods used. These papers were selected as they show that discussions about different behavioural reactions and diversity in ICT abilities are not confined to student nurses. The discussions also represent best research practice from other sectors. Table 2 (See pages 82-83) summarizes the literature reviewed.

Schedlitzki, Young and Moule's (2011) study of management students' experiences with blended learning, refer to lack of confidence with online learning as "new and scary." Ward, Glogowska, Pollard et al.'s (2009) study of health professionals' attitudes towards ICT, imply competence through statements about education, training and development such as "efficient at work", "easily able to learn new computer skills" and "need more training." This application of competence resembles the theoretical model of performance (Rummler and Brache, 1995; Gilbert 1996). Ward et al. (2009, pp.82; 83) measure confidence as control, with statements about "lack of confidence, feeling stupid, unsure what to do, feel very intimidated". There is a polar contrast between these subjects encouraged to be honest about their performance and those in Eva et al.'s (2012) study who revealed the pressures of adopting false confidence. Whilst each study's participants were subjected to different methods, nevertheless similarities emerge in the hidden feelings about confidence.

In her study of trainee teachers' ICT literacy, Markauskaite (2007) refers to competence as a blend of technical and cognitive capabilities, such as using critical reasoning skills with technologies. Confidence is discussed using Bandura's (1986) model of self belief. Shih (2006) also draws on Bandura's (1986) model to describe individuals' judgements about their ability. Here the focus is on competence as an outcome and end user status as successful completion of a computing task. This is similar to the accomplished end-status performance defined by Gilbert (1996).

Levine and Donitsa-Schmidt (1998, p.128) in their discussion on confidence refer to beliefs and "mental constructions of experience." Using a structural equation their study introduced a causal model linking measures of computer experience, computer-related attitudes, confidence and perceived computer knowledge. The subsequent analysis shows that attitude will have an effect on confidence which in turn compounds becoming competent. The study also reveals that some individuals irrespective of their ability will have a general level of confidence, as described above (see Koriat et al., 1980; Bandura, 1986).

Compeau and Higgins (1995) equate confidence to judgments about ability. Competence is not specifically explored but their findings like Levine and Donitsa-Schmidt's (1998) evidence above, show a relationship between affect (interest), anxiety and the influence of confidence in judgment, on wanting to learn. Antonariakis (2009) does not specifically define competence, but implies its emergence in dental students' being able to work through different types of software products in accordance with the European Computer Driving Licence (ECDL).

2.7.1 Gender and computing competence and confidence

The following section discusses gender and computing competence and confidence. The purpose is not to discuss comparable gender issues from the vast range of literature. The discussion examples show how computing competence and confidence in women are reported on as a gender gap in computer use. Sieverding and Koch (2009) discuss gender and computing competence in the context of performance and achievement underestimation. For confidence, a comparison is made between Bandura's (1986) self belief model for success and the insidious effects on women when confronted with negative stereotyping as computer users.

Johnson (2009) in her reference to the prevalence of disparaging archetypal descriptions is highly critical of papers reporting on the disparities between women, computers and language. Dichotomies or binaries between poor self belief, incompetence and nonappearance of expertise (women) and expertise and competence and strong self belief (men), lead Johnson (2009) to challenge the masculinisation of computing competence and confidence. Details within these two studies report on similarities in competence in women as computer users, but also show attribution patterns and reticence amongst females, largely influenced by forces such as the media, education and family.

The gender gap does not suddenly appear in adulthood. A study by Dickhäuser and Stiensmeier-Pelster (2003) found differences between genders at school age. Attitudes towards and opinions of women as computer users were predominant in the home. The subsequent affect on self beliefs influenced the choice of computer studies or, opting to just use the computer as a tool. Dickhäuser and Stiensmeier-Pelster’s (2003) findings showed that females within their cohort preferred the latter option. The authors reflect on how this lower level of education has implications for further study and career opportunities. There are similarities between this study and that of Sáinz and Lopez-Sáez (2010). In spite of obtaining stronger academic grades than boys, girls were less likely to enrol for the *Technological Bachillerato* the Spanish pre-University baccalaureate programme for Computer Science, Engineering and Telecommunications (Ministry of Education, Culture and Sport Spain, 2009). The driving influences were peer and family related especially the mother's occupation. The findings showed a strong tradition of girls studying for jobs where computers were used in a supporting role to computing science, engineering and medicine.

These findings equate to Lozano et al.'s (2012) interpretation of competence as the capacity to be capable, but on the basis that everything is in place for this to happen which for females in the cited studies does not appear to be the case. The phenomena of self examination and reflection seem to be bound up with external bias and prejudice, which according to Sieverding and Koch (2009) affects confidence. Together these findings imply that females spend time in negotiation about their computing competence and confidence, based on what is happening around them and irrespective of abilities.

Overall this body of literature reflects the application of competence and confidence to a range of computer-related circumstances. The differing dimensions are influenced by their context and application. The evidence shows how personal and external factors can influence computing competence and confidence.

2.8 Instruments and measures used to explore computing competence and confidence in other groups

This section reviews the instruments and measures used to explore computing competence and confidence in groups other than student nurses. Antonariakis (2009) carried out a descriptive survey by questionnaire in two stages. The respondents, dental students were asked to identify if they found specific ICT activities 'mediocre', 'difficult' or 'very difficult.' These specific adjectives were chosen to show any differences before and after undertaking the ECDL qualification. Schedlitzki et al. (2011) used a mixed methods approach, gathering quantitative data related to access and frequency of use from the Blackboard site course statistics and qualitative evidence from direct interviews. The choice of evaluation methodology bridges the quantitative and qualitative approaches. Trends and themes emerging in the quantitative data were then used as reference points to ascertain participants' views. Ward et al. (2009) conducted a survey using an Information

Technology Attitude Scales for Health (ITASH) questionnaire (n=150) and PCA on a 79 item pool. Values of 1 to 4 reflected the Likert scale as strongly disagree, disagree, agree and strongly agree.

Markauskaite (2007, pp.554; 555) also used a survey with questionnaire. The prefix adjectives have a similar structure to the comfortable measure in Bogossian and Kellett (2010), but are set out as a 6 point Likert scale gauged from 0-5 as: Couldn't do that = 0, Not at all confident = 1, Not very confident = 2, Moderately confident = 3, Quite confident = 4, Totally confident = 5. Items were phrased as "I believe I have the capability to....." Using Principal Components Analysis (PCA), the key findings were the depth of the relationship and interaction between cognitive and technical capabilities and confidence. Shih (2006) surveyed 367 IT students using a questionnaire with a similar 4 point Likert scale. A PCA showed connections between confidence in ability and an increase in computer-related knowledge and skills. Structural Equation Modelling was used to assess causal relationships between the hypotheses for individual belief and computer competence.

Compeau and Higgins (1995) carried out a survey by questionnaire on (n=1020) followed by a Partial Least Squares model (similar to PCA looking for loadings between questionnaire items and constructs). Their computer self-efficacy measure used a 3 point scale of not at all confident, moderately confident and totally confident and a 5 point scale to assess anxiety. Levine and Donitsa-Schmidt's (1998) survey by questionnaire of Grade 7-12 students (n=309) contained a section about computer attitudes and confidence and also used a 5 point scale from strongly agree to strongly disagree. For competence and knowledge as a computer user, descriptive data was gathered to ascertain the possible effects of frequency of use on ability and scaled as 1 = never, 2 = rarely, 3 = often, 4 = everyday. A PCA revealed correlations between computer confidence, knowledge and attitudes. The theoretical model was also tested with structural equation.

In their assessment of gender and computing competence and confidence, Sieverding and Koch (2009, p.698) randomly assigned participants (psychology students - 99 men and 107 women), to experimental conditions which were recorded and compared. One task required subjects to assess others using a bipolar scale labelled "pure luck, both luck and ability, pure ability." Participants were also required to compare their own hypothetical computing competence using a 13 point scale from "very much worse, comparable, very much better." MANOVA (Multivariant Analysis of variance) was used to assess the interaction between gender and the two continuous variables of: evaluation of computer competence in others and self-evaluation.

Johnson (2009) used snowball sampling to collect her participants, students aged 13-17 years, observing and then interviewing them about their prowess as computer users. Each person then identified a potential participant for the study. Interestingly only the males within the cohort were enrolled in formal computer study. Thematic analysis revealed deep rooted opinions on gender and reactions to computers, influenced by technology-rich homes and technology-poor schools. Home circumstances giving access to ICT played a crucial role in young women becoming competent and confident as computer users.

The common denominator between all of the studies reviewed was computing competence and confidence. The discussions reflected contrasting educational and professional characteristics in the cohorts studied. Research in this area is not confined to health care professions. The language used to describe the experiences of competence and confidence phenomena is diverse. As a result this highlighted that a range of quantitative and qualitative methods can used to examine computing competence and confidence, but it is important to select the approach that will give the best results and findings. Studies using a mixed methods approach emerged as useful because they offered opportunities to test the results and findings from a first study in a subsequent or parallel activity. In the studies reviewed mixed methods seemed to give stronger outcomes than those using single activities.

Table 2 Summary of the studies reviewed related to other computer user groups

Study	Reference to competence	Reference to confidence	Context	Instrument	Measures	Surrogate measures eg. Attitudes Acceptance Motivation
Antonar-iakis (2009)	Practical application and professional ability	Not discussed	Dental students undertak-ing European Computer Driving Licence	Survey Questionnaire	3 adjectives mediocre, difficult and very difficult	Enjoyment Attitudes
Compeau and Higgins (1995)	Not explored	Individuals' beliefs Anxiety levels	Develop ment of a measure and test for computer self-efficacy	Survey Questionnaire	3 point scale for confidence 5 point scale for anxiety	Outcome expectations Interest in ICT Encouragement and support
Johnson (2009)	Incompetence	Poor self belief	Gender and computer use	Observation of activity followed by interview	Thematic analysis	Enjoyment Education
Levine and Donitsa-Schmidt (1998)	Perceived computer knowledge	Computer attitudes and confidence	Causal relations hip between confiden ce, attitudes and knowled ge	Survey Questionnaire	5 point scale for computer attitudes and confidence	Enjoyable Important Educational
Markauskaite (2007)	Blend of: 1.Personal ICT competence 2.Ability to support ICT competence development in students	Confidence behaviours and feelings of confidence when handling ICT	Trainee teachers' ICT literacy levels as technical and cognitive capabiliti es	Survey Questionnaire	6 point Likert scale (0-5)	Communication Creativity Collaboration
Schedlitzki et al. (2011)	Not explored	Lack of confidence. New and scary.	Manage ment students experien ces of blended learning	Blackboard site course statistics - participation rate data Interview	Frequency of usage of online learning activities Thematic analysis	Nature and quality of online discussion activities
Shih (2006)	Not explored	Bandura's (1986) model of self-belief	Effects of self-efficacy and compete nce on	Survey Questionnaire	4 point Likert scale	Improvements in academic assignments Environmental and organizational

			satisfact-ion with ICT			computing conditions
Sieverding and Koch (2009)	Performance and achievement underestimate-ion	Self-efficacy	Evaluat-ion of computer use, bias and gender	Observation of participants undertaking a task	13 point scale Evaluation of others. 3 point scale Self evaluation	Role models Employment and gender
Ward et al. (2009)	Education Training Development	Control	Health care work-force attitudes towards ICT	Survey ITASH Questionnaire	4 point Likert scale	Quality of care Organizational benefits Professional roles

2.9 Gaps in the literature

My task was to find literature that would give a broad understanding of the constructs of competence and confidence. The literature reviewed specifically comments on the features of these phenomena in individuals, and groups, but often uses different terminology for similar concepts. Having examined the evidence, I found that there were no straightforward interpretations, or accounts of the interaction between computing competence and confidence.

The majority of the findings reflect behavioural outcomes as visual observations of being or becoming competent and confident. The thought provoking evidence of Butterfield and Metcalfe (2006) suggests latent phenomena, portrayed as feelings and behaviours that individuals wish to hide from view. Bandura (1986) and others have clearly influenced thinking related to self belief and ability. Most of the descriptions portray human error as incompetence. The human capacity for making mistakes, being uncertain or less than confident is regarded as a flaw. With the exception of Dreyfus and Dreyfus (1986), all other interpretations have not considered the normality of error. Even so the Dreyfus and Dreyfus (1986) model reflects competence in a single direction. Computing competence and confidence are likely to mirror life as a combination of successes and setbacks.

Research into this area revealed some honest and often negative thoughts that individuals use to express their actual competence and confidence. People are clearly troubled by the fear of getting it wrong. Also there is no real evidence of the ways of knowing that people might use when working through a computing problem. Although illustrating observable reactions and abilities, this detail did not show the deeper unobservable and latent behavioural influences such as thinking and deduction. In the healthcare environment the practical outcome is being able to deal with anomalous events such as corrective action. The nursing literature tends to explore competence and confidence from a practice perspective but do not show how they develop or change, even though many of the research instruments cited do reflect differing degrees of competence and confidence. On balance though, the evidence does reflect mixed abilities and experiences of competence and confidence across a broad range of individuals and groups.

Some findings did imply a relationship between competence and confidence. However, the majority of studies reviewed focussed on the rules and order of being competent and confident in a specific situation. Although stated with caution, this does appear easier to measure than the development of cognitive skills and intuitions about confidence that might be present. Together the findings imply a loose relationship between competence and confidence. They do not show how competence and confidence come to be known and interact with each other. Nor do they reveal if there are any differences between actual and projected competence and confidence. This is especially so in studies where the focus is on working through a task, professional behaviour and cognitive skills used to help others (Markauskaite, 2007; Antonariakis, 2009; Ward et al., 2009).

None of the studies identified an ultimate model of competence and / or confidence that could be applied to their specific areas. There seems to be a gap in the literature between understanding the cognitive and affective skills required for competence and confidence and the interaction between the latent features of both and at what point these features might actually surface. Although latent characteristics such as cognition were examined, none of the studies attempted to find out if these hidden features could influence both competence and confidence and at what point they might be revealed.

All of the studies reviewed include tools and instruments used to measure some aspects of competence and confidence. Direct observation using a think-aloud approach, appeared to be the least used in the studies reviewed. A number of studies used multiple and mixed methods emerging from quantitative exploratory and qualitative explanatory paradigms. Together these offer insight into the range of approaches to explore and explain computing competence and confidence. This is justified where the interest is the relationship, the depth and the nature of different combinations of competence and confidence phenomena.

2.10 The research questions

Therefore the structure of the research questions needed to give answers that would show new insight into computing competence and confidence. Three questions were constructed as:

1. **What is the nature of the relationship between competence and confidence in computing skills in nursing students?**

   With the sub-question of: In what types of tasks and circumstances are these observable?

2. **If there is a relationship, is it possible to identify where under-confidence and over-confidence have an effect on the competence of student nurses as computer users?**

   With the sub-question of: What does it look like?

3. **Can an optimum level of computing confidence and competence be defined which students on a nursing course should be expected to have?**

   With the sub-question of: How would we know when we had this?

2.11 Conclusion

This chapter has reported on literature about competence and confidence in ICT, with a specific focus on student nurses as computer users. Computing competence and confidence have been also been examined in literature from a range of disciplines beyond and including health and education. The studies examined investigated the application of ICT artefacts and the issues facing different groups of contemporary learners, education and workplace organizations. The gaps in the literature highlighted the absence of investigation into unobservable and latent phenomena. These may be influential on that which can be observed in computing competence and confidence. The combined strengths offered a good insight into how different learners respond to and cope with ICT.

A number of papers use the terms related to computing competence and confidence interchangeably. However, the richness of this material does provide an opportunity to mine into the broad context rather than dismiss the core differences between them. Discussions about user groups make clear links between skill development and performance in practice. The ties with social constructs such as formal and informal support, communication and emotional status show the influence of human interaction. As ICT has an established presence in education and the workplace, these discussions identify that learning influences the development of skills and self belief. The studies reviewed reflect the advantages of diversity as these differences clearly offer a range of methodological considerations and ways to investigate computing competence and confidence. This body of literature framed the emerging research questions. Using these contexts, the next chapter sets out the methodological framework for the research.

Chapter Three

Methodology

3.1 Introduction

The previous chapter reviewed literature about competence and confidence and research into their application to student nurses as computer users. Overall survey by questionnaire and direct observation of ICT users emerged as popular methods to investigate computing competence and confidence. Three research questions were constructed from the literature. In this chapter the rejection of a single study emerges from assessment of the advantages and disadvantages of a mixed methods approach. Ethical considerations precede the design and characteristics for two sequential studies.

3.2 Why mixed methods for this research?

In spite of the raised profile of ICT in nurse education, there were a limited number of mixed methods studies investigating competence and confidence in student nurses as computer users (Johnson, 2009; Moule et al., 2010; Schedlitzki et al., 2011). Studies using mixed methods showed that multiple approaches served to balance strengths and weaknesses. The interaction from combined findings seemed to offer a much greater understanding than a single approach. The use of mixed methods reflected the dynamic interface between and complexities of computing competence and confidence. Competence and confidence phenomena by virtue of their observable contexts (see Dreyfus and Dreyfus, 1986; Swanson, 1994; Rummler and Brache, 1995; Gilbert, 1996; Bowman, 1999; Benner, 2001; Savolainen, 2002; Berman, 2006; Mulder, 2007; Lum, 2009; Lozano et al., 2012) and unobservable contexts (see Koriat et al., 1980; Bandura, 1986; Slatter, 1990; Gigerenzer et al., 1991; Keen, 1992; Parry, 1996; Kruger and Dunning, 1999; Butterfield and Metcalfe, 2001; Whitehouse et al., 2002) are clearly complex in their make-up and therein create problems for choices in research activity. Together the few studies and these multifaceted interpretations were persuasive arguments for a mixed methods approach.

The research by Johnson (2009), Moule et al. (2010) and Schedlitzki et al. (2011) highlighted the possibility of using innovative method combinations. Indeed Mingers (2001) concluded that mixed methods would help to advance methodology development in ICT research. Later work by Lobe and Vehovar (2009) also favoured mixed methods to broaden both understanding of ICT methodological concepts and the complexities of the area being studied. However with the exception of the cited literature, there has not been a strong response from nurse education to the use of mixed methods in ICT research. This is in spite of a growing body of supportive literature on paradigm considerations and decisions. For example, Johnson and Onwuegbuzie (2012) offer helpful advice about the decision making process and the creation of points of contact within and between studies using mixed methods. Furthermore Hall and Howard (2012) in their synergy of quantitative and qualitative paradigms discuss how integrated methods with mixing at different stages, are gaining momentum as the third paradigm.

Three different research questions emerged from the literature. Having multiple research questions does not automatically mean different paradigms and methods to address them and required careful examination of their structure (Molina-Azorin, 2011). The first question, **"What is the nature of the relationship between competence and confidence in computing skills in nursing students?"** was exploratory. The use of the interrogative 'What' invited a range of characteristics. Guidance in Tashakkori and Teddlie (2003) showing the potential number of variants on and correlations between competence and confidence, aligned with a numerical quantitative method. Based on the previous studies this could have given a range of opinions about previous and current ICT experiences. The potential for lots of different answer combinations influenced the decision to use an exploratory method with numerical outcomes.

The second question, **"If there is a relationship, is it possible to identify where under-confidence and over-confidence have an effect on the competence of student nurses as computer users?"** was open-ended and invited an explanatory answer based on what could be directly observed. In contrast to the first question the present tense structure of the verb 'identify' required an answer based on the here-and-now. As examination of current occurrences requires human interaction, the decision was made to use a method that would give visual evidence about what could be described, possibly answering the sub-question of 'What does it look like', as rich and thickly detailed descriptions of computing competence and confidence. These characteristics were suggestive of a qualitative participatory method.

The third question **"Can an optimum level of computing confidence and competence be defined which students on a nursing course should be expected to have?"** used 'Can' as a directional verb. Its context suggested possibility and invited a synthesis of the results from the first two questions (Robson, 2002;

Tashakkori and Teddlie, 2003). It was asking when I would know that I had established an optimum level of computing competence and confidence.

Together these points show how the added value of mixed methods would enable:

- A critical examination of the complexities within computing competence and confidence from different perspectives.

- New understanding about competence and confidence in student nurses as computer users

Creswell and Plano Clark (2007) identify the challenges of mixed methods as time consuming and the requirement for careful decisions such as the order of the activities. Morgan (1998) takes up a pragmatic theme cautioning on the technical challenges. For example, the different kinds of data and evidence collection and decisions about application and practical considerations to be worked out long before any research activity commences. Developments in the researcher's skill and knowledge are critical in order to conduct mixed methods (Leech and Onwuegbuzie, 2009; Molina-Azorin, 2011). These discussions showed that combining quantitative and qualitative approaches was potentially arduous and would not automatically give stronger findings. All of these challenges applied to this study and are discussed at the relevant points.

Together the chosen paradigms reflected the schism that separates quantitative and qualitative research traditions (Tashakkori and Teddlie, 2003). Concerns have been expressed about the confusion between integrated research and collecting and analyzing quantitative and qualitative material separately (Castro, Kellison, Boyd et al., 2010; Harritz, 2011). Guidance in Tashakkori and Teddlie (2003) supported the decision that the pragmatic aspects could be separate, but with specified links. The first link was that the results from the first study would influence the design of the second study. The second link was that there would be some similarities in the results from both studies. The third link was that the mixing would be strengthened by inviting the same subjects to participate in the two studies. The main integration would be a synthesis of the findings for each study.

It was anticipated that the synthesized findings would give more information and a better understanding of the range of computing competence and confidence phenomena. A further benefit was the reduction of "inappropriate certainty" (Robson, 2002, p.370) from a single set of results. However it was important to recognize that each set of results and findings would be attributable to the methods selected (Erzberger and Kelle, 2003).

3.3 Ethical approval

The most important aspects of any research activity are the duty of care towards, protection of and respect for the potential participants. Once the practical activities had been decided and what would be required from the students, relevant documents for research using healthy volunteers were completed and submitted to the University of Nottingham's Faculty of Health Sciences Medical School Ethics Committee and the Head of School (See Appendices 1-6). The following sections set out the important ethical considerations.

3.3.1 Coercion

As the study involved a faculty member the students may have felt obliged to participate. The supporting correspondence contained reassurance that the study would not have any bearing on their studies. Individuals were not under any obligation to take part and were also free to withdraw from the activity at any time.

3.3.2 Consent

Informed consent was obtained from each participant for each study. Students are busy individuals and it was possible that they might have forgotten what they had agreed to. A declaration was made that a copy of the consent form would be provided along with the other documentation. The consent form included all contact details. The consent form stated that participation was entirely voluntary with the right to withdraw at any time.

3.3.3 Anonymity

In the first study the potential problems of anonymity were addressed by not having access to the names of the respondents. A colleague volunteered to administer relevant practical activities in order to maintain total anonymity.

3.3.4 Confidentiality

All data such as names and contact information were stored securely in Microsoft Excel by the designated administrator on the premises of The University of Nottingham School of Nursing and Midwifery. Information was maintained and backed up on the School of Nursing and Midwifery's Information Technology hard drive. Permission to proceed was granted by the Ethics Committee and then the Head of School. Authorization was given to approach the student body by e-mail and paper poster advertisement across the School. Direct access to groups of students was also permitted, but only in the presence of another colleague and at the end of a teaching session.

Study One

3.4 Aims

The aims of the first study were to find out if there is a relationship between competence and confidence in student nurses as computer users and to see whether that relationship could be observed.

3.5 Method

3.5.1 Participants

To be credible and meaningful a quantitative study requires a significant number of participants that are representative of the population being examined. Robson (2002) identifies this as the sampling frame; the ratio between recruited subjects and the population of interest. As the interest was in student nurses the decision was made to create a study cohort from the population working towards a Diploma or Degree in Nursing. In a two year span this equates to approximately 2000 undergraduates from within the region and beyond, including international students. Learners are drawn from a wide range of social, economic, education and employment backgrounds. The age range of the student population was between 17 and 50+ years.

3.5.2 Design decisions

Using Robson (2002) and Tashakkori and Teddlie (2003), the decision to follow a fixed design framework was influenced by multiple factors.

- Fixed design studies are theory driven and influenced by previous research (Hall and Howard 2012; Johnson and Onwuegbuzie, 2012). The literature review generated a theoretical framework from established studies into computing competence and confidence.

- Fixed design frameworks require important decisions about subject inclusion and elimination prior to the practical activities. The literature review was the start of this process.

- Fixed designs require pilot work, so this would be an opportunity to resolve any problems prior to the real-time activity.

- As a lecturer known to the potential participants, a fixed design structure would help to prevent deviation from a predetermined plan, unethical bias and partiality.

- Fixed designs are legitimised by robust assessment of trustworthiness. Robson (2002) and Tashakkori and Teddlie (2003) discuss how trustworthiness and unbiased results are crucial for credibility. In fixed design studies, trustworthiness is determined by tests for validity and reliability (see later in this chapter). Both of which indicate the level of truth, accuracy and if the findings can be applied to the broader population of student nurses.

- The exploratory findings from the first study are a key point of contact and influence on the proceedings in second explanatory study.

3.5.3 Instrument decisions

The literature review highlighted survey as a good method to elicit student nurses' self assessment of computing competence and confidence (Cartwright and Menkens, 2002; Gresty and Cotton, 2003; Ragneskog and Gerdner, 2006; Bond, 2009; Fetter, 2009; Kelly et al., 2009; Bogossian and Kellett, 2010, Moule et al., 2010; Hoffman et al., 2011; Brettle and Raynor, 2012). A survey could be either carried out in person, by telephone, by e-mail with an attachment or by post. The choice of a postal questionnaire was based on the following reasons. Survey by e-mail attachment was considered, but raised the possibility that respondents would likely be those who were interested in computers, thereby introducing bias into the study. A postal questionnaire by internal or external mail was considered the best option, as with careful planning it would meet ethical criteria for confidentiality and anonymity and importantly, no obligation for the student to participate. Significantly the opinions from the students would give discrete details of their thoughts as computer users.

3.5.4 The structure and content of the questionnaire

This section reviews cited and additional literature used to inform the structure and content of the questionnaire. The final draft of the questionnaire was organised as 8 nominal and 40 interval items. The first section contained the 8 nominal items to elicit background information. The 40 interval items were divided into 20 statements each about competence and confidence and described phenomena that could be seen by others and students' unobservable personal opinions. The output from the 40 items would translate as variables for quantitative analysis. This data would influence the conduct of the second study. All of these questions contained features and descriptions that have been observed in previous research. It was important to ask questions that would give information about the types of computing tasks and circumstances where computing competence and confidence could be observed

3.5.5 Demographic information as categorical variables

Questions related to demographics included generic characteristics such as age and gender (See Figure 2, page 103). Questions about domestic computer use were influenced by the questionnaire created by Ballantine et al. (2007) where they show links between home computing activity and the development of computing competence. Barak, Waks and Doppelt (2000) discuss the dichotomy between ICT resource provision and its use, from which emerged the question about using a computer in the School of Nursing.

Figure 2 Demographic questions

Gender
Age
Current year of study
Access to a computer at home
Main reason for using a computer at home
If previous activity involved the use of a computer
Previous formal study in computing knowledge and skills
Using a computer in the School of Nursing

3.5.6 Items for measuring competence

Figure 3 (See page 107) shows the 20 items for measuring competence. The question 'I have learnt some skills by just experimenting' related to discussion on the benefits of a supportive ICT learning environment (Alpay, Needham and Murray, 2000). Cotton and Gresty's (2006) think-aloud study shaped the three questions about watching, listening and talking. 'I have learnt some computing skills by watching other people' and 'I have learnt some computing skills by listening to other people' and 'I have learnt some computing skills by talking to and asking other people'. These were created as to potentially give information about the informal learning goes on between student nurses for example, in an ICT classroom.

Adams' (2004) concern about replacing human support with online and hard copy structures influenced 'I have found the 'Help' function on the computer useful' and 'I have found computer manuals useful'. 'The taught sessions in the University about using computers have been very useful in assisting my understanding of them', evolved from the Information Age Partnership (2002) and Hartley's (2007) work on the importance of pedagogy to support the acquisition of computing competence.

Questions about spontaneous behaviour where individuals appear to work effortlessly using contextual skills and knowledge were 'Some aspects of using a computer will always be the same irrespective of the activity (e.g. switching it on and off, using a mouse or scrolling down)' and 'I can quickly work through the computing activities that I am familiar with'. These statements were based on Markauskaite's (2007) interpretation of competence, as a blend of experiential, technical and cognitive capabilities. Cretchley's (2007) study showed a correlation between procedural aptitude and exposure to different kinds of ICT software. This influenced the inclusion of a similar question related to students' ability to work through most computing activities 'I can usually work through most computing activities I am faced with in the School of Nursing'.

Cartwright and Menken's (2002) study influenced the three questions about task-related competence. 'I always use computer to search for academic literature for my assignments' and 'I always use a computer to complete my assignments' and 'Using a computer in the University has assisted in the organisation/management of my studies'. The structure of novice to expert (Dreyfus and Dreyfus, 1986) influenced the three questions on the incremental acquisition of competence 'My computing skills have improved since I commenced my current studies' and 'When I started to use a computer, my computing skills seemed to get worse before they improved even though I practised' and 'Sometimes I can complete certain computing activities without even having to think about them'.

The question about competence and problem solving 'I sometimes guess or just use my intuition when working through a computing activity I am unsure about' came from Dangwal, Jha, Chatterjee et al.'s (2006) hole in the wall study of children who had no previous contact with computers, but demonstrated reasoning and judgement skills. The parallel is that practitioners and student nurses will be exposed to unfamiliar aspects of electronic health care records, requiring ITC problem solving skills.

Ballatine et al. (2007) included questions asking how comfortable their subjects felt when carrying out a computing activity. Their questionnaire design influenced the two positive and negative statements about computing competence. 'I am a complete beginner when it comes to using a computer' and 'I have an excellent grasp of a range of computing activities linked to my studies'. However 'comfort' as a noun and a verb was deliberately avoided to prevent any misunderstanding with its aesthetic meaning. The question 'People will ask me for help if they have a computing problem' was influenced by Lindsay, Smith and Bellaby's (2008) work on the value of collaboration within peer groups.

Figure 3 Items for measuring competence

I have learnt some skills by just experimenting.
I have learnt some computing skills by watching other people.
I have learnt some computing skills by listening to other people.
I have learnt some computing skills by talking to and asking other people.
I have found the 'Help' function on the computer useful.
I have found computer manuals useful.
The taught sessions in the University about using computers have been very useful in assisting my understanding of them.
Some aspects of using a computer will always be the same irrespective of the activity (e.g. switching it on and off, using a mouse or scrolling down).
I always use computer to search for academic literature for my assignments.
I always use a computer to complete my assignments.
Using a computer in the University has assisted in the organisation / management of my studies.
My computing skills have improved since I commenced my current studies.
People will ask me for help if they have a computing problem.
I am a complete beginner when it comes to using a computer.
When I started to use a computer, my computing skills seemed to get worse before they improved even though I practised.
I can quickly work through the computing activities that I am familiar with.
I sometimes guess or just use my intuition when working through a computing activity I am unsure about.
Sometimes I can complete certain computing activities without even having to think about them.
I can usually work through most computing activities I am faced with in the School of Nursing.
I have an excellent grasp of a range of computing activities linked to my studies.

3.5.7 Items for measuring confidence

Figure 4 (See page 111) shows the 20 items for confidence. The confidence statements for each variable followed a similar design and format to the competence structure, in order to give a balanced questionnaire. McLoughlin and Oliver (1998), Stajkovic (2006), and Wilfong (2006) identified how behavioural confidence is a broad and enduring disposition, scaled between high self-belief and esteem and the exact opposite. These observations shaped the creation of 'I did not think about my level of confidence during my initial computing experiences' and 'I dread the thought of having to learn any new computing activity' and 'When using a computer my level of confidence is not an issue. I just get on with the task'. Green, Ashton and Felstead (2001) and Gorman and Corbitt (2002) recommended protected time for learners to practise basic tasks. These discussions underpinned the statement about time and anxiety as 'I am confident about using a computer providing I have plenty of time to work through an activity, otherwise I become anxious'.

Twidale's (2005) study on 'over the shoulder' learning about how students help each other informally prompted the questions 'I feel confident enough to work through a new computing activity as long as there is someone available to help me', 'I have confidence in my ability to help other students with their computing problems', 'I don't mind people watching me use a computer' and 'I have confidence in my ability to help other students with their computing problems'. In her study of 11-13 year old computer users, Upitis (1998) discussed the development of confidence whilst working through uncertainty. These findings framed 'I have some computing knowledge and skills and feel confident about learning new computing information and activities' and 'I feel confident enough to have a go at working through an unfamiliar computing activity without any help whatsoever.'

Adoyoyin (2005) identified the practical circumstances where library staff could develop ICT related confidence. This work shaped the question about computing confidence in the clinical area 'I would feel confident about working through a computer-based proficiency in the clinical area without any help. Whitehouse et al.'s (2002) work on the problems of over-confidence and under-competence influenced 'During my studies when in the University, I am confident when asked to carry out an exercise using a computer'. The question on confidence and taught provision, 'The taught sessions in the University have increased my confidence in using a computer' was influenced as before by Hartley (2007). Likewise the work of Adams (2004) shaped the three questions 'I feel confident enough to work through a new computing activity using a hard copy

‘Help’ manual’ and ‘I feel confident enough to work through a new computing activity using the online ‘Help’ function’ and I have confidence in my ability to search for online literature’.

A number of papers report that confidence is influenced by experience (Thiele, Allen and Stucky, 1999; Kupperschmidt, 2001; Cartwright and Menkens, 2002; Kenny, 2002; Ragneskog and Gerdner, 2006). This literature informed the questions ‘My confidence in my computing ability seemed to deteriorate after my initial contact with a computer’ and ‘My confidence in using a computer appears to have increased with practise’.

The question ‘Even before my current studies I felt confident about using a computer’ was influenced by the ONS (2006) finding that only 30% of adults in the United Kingdom had received formal ICT education (see chapter one). The work of Ballantine et al. (2007) about ICT domestic availability and use prompted the question ‘I am usually confident in using a computer away from the School of Nursing’.

Figure 4 Items for measuring confidence

I did not think about my level of confidence during my initial computing experiences.
I have some computing knowledge and skills and feel confident about learning new computing information and activities.
My confidence in my computing ability seemed to deteriorate after my initial contact with a computer.
I feel confident enough to have a go at working through an unfamiliar computing activity.
I dread the thought of having to learn any new computing activity.
I am confident about using a computer providing I have plenty of time to work through an activity, otherwise I become anxious.
I feel confident enough to work through a new computing activity using a hard copy 'Help' manual
I feel confident enough to work through a new computing activity using the online 'Help' function.
I feel confident enough to work through a new computing activity as long as there is someone available to help me.
My confidence in using a computer appears to have increased with practise.
I feel confident enough to work through a new computing activity without any help whatsoever.
When using a computer my level of confidence is not an issue. I just get on with the task.
The taught sessions in the University have increased my confidence in using a computer.
During my studies when in the University, I am confident when asked to carry out an exercise using a computer.
I have confidence in my ability to search for online literature.
I would feel confident about working through a computer-based proficiency in the clinical area without any help.
Even before my current studies I felt confident about using a computer.
I have confidence in my ability to help other students with their computing problems
I don't mind people watching me use a computer
I am usually confident in using a computer away from the School of Nursing

3.5.8 Scale and level of measurement

The aim was to select a scale that would generate broad but accurate responses to the questionnaire. A 4-point adjectival ordinal scale was selected to measure the responses of the students in the continuous variables (Strongly Disagree = 1, Disagree = 2, Agree = 3, Strongly Agree = 4). Ordinal scales are popular for social surveys, but the choice of adjective needs to be carefully determined by the type of questions. The decision was made to remove neutral from the scale. Although the value of neutral may be a mark of objectivity, it is also an indeterminate adjective and therein carries the risk of limitations in data generation and analysis (Johnston, Leung, Fielding et al., 2003; Yaghmaie, 2007). It could have been used by the cohort as an opt-out response.

Further contributions to the literature on scale development are either in support of or against the use of the indeterminate adjective within its structure. Thurstone (1947, p.367) invites researchers to define the scale according to their requirements, "so that the distribution takes any form one chooses." Linting, Meulman, Groenen et al. (2007) make an important point about where exactly on the scale impartial adjectives should be placed, as 'neutral' or 'no opinion' are not necessarily midpoints. Parahoo (1997) discusses the inclusion of neutral and similar detached adjectives to measure opinions. The scaling levels and the removal of the indeterminate adjective neutral had to be compatible with the eventual choice of research method.

3.6 Validity and reliability

Having created the survey and questionnaire the next task was to determine its validity and reliability. Validity and reliability are intertwined because until a measure is reliable it cannot be said to be valid. The purpose is to seek out any errors linked to measurement. This section will discuss the actions taken to address validity and reliability.

3.6.1 Face validity

Validity is the extent to which an instrument measures what it has been designed to measure, in that it will stand the test of time for subsequent research (Field, 2009). An important practicality was the detection of anomalies associated with extraneous statements, logical language, accuracy in syntax and any problems with random error in the questionnaire. This is face validity and required the involvement of individuals as willing volunteers to assess sentence structure and implied meaning. One of the problems associated with the instructions for completion and the questionnaire itself lies in interpretation, as the same statement may mean different things for different people.

In this context, validity of the questionnaire depended on who would be completing it. A group of third year students nearing completion of their studies not otherwise involved were asked to comment on the structure and flow of the draft of the questionnaire, reflecting on how they would have responded as first and second year students. Critical inspection from this initial advice revealed items which were complex, repetitive and ambiguous. For example, **'Learning computer skills in the clinical area has increased my confidence in using a computer for both academic and practical work related to my current Course.'** This was redesigned as **'I would feel confident about working through a computer-based proficiency in the clinical area without any help.'** The 50-item questionnaire was re-drafted and presented to a random group of 23 undergraduate end-of-second year students of nursing for an initial pilot activity also not otherwise involved.

3.6.2 Construct validity

Construct validity is assessment of the nature of the variables and their relevance to the study. Although significant progress had been made with this in the filtering exercise after the literature review, the expert advice of a colleague from another University was sought who made the following invaluable observations. This person has national and international status as a result of her ICT pioneering work and subsequent advisory activity for nurse education and health care informatics. The structure of the research question was suggestive of an observable correlation between the two variables of competence and confidence, so it was important to make sure that the questions were directly about these two variables.

A second factor was that in order not to impinge balance, there should be an equal number of questions on both variables. The third important factor was that structure and presentational features in the questions were similar in each section. For example the expert colleague identified that the question about online Help functions from a competence perspective should be mirrored by a question on online Help functions from a confidence perspective.

3.6.3 Cronbach's alpha coefficient as a measure of reliability

Reliability is the stability and consistency of the research instrument to measure the variables. The use of 40 continuous variables meant that in the event that one or more proved to be unreliable, they could be removed before analysis. For composite reliability the check was to look for variables which stood out as they have little or nothing in common with the other variables and therefore affect reliability. Cronbach's alpha coefficient was therefore used to assess two things. These were the overall reliability on one scale item compared to another scale item as covariance and the amount of variance within the item (Thurstone, 1947; Field, 2009). There are a number of issues for consideration when using Cronbach's alpha coefficient. The advice of a Cronbach's alpha coefficient as acceptable >.7, should be regarded with some caution (Pallant, 2007; Tabachnick and Fidell, 2007; Field, 2009). Whilst a lower figure is indicative of unreliability, the value of alpha is influenced by the number of scale items, with the possible outcome of a false-positive.

High alpha values may be influenced by the number of items and not scale reliability. Negatively worded items can influence the alpha, but these types of statements are necessary to reduce response bias. Pallant (2007) promotes the use of reversed coding to check a uni-dimensional scale for negatively worded items. In effect reverse coding is changing the order of Strongly Agree/Disagree. Szajna (1994) used a 7-point scale with end points of highly likely and highly unlikely. Her discussion on how she eventually recoded negative statements highlights the issue of having a higher number of negative covariances than positive ones, resulting in a negative and implausible Cronbach's alpha coefficient. For this study the permutations tested were:

- Positively worded scale items only
- All competence items
- All confidence items
- All scale items after reverse codes were applied to negatively worded statements

Figure 5 below shows the items where reverse coding was applied as all of these were negatively worded.

Figure 5 Reverse coded items for Cronbach's Alpha

I am a complete beginner when it comes to using a computer.
When I started to use a computer, my computing skills seemed to get worse before they improved even though I practised.
I sometimes guess or just use my intuition when working through a computing activity I am unsure about.
My confidence in my computing ability seemed to deteriorate after my initial contact with a computer.
I dread the thought of having to learn any new computing activity.
I am confident about using a computer providing I have plenty of time to work through an activity, otherwise I become anxious.
I feel confident enough to work through a new computing activity as long as there is someone available to help me.

Therefore Cronbach's alpha coefficient was carried out to determine the stability of the instrument. This assessed the internal consistency of each category in the questionnaire. For positively worded items the Cronbach's alpha = .872, items with reverse codes applied to negatively worded statements = .783, competence items with reverse codes applied to negatively worded items = .615, confidence items with reverse codes applied to negatively worded items = .615. With the exception of the competence item, the Cronbach's Alpha value = > .7 for all other items. The Cronbach's Alpha for all scale items including the reverse codes applied to negatively worded statements' = .783 and is highly acceptable.

3.7 Procedure

3.7.1 Recruitment of subjects

An e-mail and hard copy poster advert was sent out to all first and second year student nurses (See Appendix 3). To increase the numbers of subjects, appointments were made with individual lecturers who agreed to supervise contact with students after teaching sessions. Students who did not want to stay and listen were free to leave. It was important to be clear about what was being asked of the students and the research was entirely dependent on their willingness to participate, so a short off-the-cuff two minute presentation was developed and practised. The purpose of the research was explained. Afterwards, questions posed by the students in the class were answered. These covered areas such as the time-scale for returning the questionnaire and what would happen if they made an error or missed out a question during completion. A return date had been deliberately omitted as the students were volunteers and they could complete the questionnaire at their leisure. A brief overview about the potential coding system was provided to those who asked about errors and missed questions.

Interestingly many students said the study was a good idea given the computer-based activities they had experienced in theory and practice. They liked the idea of being involved in and contributing towards a research activity as a University initiative. Work e-mail and the research administrator's e-mail details were given. Students were advised of anonymity procedures and that they could withdraw from the research at any time.

Data were collected from first and second year student nurses between July 2008 and April 2009. A total of 382 students volunteered to participate in the research. This represented 18.75% of the 2000 first and second year students across the School of Nursing. From these 375 students returned one copy of the signed consent form and the questionnaire. This was a 98% response rate from the initial volunteer group of subjects.

3.7.2 Research administration and management

From that point in order to protect the students' interests, maintain anonymity, confidentiality and preserve research integrity, the administration of the study was entirely managed by the supportive colleague. She inputted the names and details of the student volunteers into a database and dealt with processing information, photocopying, posting and receiving questionnaires and consent forms and sending out the portfolio statements to those students who had participated. Individuals who expressed an interest in becoming involved were asked to make contact by return of e-mail. These details were passed on to the colleague. She then sent each potential participant an explanatory letter about the research, along with a Healthy Volunteers Information sheet; two copies of a consent form and a questionnaire which included instructions for completion (See Appendices 4-7). Details on the consent form (See Appendix 5) included a space for the student to enter their name and address.

An internally addressed and where required, a stamped addressed envelope was provided for each student. This was for them to return one copy of their completed consent form plus the questionnaire, to the administrator. She in turn extracted the consent forms and coded the questionnaires. Each coded anonymous questionnaire was then passed back for data inputting. Students were given a Statement of Participation for their development portfolios, in acknowledgement of their contribution.

3.7.3 The choice of statistical software and the creation of codes and data files

The choice of software to manage the data input and output was the Statistical Package for Social Sciences (SPSS Version 16.0). As data from the questionnaires needed to be converted into a format suitable for SPSS, the first procedure was to define the variables to be tested. Each variable was allocated a label and a code (See Appendix 8). A number of different interpretations of labels were tested, in order to meet the requirements of the SPSS framework. This was repeated for the coding instructions. Albeit that there were some restrictions on entering letters and numbers, the code column in SPSS was invaluable as it allowed alteration and experimentation with the variable descriptions until it was clear that they would provide the appropriate output for scrutiny. For example, question 7 asked

Have you undertaken any formal study in computing knowledge and skills? E.g. European Computer Driving Licence, GCSE in Information Technology, GNVQ, RSA Word Processing)

a) Yes b) No

If you have answered Yes to question 7, please write the titles of all Courses on the lines below

Question 7 was open-ended in its design and invited the respondent to provide an answer of their choice as an alternative to the ones listed (See Appendix 7). The demographic statements required a tick alongside the answer of choice. However the answers to question 7 elicited a large range of ICT courses. These responses were streamlined using a simple coding structure, to prevent excess outliers in the data output. The questions on competence and confidence required the respondent to underline their choice and were coded 1 – 4 respectively for Strongly Disagree, Disagree, Agree and Strongly Agree.

Further issues in the SPSS environment for consideration were related to logical order, adherence to unique coding, converting closed questions to a numerical format such as 1= male, 2 = female, dealing with missing data and values requiring decimal places. For missing data the choice of 666 (Field, 2009) was selected as it did not correspond with any other value. This code indicated that there was no recorded value for a participant. Prior to the final decisions on variable and data entry processes in SPSS, a number of experimental runs established which would give the best definitions and display of the characteristics. Checks for data inputting accuracy were subjected to the SPSS procedures for descriptive statistics, including the detection of anomalies related to missing and mistyped values. Statistical power in the study was dependent on the number of subjects completing and returning the questionnaire.

3.8 Analysis

Commencing with the criteria for selection and the rejection of Multiple Regression, this section will discuss the analysis tool selected for the first study, Principal Component Analysis. The discussion will illustrate the predisposing criteria for and decisions about its choice identifying the strengths and limitations. The practical considerations unique to Principal Component Analysis will be discussed under individual subheadings showing the procedures within its structure.

The evidence from the literature review appeared to show that competence and confidence were interconnected through a variety of underpinning factors, some of which were visual behaviours and others that were not entirely apparent, such as hidden fear. Therefore it was important to find an analysis tool that would meet a number of criteria. The first was that the suggested relationship between competence and confidence needed an analysis that could show a correlation between those two variables and the strength of that relationship. The second requirement was related to the fact that the research instrument, a survey required identification of the categories and that the analysis would show the level of importance for competence and confidence. This would give results about their characteristics and the order of their significance.

The third requirement was in relation to the cohort for study. Albeit that the students had much in common as learners, each person had unique circumstances and experiences. It was important to reflect these differences in the research. This required an analysis that would examine the variance or the estimate of the spread of the data. The fourth criteria was that if for whatever reason that one or more of the statements in the questionnaire should be removed because of challenges to reliability, then the analysis and results should reflect that change. The fifth requirement was that the analysis should be able to show if underlying hidden dimensions of competence and confidence were present. Sixth, as this was an exploratory study it was anticipated that the findings and emerging theory could be used to inform the conduct of a second activity.

An initial consideration was Multiple Regression as similar to correlation its objective is to explore the relationship between independent and dependent variables. This was discarded because the intention of Multiple Regression is to confirm a prediction and the variable status of independent and dependent was not known. The interest was in correlation and the possibility of a relationship between competence and confidence. There was no evidence to support a prediction. Also regression analysis has assumptions that the independent variables are measured without error (Tabachnick and Fidell, 2007). Given that the variables were grounded in human behaviour, achievement of that objective in Multiple Regression would have been difficult.

3.8.1 Exploration of ordinal data using histograms

The responses to the 40 continuous variables gave a significant amount of data that was worthy of further exploration using histograms. Each gives a graph of the frequency data for year one and year two groupings. Their purpose is to show the density of the responses on the scale. The histogram shows the shape of the distribution. The Y axis shows the number of respondents. The X axis shows the 4 point adjectival ordinal scale from Strongly Disagree (1) to Strongly Agree (4). An explanation of the scale appears as a footnote. The graphs precede the PCA results in the next chapter.

3.8.2 Methodological reasons for choosing Principal Component Analysis

Principal Components Analysis (PCA) was selected for the following reasons. One of a number of factorial methods in the statistics family of applied mathematics, PCA is a statistical data reduction technique used to explore linear relationships among a group of variables. It shows the level and importance of the variables and is sensitive to variance. It could accommodate reliability test and retest before and after the analysis and would reveal any correlation and crucially, latent characteristics in the inputted variables. The aim was to show the consistency of the direction of that straight line, in that as one ordinal variable increases in one direction, then the other ordinal variable increases or decreases at an equal rate in the same or the opposite direction. The mean values can be plotted along a straight line.

PCA enables a number of things. The first is that it can show both direction and the strength of any relationship between the variables and accommodate a scale without the midpoint neutral. The second is that it gives data that might support an informed judgement about knowing and recognizing the interaction between observable, unobservable and latent phenomena. A key influence in the choice of PCA as a data reduction technique is that it would not only detect the presence of latent phenomena but also measure the strength of any underlying dimensions. Importantly these underlying dimensions were a point of contact for the second study and subject to further investigation.

A problem of PCA is that there are no readily available criteria against which to predict the outcome, as no two studies will be the same. The range of available rotations all account for the same amount of variance but with some differences in the factoring arrangements. The choice is therefore reliant on the interpretation of underpinning theory and the potential outcome based on exploratory work. The conclusions from a PCA are restricted to the sample collected. Its strengths are psychometric credibility, mathematical simplicity and its relatively moderate computational burden (Pallant, 2007; Field, 2009). For this study its exploratory features and outcomes assisted in decisions for the subsequent explanatory investigation.

PCA will conduct numerical operations on a matrix of paired correlations between all of the variables entered for exploration. Even though the requirements for competence and confidence descriptors were precise, there was the possibility of superfluous information. This required a structure that would organise and possibly remove any redundant variables. In PCA superfluous information is removed and the remainder is reduced to clusters of components which are set out in order of significance and meaningfully interpreted. These subsets or resultant components are thought to reflect some latent or underlying processes as a result of the paired correlations. The goal is to obtain a parsimonious solution by explaining the greatest amount of the original data reflecting the real world occurrence in the smallest number of components.

The original observations were based on the reluctance of highly qualified professional staff to engage with IT activity and it was wondered at that time if there were any underlying explanations for this, beyond the obvious ones related to lack of experience and previous exposure. It was known that PCA might shed light on any underpinning or latent phenomena to explain the arrangement and strength of the inputted data. Significantly the measurements in PCA would accommodate both visual perception and psychological domains as thoughts and feelings of competence and confidence.

Finally the results and findings from this method would assist the decisions on how to proceed from the exploratory work into the second study. One of the goals of this study was to obtain information about people in their usual environments.

3.8.3 Generic application of Principal Components Analysis

Examination of the literature where PCA has been the method of choice revealed diversity across a range of disciplines such as banking, commerce and corporate finance (Chien-Ta and Desheng, 2008; Long, Mok, Hu et al., 2009), manufacturing (Clarke and Holly, 1996; Weihua, Tielin, Guanglan et al., 2003; Lu, Plataniotis and Venetsanopoulos, 2008), nurse education (Tsai and Chai, 2005; Courey, Benson-Souros, Deemer et al., 2006; Yaghmaie, 2007), evidence-based practice teaching and learning in medicine (Johnston et al., 2003), behavioural research (Fabrigar, Wegener, MacCallum et al., 1999), public health and community networks (Fabio, Sauber-Schatz, Barbour et al., 2009) and genetic mapping for disease traits (Dawy, Sarkis, Hagenauer et al., 2008).

Principal Component Analysis has been used in the study of learners per sé (Kay and Knaack, 2009) and learners as computer users (Morrison, 1983; Gholamreza and Jungwoo, 2003; Bunz, 2004; Bates and Khasawneh, 2007; Markauskaite, 2007). The latter shows that the interaction between humans and computers is a subject of formal study. Not least because of diffusion across society for learning, work and leisure purposes and the subsequent factors which affect performance and usage. Without exception all of the papers reviewed comment on the invaluable transformation technique of PCA and the emergence of underlying or latent features as a result of data compression. The following sections will explore specific practical issues related to Principal Component Analysis.

3.8.4 Sample size

Considerations about the numbers for recruitment and having a reasonably adequate sampling frame are important as PCA requires a large number of participants for sampling adequacy (Robson, 2002). The issue of obtaining a reasonably adequate random sample had been addressed by recruiting first and second year students. All had an equal chance of being included in the study. The advice is that 50 is very poor, 100 is poor, 200 is fair and "as a general rule of thumb it is comforting to have at least 300 cases for analysis." (Tabachnick and Fidell, 2007, p.613). Field (2009) advises between 5 and 10 cases per variable. The aim was to collect data from at least 300 students as correlations between variables are unreliable with small samples. With a cohort of 58 respondents and well below standard recommendations Courey et al. (2006) highlight the limitations within their findings.

Sample size can also be affected by decisions related to the management of missing data and the choice of excluding cases pairwise or listwise in the main PCA dialog box. In Principal Component Analysis, the SPSS software will only treat as missing the specific data cell and not the whole case. Although n=375 was a robust sample for PCA the decision about this issue was to wait until completion of data collection. As 71 of the 375 returned questionnaires were incomplete, '*exclude cases pairwise*' was selected (Field, 2009; Pallant, 2007). Selection of '*exclude cases listwise*' option would have eliminated invaluable data reduced the original number of questionnaires for consideration from 375 to 343.

3.8.5 Reliability of Principal Components Analysis

The tests chosen were: sampling adequacy, reduction of variables to components, the number and nature of components to be extracted, the type of rotation, if simple structure is present and the significance of those components. These were selected to: assist in making decisions about the strength and type of correlation between competence and confidence and hopefully reveal the presence of any hidden construct to explain that relationship. The emerging constructs would be for further investigation in the second study.

3.8.6 Multicollinearity and singularity

The output in the R matrix appears as a square symmetrical structure where the intersection of each row and column contains the value of the correlation between two variables. The purpose of the R matrix was to detect correlations that were a perfect indication of singularity where one would cancel out the other and very high correlations or multicollinearity where the correlations are measuring the same issue, both giving unreliable statistical inferences. With these circumstances it would not be possible to show any unique contribution of a variable to a component.

Initial examination of the correlations was to ensure that there were correlations >.3, as this is one of the decisions of whether to proceed or not with PCA (Field, 2009). A further check for multicollinearity was the determinant as this provided a good indication about the general appearance of the correlation matrix. Circa zero would have indicated that the correlation matrix was singular, where one variable would cancel out another because of the closeness of the relationship between the two. Equally a determinant of 1 would have indicated no relationship between the variables.

3.8.7 Communality values

Communality values are the estimated values of variance in the extracted factors. Tabachnick and Fidell (2007) identify that low communalities are an indication that the variables within them are unrelated to other variables in the set. For this study communality values were important because the questionnaire was based on what was already known from the literature review and previous experiences. Before extraction all communalities = 1 as Principal Component Analysis assumes that all variance is common. After extraction a more realistic picture of common variance can be seen. High communality values near to 1 increased the likelihood of the components explaining the original data (Field, 2009). It was important find out if there were any shared underlying dimensions or latent phenomena. These might reveal something new about computing competence and confidence.

3.8.8 Factorability

Given the sample size and potential diversity in responses, it was inevitable that the end result might be lots of small correlations <0.3. Values <0.3 are significant, but this is dependent on sample size. With the anticipated large sample, statistical significance could be shown. At the face and construct validity stages questions with similar wording had been either removed or altered, thereby eliminating the possibility of an identity matrix. This is a matrix with no correlation whatsoever. Albeit that there would be some small correlations the aim was for substantial groups of variable values which would contribute towards a few significant components. These would assist in deciding which variables make a contribution towards components. Table 3 (See Page 135) shows the recommendations for component loadings (Tabachnick and Fidell, 2007; Field, 2009).

Table 3 Component loadings based on sample size

Sample Size	Loading value
50 cases	0.722
100 cases	0.512
200 cases	0.364
300 cases	0.298

Variable output was sorted by size and absolute values for component loadings. The aim was to obtain over 300 completed questionnaires and therefore set absolute values at 0.298. In their administration of a 20-item Likert-type instrument about online game skills to 2140 participants, Schrader and McCreery (2008) found sufficient loading at 0.3 for a variable to be included in a component.

3.8.9 Factor regression scores

Field (2009) recommends conducting T-tests on the factor regression scores rather than examining individual scores from the original data. Factor regression scores are the raw scores which correspond to those items from the questionnaire which load onto a linear component. The selection of the adjective ‘raw’ is because the variation in the original data is preserved (Tabachnick and Fidell, 2007). Mathematically all factor regression scores on a component are then given a weighted average, irrespective of the loading value. For this study the reason for this action was to identify any mean differences between first and second year students in the sample using the linear components generated in PCA. It was wondered if there were any differences in how they approached their studies when required to use a computer and the strength of these differences. Another reason for selecting the categorical variable of ‘year of study’ was because it was the only one influenced by the University. The other categorical variables are all determined by the students themselves.

It was anticipated that there would be relationship between competence and confidence, so using one categorical independent variable and one continuous dependent variable, Independent-samples T-tests were conducted to see if there were any significant statistical differences in mean scores of groups of subjects. The statistic used was Eta squared.

Let

$$\text{Eta-squared} = \frac{t2}{t2 + (N1 + N2 - 2)}$$

In order to interpret this value the guidelines recommended by Cohen (1988) were selected (See Table 4).

Table 4 Interpretation of Eta squared

Value	**Effect**
.01	Small
.06	Moderate
.14	Large

(Cohen 1988 cited by Pallant, 2007)

Checks for the T-test assumptions required examination of the results from Levene's test for equality of variances. This test checked whether the variation in the scores for first year and second year students were the same against the dependent variable, the factor regression scores. To achieve equal variances assumed status, required the significance value to be >.05. A value from this test at equal or <.05 would have indicated a significant difference in the mean scores on the dependent variable (factor regression scores) for first year students and second year students (Pallant, 2007).

3.8.10 Kaiser Meyer Olkin measure of sampling adequacy and Bartlett's test of sphericity

The Kaiser-Meyer-Olkin test assesses the size of the partial correlations in the R matrix. The PCA output delivers both an overall average and individual Kaiser Meyer Olkin values for each pair of correlated variables. To carry out a Principal Component Analysis required the individual and the overall KMO value to be >0.6. Bartlett's Test of Sphericity examines the null hypothesis of whether the population correlation matrix resembles an identity matrix or perfect independence of all variables. This needed to be <.0000 in order to reject the null hypothesis. However the practical utility of Bartlett's test is questionable as it will report significance irrespective of the quality of the study (Field, 2009).

3.8.11 Reducing the variables down to components

As PCA is about reducing the large number of variables down to a few components, the next decision was about how many might be extractable from the correlation matrix. The first aim was to demonstrate a high percentage of the variance or spread of the data set in the first few components, displaying in decreasing order from most to least variance. The second aim was to show how data collected on a question contributes towards each specific component. The importance here was the decision of what to keep and what to discard as there may have been variance on all variables.

Eigenvalues represent the amount of variation explained by a component. Their corresponding eigenvectors consolidate the variance in a matrix. The aim was to account for variance in the measured variables. This was dependent on a balance between retaining enough variance to explain the factor solution whilst adhering to the principles of parsimony. A common decision is to use the default of Kaiser's criterion and retain eigenvalues at >1. The choice of value is at the researcher's discretion and the subjective nature of these decisions has been a source of debate (Fabrigar et al., 1999; Joliffe, 2002; Tabachnick and Fidell, 2007; Field, 2009). The custom and practice is an arbitrary decision to set the eigenvalue at 1, with the risk of too many or too few components and problems associated with under and overloading of components.

Field (2009) advises on the Eigenvalue of each component or its index of variable meaningfulness to show that components with scores >1 can be legitimately retained. Tabachnick and Fidell (2007) advise that with eigenvalues >1, variables should equate to between 7 and 4 components. Alternatively Joliffe's recommendation is scores >.7. Decisions linked to how many variables to retain rests with the researcher. This necessitates evaluation of two conflicting needs; the need to find an uncomplicated solution with as few variables as practically possible and the requirement to account for as much of the variance in the original data set as possible. The size of the loading reflects the extent of the relationship between each variable and its component. Yaghmaie's (2007) study of factors which affect computer performance and usage produced a 12-item scale with a two-factor solution.

Long et al. (2009) state that analysis of all variance as sometimes preferable to specific components on the basis of seeing patterns and themes in the overall spread of the data. In their decisions on when to stop factoring, Long et al.'s (2009) study of corporate performance on the Shanghai and Shenzhen stock markets opted to present the variance explained instead of factors. The premise was that interesting underlying or latent structures were embedded in the smaller factors. This was especially relevant in their study on the innate structure and financial governance of the Shanghai and Shenzhen stock markets. Fabrigar et al. (1999) cite the paucity of scientific information on decisions about eigenvalue cut-off points and the risk of over and under-factoring because of arbitrary judgments.

These discussions influenced the decision to examine both the lower components and the total variance to see if they would reveal anything of significance to the study. Also before deciding how many components to retain, a number of experimental runs were carried out using different eigenvalues set at 1, 0.8 and 0.7. The objective was to set the eigenvalue to reflect the least number of components to account for as much of the variance as possible. The aim was to give a rounded picture or viewpoint of the variance in competence and confidence. The criteria for eigenvalues raised important considerations, so a number of experimental runs were made before the final decision was decided upon.

3.8.12 Decisions about how many components to retain using the Scree Test and Parallel Analysis

The Scree Test and Parallel Analysis supported decisions about the number of components to extract. First proposed by Catell (1966 cited by Field, 2009) the Scree Test presents a visual representation of the eigenvalue plotted on the Y-axis, against each component it is associated with, plotted on the X-axis. Scree as a noun depicts the fall and arrangement of rocks at the base of a cliff, sequenced from large boulders to the smaller rubble. The analogy is the mathematical arrangement of components as rocks along the abscissa. The larger rocks reflect the larger components. These are of first interest as they reflect the cumulative percentage of the greatest amount of variance. Additional reliability criteria used to check the credibility of the Scree test were the sample size, the number of high communalities and those components that had several variables with high loadings.

Criticisms of the Scree Test are aimed at its lack of precision and subjective interpretation (Fabrigar et al., 1999; Pallant, 2007; Tabachnick and Fidell, 2007; Field, 2009). Reliability was therefore dependent on large sample size, high communalities and components that had several variables with high loadings. The visual information the Scree plot assisted in determining how many eigenvalues to retain. Szajna (1994) illustrated how Scree Plot generation supported a 4-factor solution, explaining just 50.7% of the variance. Based on the visual evidence, Gholamreza and Jungwoo (2003) in their measures of perceived end-user computing skills proposed a 12-item instrument to measure end user computing knowledge and ability. A sample of 282 end-user responses was obtained. One Eigenvalue of 7.8 emerged, explaining 65% of the variance.

Originating from Pearson's 19th study of randomly generated numbers by the roulette wheels in the Monte Carlo casinos, Parallel Analysis has been found to be an accurate method for the selection of components (Watkins, 2006). The only requirement is that the simulated data should be generated from the same number of variables and participants in the real study. The actual eigenvalues from this study were compared with the simulated set, only those eigenvalues greater than the random ones were retained.

3.8.13 Rotation

Principal Component Analysis seeks to explain the variation in the original data set using a few underlying components. Having selected the number of components to be retained the next decision was how to interpret them. In order to do this the components needed to undergo rotation. Whilst PCA will often result in a natural interpretation, the role of rotation is to strengthen any possible explanation for the underlying components (Dunteman, 1989). The two main types of rotation are orthogonal and oblique. Orthogonal rotation assumes that the variables will be unrelated whilst oblique rotation required an assumption of a relationship between competence and confidence.

Morrison (1983) in his research on attitudes towards computers surveyed 412 students divided as two data sets, internal and external students, using a 20-item scale. Data analysis rotated with varimax (orthogonal and unrelated) criterion revealed a four factor solution, accounting for 49.2% of the total variance. Oblique was the choice of rotation of Bates and Khasawneh (2007) in their research on self-efficacy and college students' perceptions of online learning systems. This was on the grounds of the anticipated behavioural correlation between the components. Therefore different rotations were run to assess the possibility of correlation.

However given the literature review and the human behavioural relationship between the two variables, it was anticipated that an oblique rotation would produce a realistic solution. The output with oblique rotation yields two matrices, the pattern matrix of unique relationships (no overlap among components) between each component and each variable and the structure matrix of the correlation between components and variables. Having selected an oblique rotation it was anticipated that it might be possible to reproduce this pattern of unique relationships with an appropriate choice of method in the second study.

3.8.14 Interpretation of the rotated components

The component loading value was set at >.298 to reflect >300 cases. Tabachnick and Fidell (2007) advise that greater loadings equate to the variable being a purer measure of the component. Table 5 is a guide of loading values and shows the unique relationship between the factor and the variable and the overlapping variance between each component (Tabachnick and Fidell, 2007).

Table 5 Guide for interpretation of loading values and overlapping variance

Loading of variable onto component	Overlapping variance between each component %	Outcome
.71	50	Excellent
.63	40	Very good
.55	30	Good
.45	20	Fair
.32	10	Poor

In the pattern matrix, the higher the load of the variable the more it is a pure indicator of the component (Tabachnick and Fidell, 2007; Field, 2009). The decision was made to highlight the greatest loadings in each component. This was in order to see if there was a tendency towards competence or confidence or an equal distribution of the two across the components.

3.8.15 Simple structure

A further determinant on the decision between orthogonal and oblique rotation was related to simple structure. The criterion for simple structure was several variables would correlate highly with one component and only one component correlated highly with each variable. In sum simple structure meant that not all variables will be reflected in every component (Thurstone, 1947).

3.8.16 Summary of the decisions and outcomes for Principal Component Analysis

Principal Component Analysis is a multivariate statistical technique which reduces the dimensions of a large set of variables into a smaller set of components whilst retaining maximum information from the original data set. The utilities within PCA assist in making important decisions about: the credibility of the original data such as sample size and the treatment of missing data, linearity and the level of correlation between the variables, the visual appearance and loadings of the variables on the components and the influence of rotation on interpretation of underlying explanations. The main results from a PCA are the emerging components and the underlying variables within them, the Eigenvalues explaining most of the original data and the effect of rotation on the components.

Study Two

3.9 Influences from the first study

A number of key influences emerged from the first study from the major analyses – the main components, their characteristics and how they rotated. The components showed the predominance of confidence, students' preferences for small group work when undertaking computing activity and the importance of learning through watching, talking, listening and experimenting. This inferred an interaction between computing activity, learning and socialization. Crucially this finding was confirmed in the geometric interpretation of the rotation (See Figure 6, page 151) showing the overlapping relationship between the components and the variables. These important results prompted a review of the initial plan to observe individual students working through a computing task. The decision was made to instead observe small groups of student nurses working together as computer users to see if they did talk, watch, listen and experiment. An application was submitted to the Faculty of Health Sciences Medical School Ethics Committee (See

Appendices 9 - 11), requesting the change from individual to group observations.

3.10 Aim

The aim of the study was to find out if under-confidence and over-confidence have an influence on computing competence and to possibly show where those characteristics surface

This study was therefore designed to answer the second research question:

If there is a relationship, is it possible to identify where under-confidence and over-confidence have an effect on the competence of student nurses as computer users?

With the sub-question of: What does it look like?

3.11 Method

The influence of specific questionnaire items on the second study population

The following questions acted as a point of contact between the first and the second study as decisions about the population in the second activity were based on potential responses to:

'**People will ask me for help if they have a computing problem / I have confidence in my ability to help other students with their computing problems.**

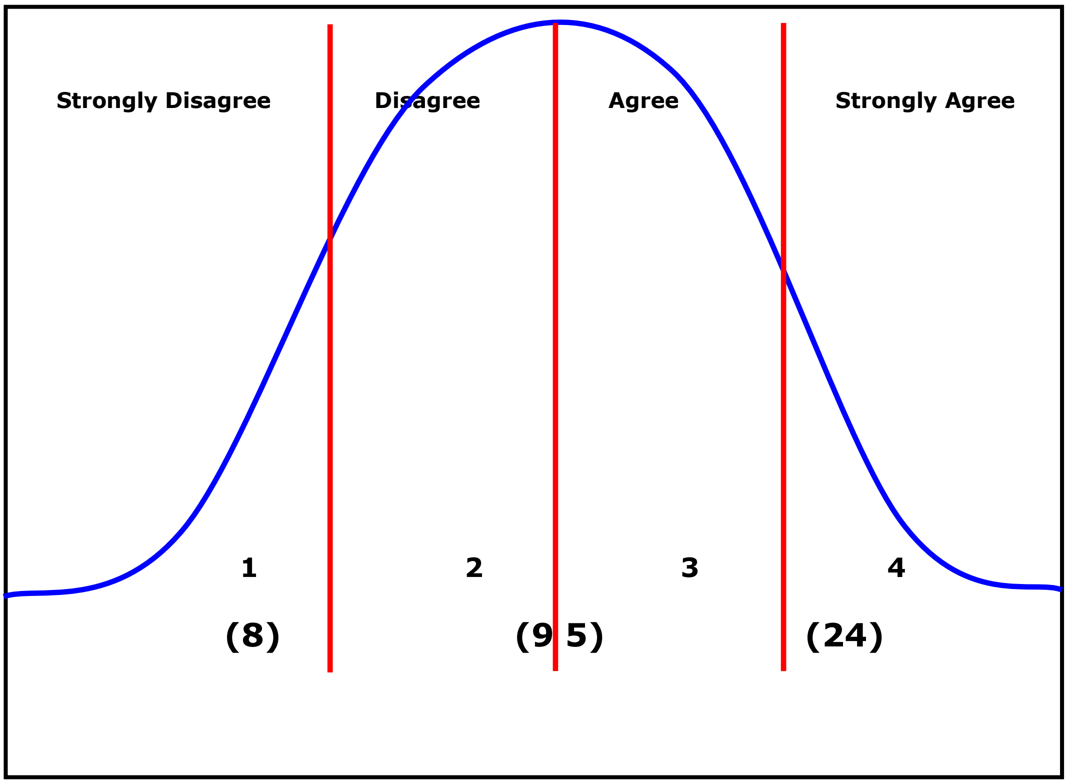
I can usually work through most computing activities I am faced with in the School of Nursing / During my studies when in the University, I am confident when asked to do a computer exercise'

These questions were selected as their design reflected opinions based on the subjects' experiences as nursing students. Subjects would be selected according to their homogenous and heterogeneous responses. It was anticipated that homogeneous responses would be treated as separate 'Strongly Agree and Strongly Disagree' categories reflecting the extremes of competence and confidence and the heterogeneous responses would represent a mix of 'Agree and Disagree'.

3.11.1 Identification of participants for the second study

Robson (2002) identifies the difficulties in estimating the sample size for an explanatory study. This decision was influenced by the choice of method and the number of volunteers. SPSS was used to isolate and analyze specific responses relating to selected pairs of questions. The spread of the responses to the four questions broadly reflected a normal distribution curve (See Figure 6, page 151), illustrating the largest frequency of scores from the students' answers in the middle two quartiles and the smallest in the extreme quartiles. Not surprisingly the heterogeneous group showing the responses of Agree / Disagree to the four questions was the largest with 95 respondents. At just 8, the response of Strongly Disagree to the four questions was the smallest number and 24 students identified that they Strongly Agreed to the four questions.

Figure 6 Normal distribution curve illustrating frequency of scores from the paired statements



3.11.2 Recruitment of participants, research administration and management

Based on the responses to the identified questions, the participants for the second study were identified through their code number and name, by the research administrator. She then made contact through e-mail and a letter with a return stamped addressed envelope. The plan was that students who responded would be contacted again and provided with information and two copies of a second consent form, including a stamped addressed envelope for return of one copy (See Appendices 12 and 14). Administrative arrangements from the first study regarding storage of information and maintenance of confidentiality were applied. Students would be given date, time and location details for the planned activity. All participants would receive a Statement of Participation for their academic portfolios.

3.11.3 Challenges

In spite of two postal requests across a four month period, responses to the invitation to participate on the second study yielded just four students from the potential cohort, identified on the basis of their responses to specific questions in the first study survey. The four third year students were all based in the same Education Centre. The reasons for the lack of volunteers might have been due to study workload linked to assignments, clinical placements and requests from other researchers. It would have been unethical to approach the students in study one to ascertain their reasons for non-participation. The decision was therefore made to approach two fresh individual Year Groups (years one and two) both based in one Education Centre whom had not participated in the first study.

3.11.4 Ethical considerations and the new study population

Once the decisions had been made to contact students who had not taken part in the first study, the next consideration was duty of care to them as potential research volunteers. A first year and a second year intake group were contacted by e-mail. Those who registered an expression of interest were then sent two copies of a letter with consent form, one for their reference plus a copy of an Information Sheet for Normal Healthy Volunteers (See Appendices 13 and 14). The responses were managed by the research administrator.

3.11.5 Organisation of the overall study population

By chance the responses to the questions from the four third year students were equally divided as Disagree / Strongly Disagree and Agree / Strongly Agree. To work through the computing task they were organised into homogeneous pairs reflecting the extremes of high and low levels of confidence. The decision was made to treat the new additional volunteers as the Heterogeneous groups for the study.

Fifteen first and second year student nurses volunteered to take part in the study. They were organised into five groups of three and according to their year of study and cohort. The reason for organisation through year was influenced by the factor regression scores from the data in the first study, used to identify any mean differences between first and second year students in the sample using the linear components generated in PCA. Along with the 4 students from the original cohort, this gave a total of 19 students representing years one, two and three of the Course. Figure 7 shows how this study population was organised

Figure 7 Organisation of the overall study population

Strongly Disagree **Homogeneous** **2 participants**	**Disagree / Agree** **Heterogeneous** **3 participants per Group**	**Strongly Agree** **Homogeneous** **2 participants**
Group 1 (Year 3)	Group 2 (Year 2)	Group 7 (Year 3)
	Group 3 (Year 1)	
	Group 4 (Year 1)	
	Group 5 (Year 1)	
	Group 6 (Year 1)	

3.11.6 Data collection and management for the new heterogeneous group

As the new groups were the same as the survey cohort, the participants were invited to complete the questionnaire. An e-mail letter was sent to the new students who had taken part in the filming activity thanking them for their participation and inviting them to complete the questionnaire. Respondents to the e-mail were then sent by external post a stamped return-addressed envelope plus relevant documentation (See Appendices 6, 7 and 15). Nine students returned the questionnaire.

3.11.7 Responses to the paired statements

Table 6 (See page 157) shows the responses from the nine students in the new group to the paired questions. These responses were broadly similar to those in the normal distribution curve with the majority of student nurses agreeing to the statements. The table adds to the first set of data showing that most student nurses were in the Heterogeneous categories with a small representation in the extreme Homogeneous categories. It also retrospectively supported decisions for the film group arrangements.

8 students agreed with the statements **'People will ask me for help if they have a computing problem / I have confidence in my ability to help other students with their computing problems',** whilst just 1 student disagreed to the first statement and strongly disagreed to the second statement'. Split responses to this pairing can be seen in student ID no. 7 who disagreed and strongly disagreed to the statements. 5 students agreed and 2 students strongly agreed with the statements

'I can usually work through most computing activities I am faced with in the School of Nursing / During my studies when in the University I am confident when asked to carry out an exercise using a computer'.

A split in the responses to this pair of statements can be seen in student ID no. 1 who responded as 'agree' and 'strongly agree' and student ID no. 7 who responded as 'agree' and 'disagree'. The 3 students who gave split responses were in the first year of their studies.

Table 6 Output for paired questions related to the new heterogeneous group

Colour coded response		1 Strongly Disagree	2 Disagree	3 Agree	4 Strongly Agree	1 Strongly Disagree	2 Disagree	3 Agree	4 Strongly Agree
Questions		Pair One				Pair Two			
		People will ask me for help if they have a computing problem		I have confidence in my ability to help other students with their computing problems		I can usually work through most computing activities I am faced with in the School of Nursing		During my studies when in the University, I am confident when asked to carry out an exercise using a computer	
Student ID	Year								
1	2	3		3		3		4	
2	1	3		3		3		3	
3	2	3		3		3		3	
4	1	3		3		3		3	
5	1	3		3		4		4	
6	1	3		4		4		4	
7	1	2		1		3		2	
8	1	3		3		3		3	
9	1	3		3		3		3	

3.11.8 Rejection of participant observation and the selection of structured observational analysis

For observational methods with a qualitative focus, the main approaches are structured observation (Ericsson and Simon, 1993; Graziano and Raulin, 1997; Robson 2002; Tashakkori and Teddlie, 2003; Willmer, 2007) and participant observation (Hammersley and Atkinson, 1995; Ezeh, 2003; Doel and Orchard, 2006). The aim of both approaches is similar, to provide accurate reflections of social phenomena. Participant observation was rejected as an approach for this study on the grounds that it was not possible to be a member of that particular culture. The decision was made to carry out structured observations of small groups of student nurses. Structured observation was the preferred method over participant observation because it is a one-way examination of behaviour.

The selection of a specific structured observational method - concurrent think-aloud and protocol analysis

My next task was to select that would be suitable for this study. To gain a better understanding of the complex phenomena of competence and confidence it was important to choose a method that would give strong detailed characteristics of student nurses as computer users. I also needed to consider how direct my structured observation would be, such as being in the same vicinity as the students. I wanted to do something that would reflect as near as possible real-life (Robson, 2002). The problem with any direct observation is how much impact it has on the behaviours of the participants and if they would react differently if not observed. Discussions questioning the detached stance and distance of the researcher in structured observation question show how their own beliefs and expectations will infiltrate every stage of the research process (Robson, 2002; Dangwal et al., 2006; Leicht, Hunter, Saluja et al., 2010).

In reality detachment can only occur if individuals and groups do not know that they are being observed. Therefore this study required a method that would illustrate competence and confidence as they occurred even though the groups would be aware of my presence. Structured observational analysis is a pre-determined organized activity (Ericsson and Simon, 1993; Robson, 2002). The components of which are a defined task and a list of the behaviours that might be displayed as a reaction to the task. Both components are then coded using a shorthand structure which is the researcher's checklist. The researcher then refers to this checklist during an observation and marks against an action as it occurs. In addition to the task and the behavioural actions I wanted to know what student nurses were saying as they worked through the task.

It was important then to select a method that would enable me to map the behavioural reactions to each stage of the task and the verbal commentaries as they happened. I anticipated that this would give a good range of information about competence and confidence in student nurses as computer users. This information could then be organized into themes that illustrated the competence and confidence of those students. The method that met all of my requirements was think-aloud and protocol analysis (Ericsson and Simon, 1993).

3.11.9 Variants of think-aloud and protocol analysis

There are a number of ways to elicit verbal reports so decisions about which method of think-aloud would be engaged for the study were important. Using the criteria of Ericsson and Simon (1993), these can be broadly categorized as: Type 1 or introspective concurrent protocol where the subjects are thinking aloud whilst carrying out the activity, Type 2 or retrospective post hoc protocol where comments describing the task are gathered on its completion and Type 3 post-reflective protocol where the subjects are encouraged to give an explanation or reason for their actions. Comments are collected through recording and are then transcribed as protocols.

Of particular interest was the study by Neves (1977 cited by Ericsson and Simon, 1993 and Brand, Reimer and Opwis, 2007). Subjects were asked to think-aloud their strategies using a Type 1 introspective approach for solving the famous Tower of Hanoi puzzle. Neves' approach appeared to have transferable properties to the scenario of setting a computing task for a small group to work through and asking them to think-aloud about their competence and confidence. Asking the students to think-aloud during a task would provide some insight into internal deliberation and a possible understanding of mental events as they occurred.

3.11.10 Application of concurrent think-aloud and protocol analysis

A review of the literature revealed the versatility of Concurrent Think-Aloud and Protocol Analysis across a range of research domains both in real-time and laboratory setting for: usability testing (Probst and Tapsell, 2008), human computer interaction (Cotton and Gresty, 2006), musicology (Richardson and Whitaker, 1996) evaluation and mobile technologies (Jaspers, 2009), education and the assessment of learning styles (Blackwell, Galassi, Galassi et al., 1985), healthcare provision and clinical decision making (Twycross and Powls, 2006) and second language acquisition (Plakans, 2009).

In addition to its function as a research method, Concurrent Think-Aloud and Protocol Analysis have also been used across a range of professional settings to establish need and monitor progress of service user groups. Branch (2001) used it to gather evidence related to information seeking behaviour in junior high school students. Leow and Morgan-Short (2004) employed Concurrent Think-Aloud to collect commentary related to problem solving in second language.

In manufacturing industries in areas such as gaming, engineering and mobile technology production, some usability studies appear to utilize a Talk-aloud method where the participants are asked to describe the undertaken task as actions being performed and what is happening, rather than report mental activity during a task (Malhotra, Laxmisan, Keselman et al., 2005; Wideman, Owston, Brown et al., 2007; van Elzakker, Delikostidis and van Oosterom, 2008). To assess construct validity in questionnaire design, Darker and French (2009) asked subjects to provide usability comments during its completion. The evidence shows a subtle but crucial difference between concurrent verbalization related to reaction, thoughts and feelings and the processes associated with product reliability testing and usability studies.

3.11.11 Strengths of concurrent think-aloud and protocol analysis

The wide application of Concurrent Think-Aloud shows its versatility as a research method and as an assessment tool in product design, with transferable properties between simulated and natural environments. The researcher is detached from the subjects being studied and their role is made clear from the outset. A key strength is the capture of commentary and behavioural observations as they occur. The concurrent protocols reflect the information processed and the reactions to the processes (Kuusela and Paul, 2000).

This method has been shown to provide a rich vein of data because verbal protocols both trace and explain the decision making process at the same time, therefore providing their own interpretation (Jaspers, Steen, van den Bos et al., 2004). Working through a task where written instructions are provided, requires verbalization of the immediate memory as opposed to a deeper introspection processes such as unaided recall in a written examination. Errors due to false recall are likely to be low because of the level of cognition involved.

The verbal protocols from Concurrent Think-Aloud give findings which are objective because of the openness and accessibility of the evidence (Hoppmann, 2009). Therefore a high face validity is associated with a concurrent think-aloud protocol. Crucially this is reliant on the subjects being given clear information about what is required of them as this could be either their reactions to a task or, their evaluation about the usability of the product. Coding and scoring systems can be customized to reflect the questions raised for the study (Arnkoff and Glass, 1989). A small number of participants can give a rich source of evidence related to cognitive and decision processes (Shumway, Sentell, Chouljian et al., 2003).

3.11.12 Limitations of concurrent think-aloud and protocol analysis

The limitations of concurrent think-aloud and protocol analysis can be broadly organised as participant reluctance, timing, quality and quantity of verbal output and researcher interpretation. The contrived nature of being asked to think-aloud is a subtle but important shift from natural responses and realism. Not all people are suitable for thinking-aloud even in a group situation. This is confirmed by Schneider and Reichl (2006) in their comparison between the mental health connotations and reactions towards individuals who talk to themselves and the behavioural challenges facing research subjects expected to do just this whilst working through a task. The act of thinking-aloud may be perceived as unnatural and inappropriate. Stratman and Hamp-Lyons (1994) discussed how hearing the sound of one's own voice is potentially inhibitive. Furthermore albeit that a task requires immediate recall there may be a void between cognition and verbalization, crucial if timings are of significance.

The requirement to think aloud whilst performing will invariably require more time than asking the subjects to work in silence (Van den Haak, de Jong and Schellens, 2003) and it is important that this consideration is built into the research design. There appears to be subtle but important differences between quality and quantity of verbal fluency. Gresty and Cotton (2003, p.48) offer a salutary caution on the potential for "meaningful data or merely a rambling discourse." Schneider and Reichl's (2006) quantitative approach measured verbal fluency as the total number of words produced in a one minute period. In reality it may be doubtful if verbalization can capture every thought and indeed if the researcher's extraction and interpretation of the protocols truly represent what has been both said and meant. Irrespective of comforting reassurance, researcher presence may inhibit natural behaviour with a switch from response to performance when individuals know that they are being watched, potentially leading to inaccurate conclusions (Tashakkori and Teddlie, 2003).

3.11.13 Sample size for concurrent think-aloud

A dissimilar finding in the concurrent think-aloud studies reviewed was the range of subjects. For example, Schneider and Reichl (2006) tested think-aloud on 101 subjects. Lodge, Tripp and Harte's (2000) study reported on self-talk via think-aloud in 88 8-9 years old children. Edwards, Thomsen and Toroitich-Ruto's (2005) sample size was 15 subjects. Aitken and Mardegan's (2000) work cited just 8 participants. Some of the studies examined did not distinguish between sample size as the total number of participants, and if and how they were organised as sub-groups for a think-aloud task. Absence of a proven structure related to methodological decisions and sample size for comparison, was challenging but not insurmountable.

The general rule of thumb for the sample size appeared to be the purpose and characteristics of the activity and the setting in which it occurred. As a result of examining the literature decisions related to sample size were based on: quantity and quality; a small number of participants but working on a substantive activity, technology; the practicalities related to video recording and software to collect and edit evidence for a few subjects, study integrity; that the evidence collected and processed from a small number of participants engaging in concurrent thinking aloud would produce objective verbal protocols.

3.12 Procedure

3.12.1 Defining the test object for the computing task

Research involving test objects as tasks for Thinking-Aloud are either problem- based, for example a challenging scenario (Fonteyne, Kuipers and Grobe, 1993; Aitken and Mardegan, 2000; Noh, 2005; Hoppmann, 2009), procedure-based, for example aspects of musicology such as conducting and composing (Richardson and Whitaker, 1996) or process tracing, for example tracking medical students' actions when working through an online pharmaceutical resource (Nicolson, Knapp, Gardner et al., 2011). For this activity, problem solving and procedural adherence was not the issue as the interest was in the appearance of competence and confidence during performance, irrespective of being correct or incorrect.

A Reusable Learning Object (RLO) from the University of Nottingham's repository of online resources was chosen as the test object for the task, selected because the student nurse population are familiar with this structure. The discussion in chapter one identified the composition of and rationale for supporting students using RLOs (Windle et al., 2011). Learners are required to draw on skills and knowledge associated with mental calculation and reasoning not only in relation to the subject area but also the use of a computer. The selected Reusable Learning Object was about working in patients' home settings (Todhunter, 2005). The task required the students to work through specific aspects of the selected Re-usable Learning Object.

It was important to ensure that the task was reasonably demanding, stretching the students' ability to work through its processes, whilst not being too complex or too simple and significantly that the task was relative to the research question. Figure 8 (See page 169) shows the task information given to the participants.

Figure 8 Computing task information

This is an extract from a Reusable Learning Object (RLO). You have 10 minutes to complete the task	
1. Find the URL for the School Of Nursing's list of Reusable Learning Objects. Click on **School RLOs** on the left side-bar. Scroll down the list and click on Home Visiting.	http://www.nottingham.ac.uk/nmp/sonet/rlos
2. Read the introduction	*Do not click on the voice activator*
3. Go to Living Room 2	*Find the hotspots and work through each of them. State aloud how many hotspots you have found.*
4. Go to the Community Crossword	*Complete any three of the words. State aloud when you have completed them*
5. Find the quiz	*Complete question 6. State aloud when you have completed the question*
6. Close the programme	*Return to the University of Nottingham homepage. State aloud when you have done this*

3.12.2 The task conditions

The requirement for the study was for students to think aloud whilst they worked through the activity. The explanation given was that this is not about the content and usability of the Reusable Learning Object as their opinion, but their spoken thoughts and feelings related to finding their way around the computer. Ericsson and

Simon (1993) advise that subtle prompts such as occasional reminders asking the subject to state their thoughts are useful, but should not be confused with instruction. Likewise speech should not be used just to fill a void.

Given the objective of the exercise, to assess competence and confidence in computer users, it was appropriate to let the students' progress as naturally as possible with occasional prompts. Once collected this commentary would be transcribed into protocols which would be then content analyzed using codes (Blackwell et al., 1985; Ericsson and Simon, 1993; Hoppmann, 2009). The coded comments would then be organised as themes illustrating competence and confidence.

3.12.3 Coding schemes for the task

Robust assessment of computing competence and confidence was dependent on if the codes would support an answer to the research question. Considerations about the coding scheme identified the necessity for two different sources of information. These were:

1. The stages of the task as the first level of coding. These were the Protocol Segments

2. The verbal comments made by the participants as the second level of coding. These were the Verbal Protocols.

It was anticipated that the two levels of coding would show the fit between the stages of the task and the verbal statements produced by the participants as explicit and observable goals whilst working through the task (Ericsson and Simon, 1993). The first level of coding, the Protocol Segments was organised to reflect the stages of the Re-usable Learning Object, the participants' behaviours, facial appearance and status within the activity. The Protocol Segments were dependent on the Verbal Protocols created from the commentary made by the participants as they worked through the task. Therefore the second level of coding from the commentary could not take place until filming had been completed. The coding scheme for the visual output was constructed using a recommended format (Bettman and Park, 1980; Ericsson and Simon, 1993). In sum this is naming by description, the sequence of actions and events and a coding scheme that is representative of the protocol segments.

Initially a pen and paper exercise, this activity evolved from a broad outline to a carefully refined, honed set of codes. Before attempting to carry out any coding activity, a number of issues needed to be addressed. The pragmatic nature of the research question set for the study, asked for evidence of behaviours related to competence and confidence. The stages of the task and the assigned codes needed to reflect participants' behaviours which could be observed and analyzed. This was in order to produce evidence about possible links between competence and under and over-confidence.

3.12.4 Defining the behaviours and events in the coding scheme

Key considerations were the behaviours and events in the set task and the subjects who would be performing those behaviours. For each type of behaviour it was crucial to anticipate and define as many behaviour variations for one specific type and then allocate each a name and a unique code. Too many codes would make for a complex scoring system.

In the design process two types of behaviours were prevalent. These were State Event behaviours, those that have duration and absorb a long period of time such as students talking to each other and Point Events, which reflect spontaneity. Point Events are often used in studies where behaviour may be unpredictable and not entirely relevant, such as that observed in animals and young children. The State Events needed further categorization as mutually exclusive and exhaustive. The exhaustive State Events required related reactions and behaviours to be grouped together as a range from positive to negative. For example this could be happy and unhappy.

However although coding preceded the filming activity, to some extent the structures in the Mental State segment were at best only estimates of the types of behaviours that students were predicted to display whilst participating in the defined task. Codes were also allocated as mutually exclusive, meaning that behaviours can be expressed as sequenced occurrences, but only one behavioural state can be active at a time.

The decision was made to create a simple structure to use for a pilot activity. This could be modified as recall improved and the processes took on a familiar stance. For example, Point Event would not be used as a characteristic unless the pilot activity supported its inclusion. Figure 9 (See page 175) shows the preliminary codes created for the observations and how they appeared as State Events. The coding distinguishes between four different categories, designed to reflect the questionnaire statements in the first study. For example, 'I am confident about using a computer providing I have plenty of time to work through an activity, otherwise I become anxious', links with the Mental State 'Anxious'.

The codes were:

1. The search process and working through each phase of the task.
2. The observed mood alterations of the participants.
3. Correct or incorrect status whilst working through the task.
4. Screen location in the event of being incorrect.

Figure 9 Preliminary codes for observations

Behaviour Name	Description	Code	Properties	Modifiers
Segment				
phase 1		**1**	State Event	
phase 2		**2**	State Event	
phase 3		**3**	State Event	
phase 4		**4**	State Event	
Phase 5		**5**	State Event	
Phase 6		**6**	State Event	
Mental State				
Happy		**Y**	State Event	
Neutral		**N**	State Event	
Anxious		**A**	State Event	
Status				
Correct		**C**	State Event	
Incorrect		**I**	State Event	**1.** Wrong or misspelling of URL **2.** Clicked on the voice activator **3.** Could not find living room 2 **4.** Wrong place on the screen 5. Could not find the crossword **6.** Tried to type the word into the actual crossword instead of the word fill area **7.** Did not know how to close the Crossword **8.** Could not find the quiz **9.** Could not find question 6 **10.** Did not know how to return to the University's homepage URL **11.** None of the activity completed
Screen Location				
Toolbar		T	State Event	
Menu		M	State Event	
Page		P	State Event	
Side-bar		S	State Event	
Else		A	State Event	

3.13 Using the Observer XT software to manage, organise and analyze the evidence

The plan was to give the students the RLO task to work through and ask them to say what they were concurrently thinking. It was anticipated that the underlying components identified from the PCA might manifest in the stated thoughts. The traditional approach for structured observation was by watching and then recording observed behaviours using a pencil and paper. Largely reliant on the observer's speed of perception, absorption of information, impartial interpretation and accurate documentation, criticisms have been levelled at inaccuracy, misinterpretation and failure to log vital behaviours at the time of their occurrence, rendering the protocol as incomplete (Ericsson and Simon, 1993; van Someren, Barnard and Sandberg, 1994; Kuusela and Paul, 2000).

Technology has been used to recreate the principles of the traditional approach through film and software, where subjects are recorded and their captured behaviours analyzed. The advantages of using recorded film supported by technology are: the creation of back-up systems once the observations have been collected, the richness of the logged evidence and the possibility to playback, review, dissect and explore minutiae direct and wider environment details after the event. The Observer XT software was used to manage, organise and analyze the collected evidence. It was anticipated the software's visual analysis feature might offer some unique insight into the characteristics of computing competence and confidence for learners working in small groups.

3.14 Research accuracy and credibility

The credibility and accuracy of Protocol Analysis using a qualitative paradigm showed the most suitable components as researcher distance, transparency, transferability, validity and reflexivity (Ericsson and Simon, 1993; Robson, 2002; Yang, 2003; Cotton and Gresty, 2006). These were selected as good safeguards to question ambiguity, to challenge potential researcher bias and act as reference points to check the match and credibility between the process and the outcome from Concurrent Think-Aloud to Protocol Analysis.

3.14.1 Researcher distance

A study involving subjects known to the researcher runs the risk of being personalized. Robson's (2002) advice to create a distance between the research participants and the researcher was helped by the use of a camcorder to record the observation and the software to manage the evidence. The act of watching whilst scribbling furiously would have been a potential distraction for participants, unrealistic and subjective, especially with a single observer. For this qualitative study the use of film supported by technology addressed the risk of missing phenomena as they occur. Occasionally some groups appeared to forget about observer presence and had to be prompted to think-aloud.

3.14.2 Transparency

In discussing the merits of transparency Conti and O'Neil (2007), identify the responsibility of the researcher to be accountable for their knowledge claims and personal interests to be declared from the outset. Safman and Sobal (2004) cite the importance of completeness and honesty in the reporting processes at each stage of the research, including the challenges incurred and irrespective of the outcome. It was important to reveal problems as they occurred, showing how they were resolved. Filming activity and contact with the participants was unremarkable. At application level the method progressed exactly as planned and is evident in the film clips and the event logs.

3.14.3 Transferability

It should be possible to transfer the sampling plan, method and the findings beyond the conditions of this study (Tashakkori and Teddlie, 2003). In context this meant that the location and conditions of the filming activity, management of the evidence and its interpretation could have been replicated in its entirety. Maxwell (1992) offers an alternative in the differentiation between internal transferability where the conditions, findings and conclusions from the study are only relevant to a specific study and external transferability where the terms of reference apply to the wider population. It was cautiously anticipated that an external reference would be the outcome, in that the study can be replicated in its entirety to assess competence and confidence in any learner group.

Cohort size may have implications for transferability and generalizability. The behaviours of the volunteer groups of students working through the assigned computing task should reasonably correspond with the behaviours of any groups of students carrying out a similar activity. In order to show transferability the content of the Protocol Segments needed to illustrate three factors. These were: to reflect a range of possible outcomes that accommodated the task being undertaken, how it was carried out and the students' behaviours whilst working through it.

The overall application, conduct and management of the research were unremarkable. Using Maxwell's (1992) external framework replication was attestable through the following. Initial verification of transferability was evident in the first level of coding, where the Protocol Segments for the Re-usable Learning Object, were predefined and managed by The Observer XT. This output created its own interpretation because the software produced a visual chart for each group showing their facial expressions and how they completed the task, whether error-free or otherwise.

Proof of external transferability was evident where the visual analysis output of events was plotted horizontally against a time axis, thereby enabling inspection of the different data modalities. The verbal protocols were evidence of each group's reaction to getting it right and / or wrong. The second level of coding emerged from reading, transcribing and grouping the concurrent Think-aloud verbal protocols into themes and these can be traced back to the film clips. The application of Maxwell's (1992) external framework to the findings was limited to this cohort.

3.14.4 Reflexivity and my influence on the think-aloud method

It was important that I considered issues related to reflexivity. I was aware that my interest and involvement would inevitably influence my position, values, conduct and the proceedings and outcomes. For the process and outcomes for Think-aloud, careful attention should be paid to the nature of the relationship between the researcher and the participants, and their wellbeing during the activity. Ericsson and Simon (1993) present a detailed clinical and detached approach in their advice on Think-Aloud. They give useful, practical information about observer bias at the evidence collection stage.

However they make frequent reference to the 'experimenter' (see Ericcson and Simon, 1993 pages 27, 82, 245). The cited examples clearly show clinical detachment between the individuals conducting the activity and their subjects as passive recipients. This approach was at odds with the ethical caring requirements for the study. I found a number of studies using Think-aloud that have dealt with the challenges presented by reflexivity. Jaspers et al (2004) identify how the mere presence of the researcher undermines the evidence collection. Their work provided me with useful insight into minimizing the interaction with participants. For example, attention to position, movement and limiting any commentary are the best-available solutions to minimize researcher influence. The work by Blackwell, Galassi et al (1985) endorses the use of groups rather than individuals for Think-aloud, because of isolation and exacerbated anxiety. They discuss the benefits of mutual support between participants. Interestingly this paper also makes the case for recording devices, where the log can be scrutinized afterwards to detect researcher influence. Schneider and Reichl (2006) advise that the act of thinking-aloud is difficult for some subjects and therein runs the risk of researcher involvement and influence. Stenfors-Hayes, Hult (2013) and Dahlgren (2013) identify the importance of setting out a detailed description of the events as they happen at each stage. These papers influenced my decision to include in the study's report any changes that were made to honestly show how, where and why my influences as researcher occurred.

My task was therefore to proactively address all of these elements. I was also aware that choosing an RLO for the Think-Aloud activity I had designed, would influence my approach towards evidence collection and analysis. Second, being present and interacting with the students during the think-aloud required careful self-appraisal from a reflexive viewpoint. Whilst reflexivity operates in the language context as "What are you thinking?" researcher emotions and behaviours can be powerful influences. Previous studies report on this as the Hawthorne effect, where the mere presence of the researcher and not the conditions will influence the behaviours of the participants (Tashakkori and Teddlie, 2003). Inevitably I was influencing each stage so my involvement had become personalised. I needed to be sensitive to my identities as a lecturer and a researcher. Inevitably I had some expectations about the outcome of the research. It was therefore important to show clear exposition of the evidence collection method with highly detailed findings, analysis and discussion. In sum I had to be able to trace the reflexive process across the study, showing if, how and where I had influenced the conduct and proceedings.

In practice the main challenge to reflexivity was simply being present during the filming activity. I took on board the advice of Cotton and Gresty (2006) and Lundgren-Laine and Salantera (2010). They emphasize the position of the researcher and the subtle, but important difference between research distance and reflexivity; trying to be aware of personal feelings, in this case hopes and ambitions for the outcome. Reflexivity requires an understanding of the context in order to show an accurate interpretation of spoken thoughts, meanings and behaviours of others (Benton and Craib, 2001; Black, 2008). This was a useful backdrop during the discussion with students prior to commencing the filming activity.

It was important to make sure that they understood exactly what was required and recognize those feelings that might have an influence on neutrality, especially as the potential subjects were known beforehand.

In spite of the pilot study and carefully rehearsed explanation, delivery of the procedural information, my understanding and implementation of reflexive principles seem to improve with each subsequent group. With the initial group there was a tendency to use hand gestures when asking "What are you thinking?" I resolved this by keeping both hands clasped. However I felt that this behaviour may have influenced the students' responses. The decision was made to review the observer input for the first and last groups to be filmed. Sequentially these were the Heterogeneous Group 2 and the Homogeneous Strongly Disagree Group respectively. A review of the film clips for observer input with these two groups shows a tendency to ask "What are you thinking?" in a conversational style to the first group. This may have influenced their chatty and friendly responses about a range of issues. In contrast the tone for "What are you thinking?" for the last group was in a flat quiet tone with no change in voice dynamics. The film evidence shows that this group responded with concurrent think-aloud commentary directly related to personal competence and confidence.

3.14.5 Descriptive content and interpretive validity

For this study descriptive content and interpretive validity were selected on a number of grounds. For descriptive and interpretive validity, the Protocol Segments were reviewed in respect of their description and interpretation and mapped against the Reusable Learning Object. The next consideration was related to content validity and the simulation of what would usually be a real-time activity. Setting the participants to work through the RLO activity was an example of what students would normally do to develop their understanding. It was anticipated that the preliminary evidence collection stage to show interpretive validity would be unremarkable as this was based on what was happening in the film clips.

In their discussion on evidence collection strategies, Tashakkori and Teddlie (2003), regard validity and trustworthiness as synonymous with a requirement to show the perspective of the participants rather than those of the researcher. Figure 10 (See page 190) shows how the perspective of the participants was addressed. Whilst the first camera focused on faces and picked up the commentary, the second camera on the monitor recorded the events on the laptop. The software contained a facility to run the two film clips parallel, to assess accuracy in the subjects' behaviours and their commentary against what was happening in the task. This authenticated interpretive validity of the participants' contribution. Likewise the observed evidence in the films and the processing and management by The Observer XT validated the truthfulness and reality of the events as they occurred. The use of Concurrent Think-Aloud to collect commentary gave high face validity to these parts of the proceedings, demonstrating a clear relationship between the evidence and the study of competence and confidence in student nurses as computer users.

A significant number of usability comments were Talk-Aloud as opposed to Think-Aloud about the RLO. This was a challenge to face validity. The clarity of the information given to the participants at the beginning of the task did improve with practice. Albeit retrospectively, the changes made to the Protocol Segments corresponded with what was actually observed. Codes allocated to the Protocol Segments were a close fit to the content of the task and therefore conformed to descriptive and content validity.

3.14.6 Challenges to interpretive validity

Although the film clips and the saved commentary logs would be evidentially concrete, interpretation of the findings from this material would be discretionary. The felt judgement of the observer and deductive reasoning are independent of observation. From the outset it was appropriate to declare the gap between the evidence collection and interpretation stages as interpretive validity was autonomous from empirical observation. Whilst the observable elements could be seen the problems were related to the unobservable and latent phenomena those hidden aspects that might emerge, that are part of our persona. Potential problems were also anticipated with students chatting about issues not directly related to the activity. It was therefore important to be aware of the consequences of poor judgment when interpreting the evidence.

3.15 Organising and managing the filming activity

Two video cameras were set up to simultaneously to record each group of participants working through the task and the events on the computer screen. Ericsson and Simon (1993) recommend time for comfort adjustments such as seating and lighting and a gentle warm-up to acquaint the subject with the proceedings. Warm-up tasks may be asking participants to think about and concurrently state how many windows they have in their home by adding the figures as they go through each room, or concurrently stating names of different cars and types of a food product.

Aitken and Mardegan (2000) in their study of critical care nurses engaging in concurrent think-aloud identify the usefulness of warm-up exercise time, but do not give details. The decision was made to give the students a taste of the exact RLO activity as a warm-up exercise with occasional instruction to keep talking aloud. The rationale for this was the opportunity for a practice run, to review instruction details and resolve any problems.

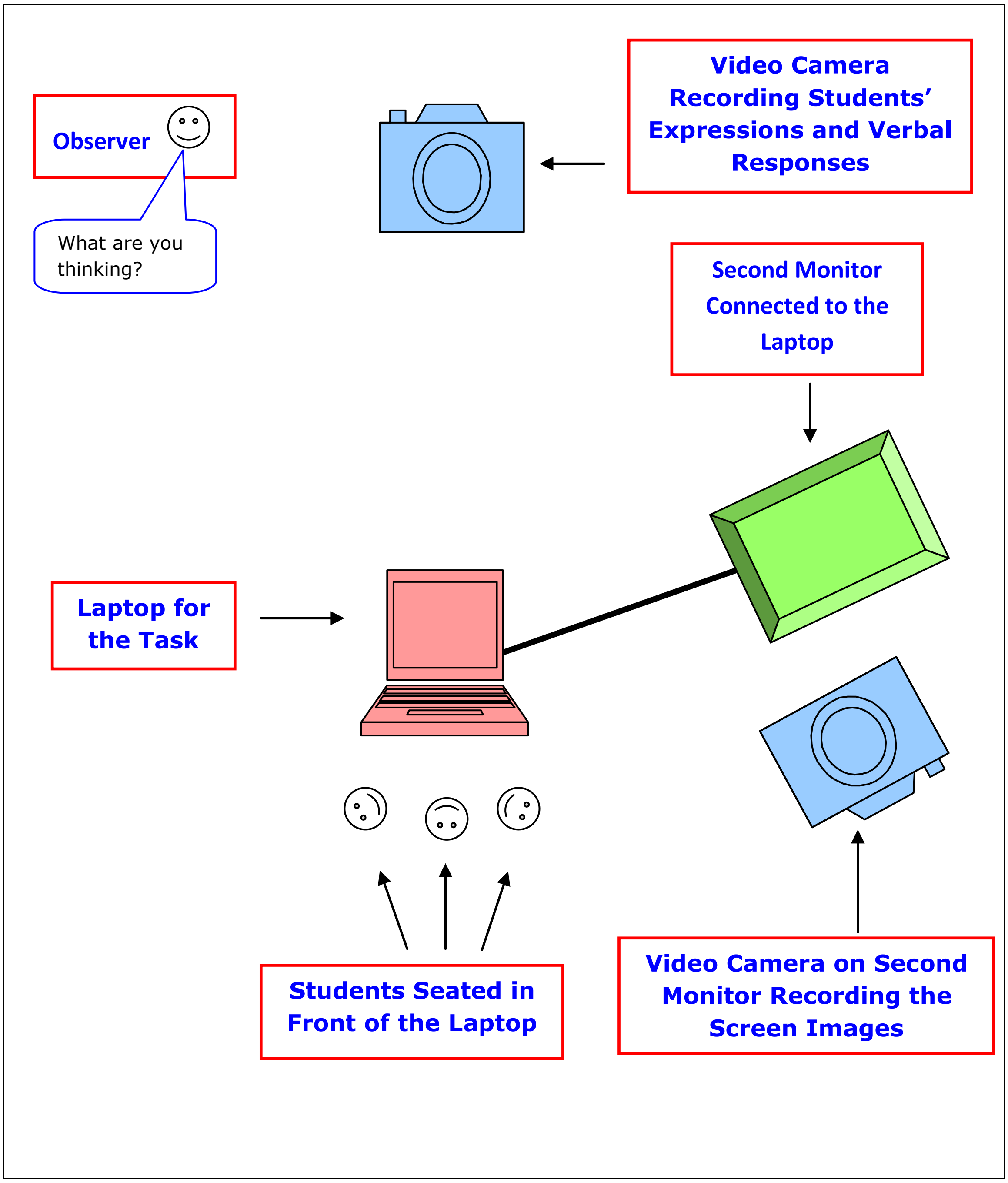
3.16 Pilot study

Robson (2002) advises that fixed designs should be piloted on the basis that they pre-test the practical conditions. A pilot study offered further scrutiny of the relationship between the research question and methodology with opportunity to review the theoretical underpinnings for transparency, reflexivity transferability and validity. Pragmatic considerations were technical matters such as dedicated time with the equipment, software familiarity and detail related to interaction and communication with the participants.

Three students responded to an e-mail asking for three volunteers not involved in the actual research, to take part in a small pilot study. A brief overview of the study and explanation of what would be required and their rights as healthy volunteers in accordance with the University's Ethics policy were given, along with a reminder that they could withdraw at any point in the proceedings. An explanation about the type of thinking required and the differences between Concurrent Thinking-aloud as opposed to Talk-aloud for a usability study were outlined. All acknowledged they understood Concurrent Thinking-aloud.

It was left to the students to decide on their part in the contribution. Each student was given a copy of the task but just one student held it for the others to view. Without prompting they adjusted the height of the chairs, arranging themselves in a crescent shape. This appeared to give good visuals of the laptop screen and each other in order to carry out the task comfortably. Figure 10 (See page 190) shows the arrangement of the room for the pilot activity.

Figure 10 Outline of the environment for a pilot of the concurrent think-aloud method



For some concurrently thinking and verbalizing is unnatural, as thought tends to co-exists with silence followed by speech. It was important that study subjects were given the correct information as to what was required of them. Actual recording commenced only once they felt ready to commence the task after the warm-up exercise. Researcher proximity was clearly an important consideration in being able to observe the students, operate the cameras, give occasional prompts as gentle reminders to keep thinking aloud but not have an overwhelming presence. Lodge et al. (2000) identify the subtle difference between the researcher being positioned within hearing distance but out of the participants' line of vision. As this was a pilot the decision was made to stay within their line of vision and examine the consequences retrospectively.

3.16.1 Evaluation of the pilot study

The activity took 22 minutes including the explanations and the warm-up exercise. On completion the students reported that they had found thinking aloud a positive experience. Comments were related to informality, small group work, mutual support and making a contribution irrespective of level of understanding. The students stated that the task instructions were clear and easy to follow. The prompt of "What are you thinking?" was not distracting. When asked about the environment all concurred that the conditions were comfortable. The decision was made to stay in their line of vision.

Opportunity to work on Observer verbal and non-verbal skills proved invaluable, with opportunity to think about the balance between succinct statements and information overload. It was important to find the right point to encourage the students to think-aloud as an occasional prompt, rather than constantly interfering. There is no single correct approach to prompting. Edwards et al. (2005) reminded their participants to think-aloud if they paused for longer than just a few seconds. Aitken and Mardegan (2000) let their subjects determine the course of thinking-aloud. This evidence clearly shows that is the responsibility of the observer to determine positive conditions for evidence collection and assess the characteristics of the participants.

The presence of the lecturer might have influenced the students' impeccable behaviour. This may have had implications for the truth element in the verbal protocols. Hoppmann's (2009, p.214) advice was to ask the participants to "express every thought that crosses their mind while performing an assigned task" including cursing and temper, in order to map behavioural changes. It was decided to use this approach and tell the students that any expletives because of frustration would be absolutely fine as this would give a good indication of their real thoughts and feelings. This might be challenging for some because of the professional expectations of student nurses and the requirement to adhere to a behavioural code of conduct, including attention to communication skills.

3.16.2 Coding and validity issues emerging from the pilot study

The pilot work offered a useful opportunity to review the content and the validity of the coding scheme. Too many or insufficient or irrelevant codes could have created confusion at the observation and analysis stages of the study. The adjectives bored and angry were added to the structure. The decision was made to eliminate the modifiers column as it reflected a subtle but incorrect shift towards a usability study.

A crucial aspect of validity was to find out if the codes would provide an accurate reflection of the demonstrated behaviours. This raised the possibility that in spite of having reviewed the coding scheme for behaviours, the unexpected may arise. It was cautiously anticipated that repeating the activity using the revised codes (See Figure 11, page 194) would give consistent and reliable results.

Figure 11 Revised first level coding scheme for protocol segments

Behaviour Name	Description	Code	Properties
Segment			
phase 1		**1**	State Event
phase 2		**2**	State Event
phase 3		**3**	State Event
phase 4		**4**	State Event
Phase 5		**5**	State Event
Phase 6		**6**	State Event
Mental State			
Happy		**Y**	State Event
Bored		**B**	State Event
Neutral		**N**	State Event
Angry		**G**	State Event
Anxious		**A**	State Event
Status			
Correct		**C**	State Event
Incorrect		**I**	State Event
Screen Location			
Toolbar		**T**	State Event
Menu		**M**	State Event
Page		**P**	State Event
Side-bar		**S**	State Event
Else		**A**	State Event

3.16.3 Application of the software to the pilot study

Carrying out an observation using The Observer XT involved a number of processes. The first level of protocols, the activities within the RLO task were coded and inputted into the software. Having uploaded the pilot film, the next task was to watch it and transcribe the students' narrative as an event log into the free text column. The event log would become the second level of protocols. In setting up the event log the first issue for consideration was the type of independent variables which might be useful as descriptors. Independent variables do not have any influence on the processes within a qualitative approach for Structured Observational Analysis. Their role is entirely contained within the software, just to provide identification information about the participants.

For initial practice and familiarization, the variables loaded were simply gender, year of study and Course. The Observer XT facilitates a number of hierarchical levels for the grouping of subjects. This can be a group with two or more subjects under one heading when behaviours have a collective appearance such as the three students staring intently at the screen and also a level with just one subject showing individual responses. The pilot activity confirmed the usefulness of these options, to obtain a visual analysis of individual and group activities and behaviours.

3.17 The main study

Filming for the seven group and pairs of students was organised across a three month period between November 2010 and January 2011. At intermittent occasions the participants were asked "What are you thinking?" Some groups needed more reminders than others. Occasionally there would be no response and the question would have to be repeated. In spite of the request to refrain from making usability comments some responded to "What are you thinking?" with an evaluation of the RLO, stating what they were doing. This seemed to improve when the question was changed to "How are you feeling?"

The filmed evidence was organised as two film clips from the two cameras. The first clip was of the events unfolding on the remote screen depicting the RLO task. The second clip was of the students working through the task. Each set of films was named and organised for media file storage and in sequence to show the individual identity of each group and their participation order. The first task was to watch the films in their entirety without any action. The rationale was to have a look at what was happening, gain some insight about the actions and behaviours of each group or pair, and then consider the preliminary management of the findings and eventual protocol analysis using the advice of Ericsson and Simon (1993).

3.18 Adaptation of the first level of coding, the protocol segments

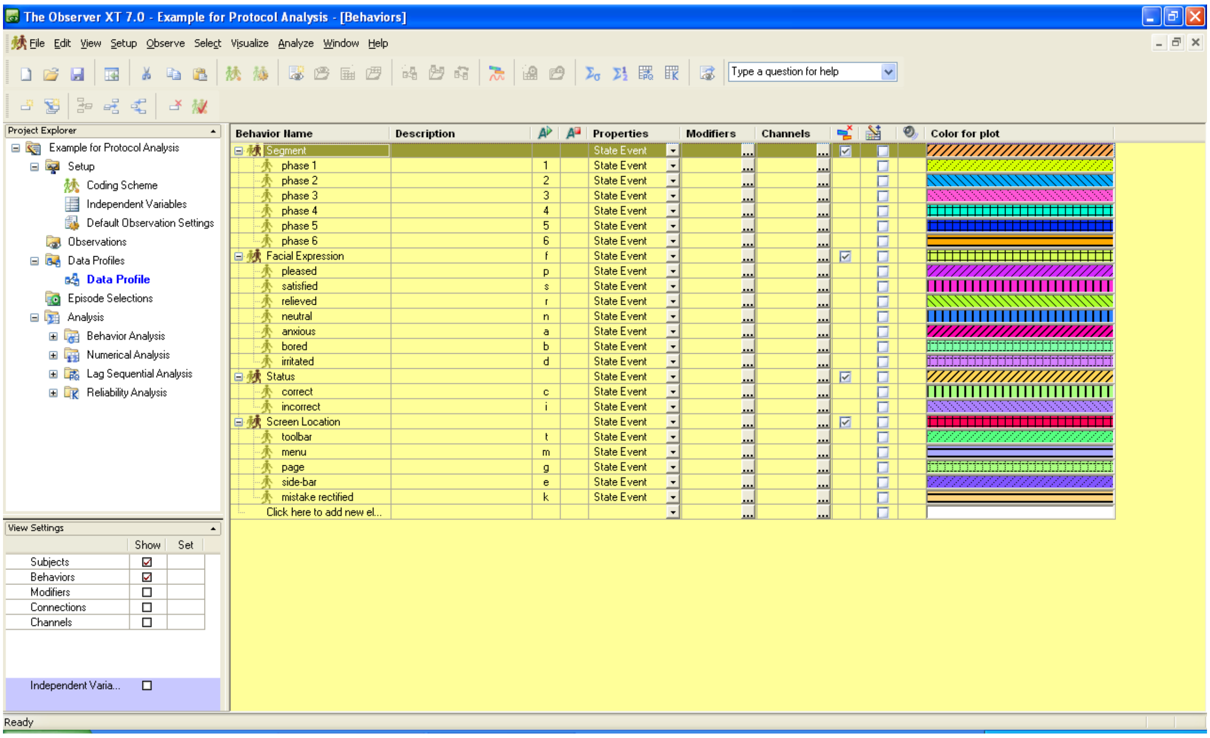
After watching the films a number of changes were made to the first coding scheme. The segment title 'Mental State' was replaced with 'Facial Expression' as the mental status of the subjects was unobservable. At best it could only be deduced and not actually viewed by the observer. The facial expressions displayed by the participants did not entirely reflect the range of adjectives. This protocol segment was recoded a number of times before a final version was determined.

The range of adjectives reflected positive and negative facial expressions as pleased, satisfied, relieved, and neutral as a midpoint, followed by anxious, bored and irritated. The adjective angry was removed as no participant appeared to be furious, display any extreme irate behaviour nor enraged facial expression during the filming. In the (rejected) method of participant observation Mead (1934 cited by Tashakkori and Teddlie, 2003), advocates for the role of the observer and their relationship to the study subjects to be clearly defined from the outset in an attempt to create conditions which reflect a natural setting. Mead's take on the presence of the observer has transferable properties, getting people to concurrently think-aloud whilst being watched. The presence and relationship of the observer as a lecturer, to the students as participants, may have influenced their responses.

At the design phase the coding activity for the task had accommodated for error, but not the point when mistakes might be corrected. A number of participants made errors in the task which were duly rectified, but these were not represented in the visual analysis for each event log, rendering the visual analysis output as inaccurate. A code for 'mistake rectified' was added to the protocol segment 'Location' prior to further examination of the films. This changed the structure of the Visual Analysis. The Visual Analysis output now illustrated where errors occurred and when they were corrected.

Figure 12 (See page 199) illustrates the reconfigured coding scheme organised using the software. The structure shows the first level of coding as Four Protocol Segments containing twenty sub-elements. These are: Phases of the Re-usable Learning Object, Facial Expressions, Status whether correct or incorrect whilst working through the task and Location in the event of being incorrect and then rectifying the mistake.

Figure 12 Reconfigured coding scheme showing revised first level protocol segments in The Observer XT

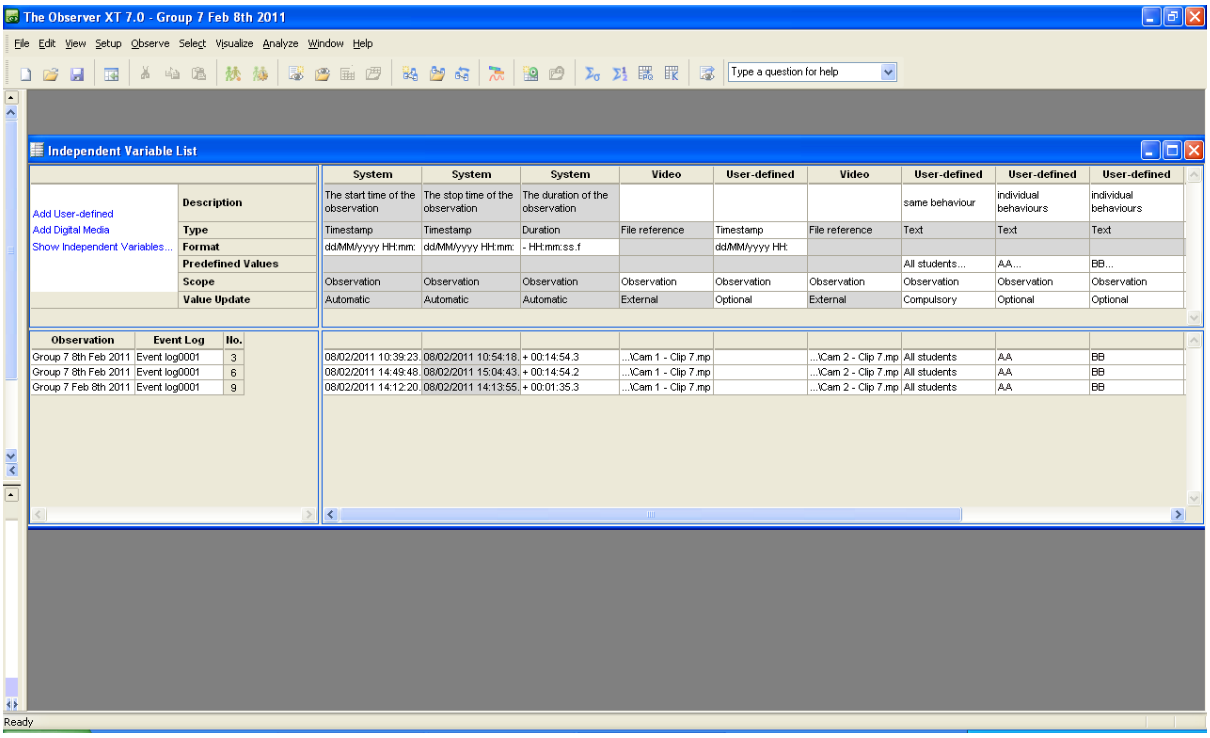


3.19 Using the software to manage and present the evidence

Each group was assigned its own file name with individual codes for all subjects. Scoring and documenting for two media files simultaneously required a number of preliminary actions which The Observer XT refers to as Predefined Values. The Predefined Values decided on for this study were: the creation of a name for each observation, uploading the films into Offline scoring mode (meaning that scoring using the pre-determined protocol segments would not be carried out live or in real time) and entering a name for each media file, inserting the initials of each student as individual subjects and also entering a code for them working together as ‘All Students’. Each Predefined Value contained an optional label for descriptive background information. All labels had to comply with American Standard Code for Information Interchange (ASCII) characteristics, meaning that the software will only recognize plain formatted text and number. The Observer XT then created an automatic timestamp for each set of films.

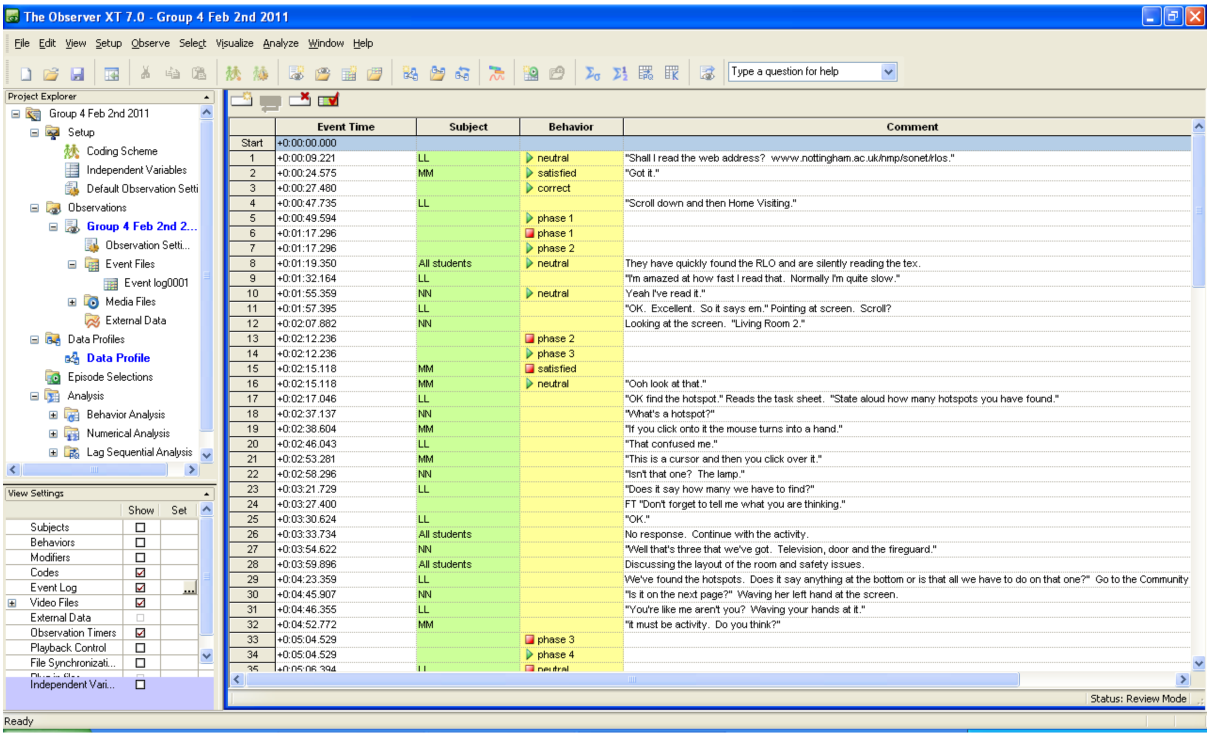
It proved to be really advantageous to use a timestamp to review specific parts of a film clip or log events. Once they have been created, the software embeds and recognizes the Predefined Values for each set of media files, irrespective of how many event logs for each group are created. Predefined Values were created for each group and their corresponding media files. Figure 13 (See page 201) is an example of the Predefined Values for one of the groups.

Figure 13 Example of predefined values in the Observer XT



Anonymity was created by alphabet lettering instead of subjects' names and the removal of photographic details. Figure 14 (See page 202) is a section of the scoring undertaken in one event log, but its generic structure relates to all participants. To support the mutually exclusive label in the coding scheme, the behaviours were also defined with Start and Stop codes. In the software Start and Stop can be activated by pressing Enter on the computer keyboard and then the code for the new behaviour or activity. The timestamp can be seen against each individual comment with Start and Stop coded as a green triangle and a red square.

Figure 14 Section from an event log



3.20 The creation of protocols from the event logs

A verbal protocol is the structure or form the spoken comment takes on after it has been stated, recorded and analyzed (Ericsson and Simon, 1993). The transition from audio-visual to transcript in the event log to verbal protocol involved a sequence of actions. The film clip was paused to type the comment into the event log column. At the same time using the pre-determined codes for the Protocol Segments, the actions and expressions of the participants were scored by hitting the relevant keystroke. The list of comments and actions was saved and backed up in Project Explorer (See left section of Figure 14).

The event log facility within The Observer XT enabled actions from the pre-defined Protocol Segments (the first level of coding) and comments to be scored for each group or pair of participants as the Verbal Protocols (the second level of coding). This required a significant number of reruns of the films in The Observer XT to insert and score events for Protocol Segments and transcribe the participants' comments not picked up on previous viewings. The logged events and transcribed comments from the film clips were then exported from The Observer XT into Notepad as .txt files and copied into Microsoft Word. Once in Microsoft Word, removing the formatting ASCII characteristics from the text gave a tidier visual presentation and made reading and reviewing easier.

The task was to look for all statements that reflected concurrent thinking aloud about computing competence and confidence. The aim was to extract comments which would be meaningful and relevant as transcribed verbal protocols. Likewise parsimonious filtering has implications for the richness of the discourse between participants. The advice of Ericsson and Simon (1993) is to encode each verbal protocol using discrete closed categories, seeking out semantically rich text. This proved to be very difficult as in all reality human beings do not segregate affective and cognitive domains into distinct sentences when talking to each other, even in research conditions. For example, some of the students' comments reflected interconnected statements as Think-Alouds about competence and confidence and Talk-Alouds about the RLO as a usability activity.

3.21 The creation of themes from the verbal protocols

When reading commentary that requires the identification of themes, Miles and Huberman (2002) recommend searching through the text and looking for how often a characteristic occurs. Having established the nature of the verbal protocols, the typed protocols were printed out and simply allocated a coloured mark when similar reoccurred. Simple in design yet pragmatic in its execution, the advantages of this method are: an increasing awareness of patterns and trends, recognition of relevant, peripheral and extraneous information and crucially showing a link with the nature of the study. This was preferable to simply changing the on-screen font colour as it slowed the process, taking time to really look at and absorb what types of themes were emerging. In their discussion on encoding vocabulary Ericsson and Simon (1993) and Robson (2002) identify that protocols will contain clues revealing the subjects' ability to control and evaluate the processes within a task.

In the repeated cycles of interpreting, defining, and revising the emerging protocols, it became increasingly clear that to show where under-confidence and over–confidence influence competence, this groundwork would set the parameters for the themes to be included and the findings from those themes. To some extent the verbal protocols and themes seemed to emerge in tandem whilst reviewing film clips, writing event logs and reading through the transcripts.

3.22 Conclusion

The structure of the first research question influenced the choice of an exploratory study using a quantitative approach. The research instrument was a survey using a postal questionnaire. The rationale being that a postal questionnaire was non-invasive and the substantial evidence from the anticipated data would assist in the making of an informed judgement about any real-world correlation between competence and confidence. The selection process for the competence and confidence variables ensured that an equal number of items were included for both. Cronbach's alpha coefficient analysis was selected for reliability assessment. The results will show how well the continuous variable items hang together. Principal Components Analysis was identified as the most suitable method to answer the research question because of its parsimonious properties. In extracting the largest amount of information possible, its data reduction processes result in a smaller set of components. The range of tests within Principal Components Analysis confirmed the suitability of the survey questionnaire and the size of the cohort. The crucial decisions required for a PCA were related to: the type of variables for investigation, the nature and relevance of the measured variables to the characteristics of the potential sample for study, the size of the sample, the factorability of the R matrix, the number of extracted components, the type of rotation and their importance in determining any underlying construct.

The choice of a qualitative approach was influenced by the design of the second research question. Previous participant observation research showed the benefits of using Concurrent Think-Aloud and Protocol Analysis. Exploration of this body of work illustrated diversity in its application. Therefore an objective was to make methodological choices related to structure, direction and credibility within the processes. It was anticipated that the selection of this method would support the manifestation of a sequence of events and the parsed protocols would emerge as themes. With the technological support of film and software, Concurrent Think-aloud and Protocol Analysis appear to be suitable structures to profile commentary and behaviours for computing competence and confidence. The following chapter sets out the results of the studies.

Chapter Four Results

4.1 Introduction

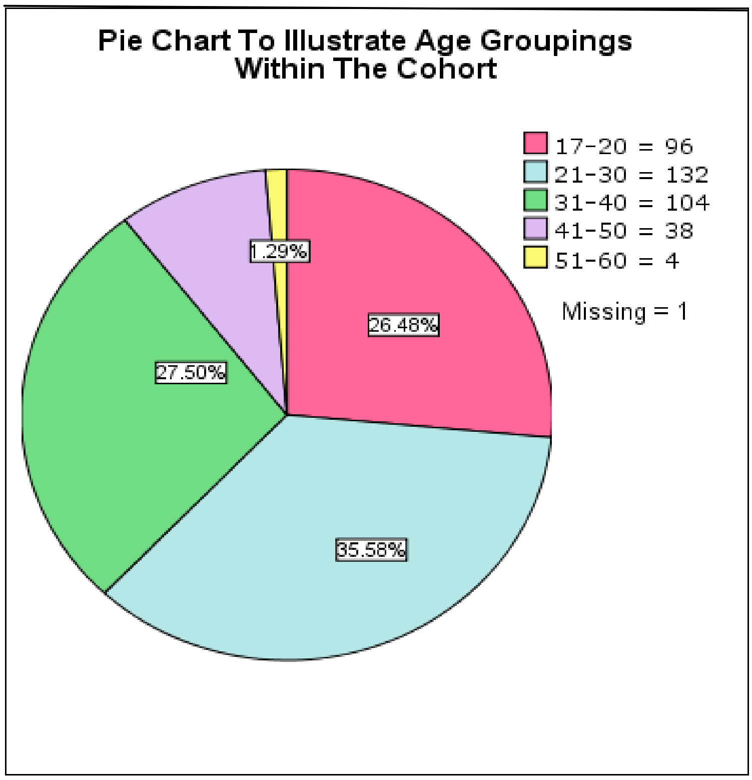
The previous chapter set out the methodological intentions for the research. The choices of a quantitative exploratory and a qualitative explanatory study underpinned decisions to carry out a survey by questionnaire with a Principal Components Analysis, followed by direct observations using concurrent think-aloud and Protocol Analysis. This chapter reports the results from these two studies.

Study One

4.2 Demographics

Of the 375 survey respondents, 337 (90%) were female and 36 (9%) were male. The male to female ratio was 1:10. This ratio was broadly representative of the student nurse population. Figure 15 (See page 208) shows the age groupings. The majority of the students fell within the 21-30 years age bracket, slightly larger than the following group, 31-40 years. The smallest group were in the 51-60 years age group. The mean age of a student nurse for the whole cohort fell within the 21 – 30 years age group (standard deviation = .9). 237 (63%) students were in the first year and 130 (34%) students were in the second year of their studies. Eight students did not complete this question. 338 students (90%) used a computer in the School of Nursing Information Technology Suite. 372 students (99.2%) had access to a computer at home. 58% of the group who had a computer at home identified study as the main use whilst 40% gave leisure as the main reason.

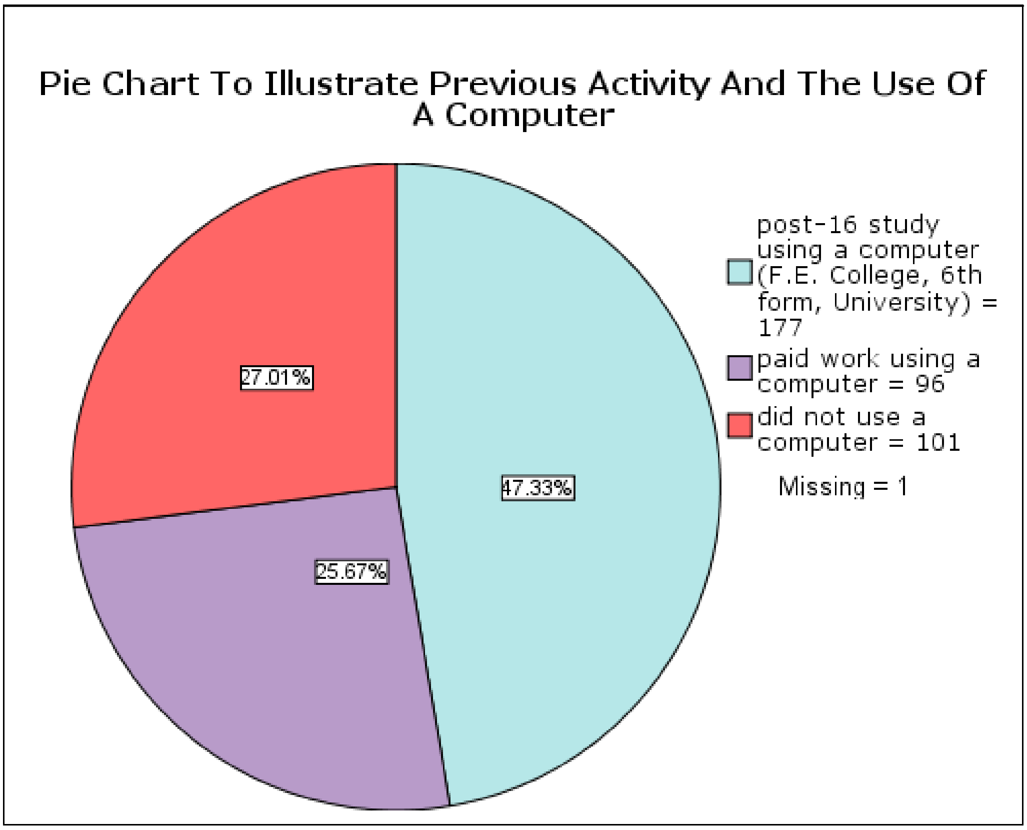
Figure 15



4.2.1 The use of a computer for previous activity

Figure 16 shows the number of students who used a computer in their previous activity before commencing their nursing studies. Nearly half of the respondents at 47% (176) used a computer in their post-16 studies whilst 25% (96) used a computer within their paid work environment and 27% (101) identified that using a computer was not typical in their previous activity.

Figure 16

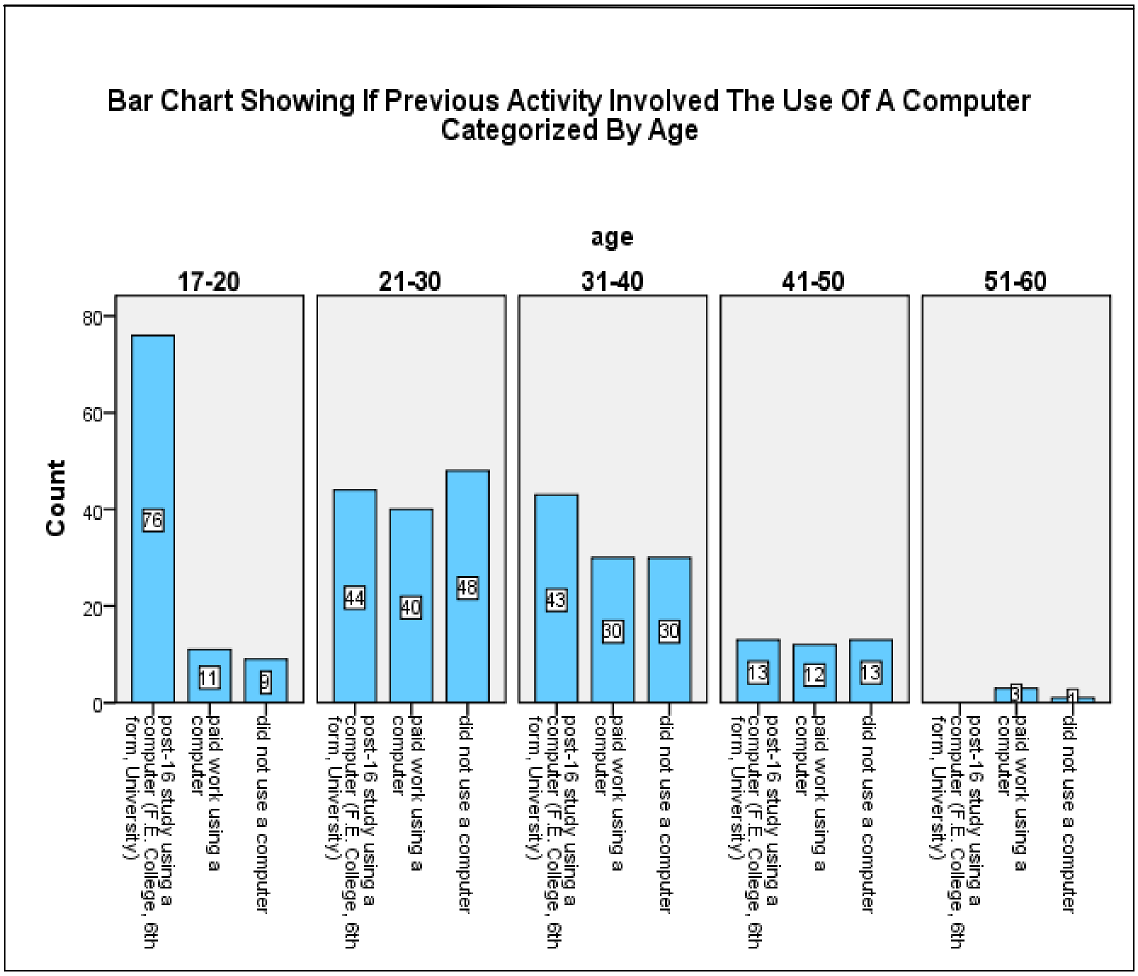


4.2.2 Previous use of a computer categorized by age

Figure 17 (See page 211) 'If previous activity involved the use of a computer, categorized by age' revealed that the younger students were more likely to have been using a computer through post-16 study, rather than work based computer activity. Just 2.4% (9) in the 17-20 years old group identified that they had not used a computer in their previous activity. In the 21 – 30 years age group, the three categories of post-16 study, paid work using a computer and did not use a computer were evenly distributed at 44 (11.8%), 40 (10.7%) and 48 (12.9%) respectively.

A similar distribution was also evident in the 41 – 50 years age group at 13 (3.5%), 12 (3.2%) and 13 (3.5%). In the 31 – 40 years age group the distribution was different with 43 (11.5%) respondents stating that they had accessed post-16 study compared to 30 (3%) for paid work using a computer and 30 (3%) for did not use a computer prior to their current studies. There were just 4 respondents in the 51 – 60 years age group of which 3 people stated that their previous activity was paid work involving the use of a computer and 1 person identified that they had not used a computer prior to commencing the Nursing course.

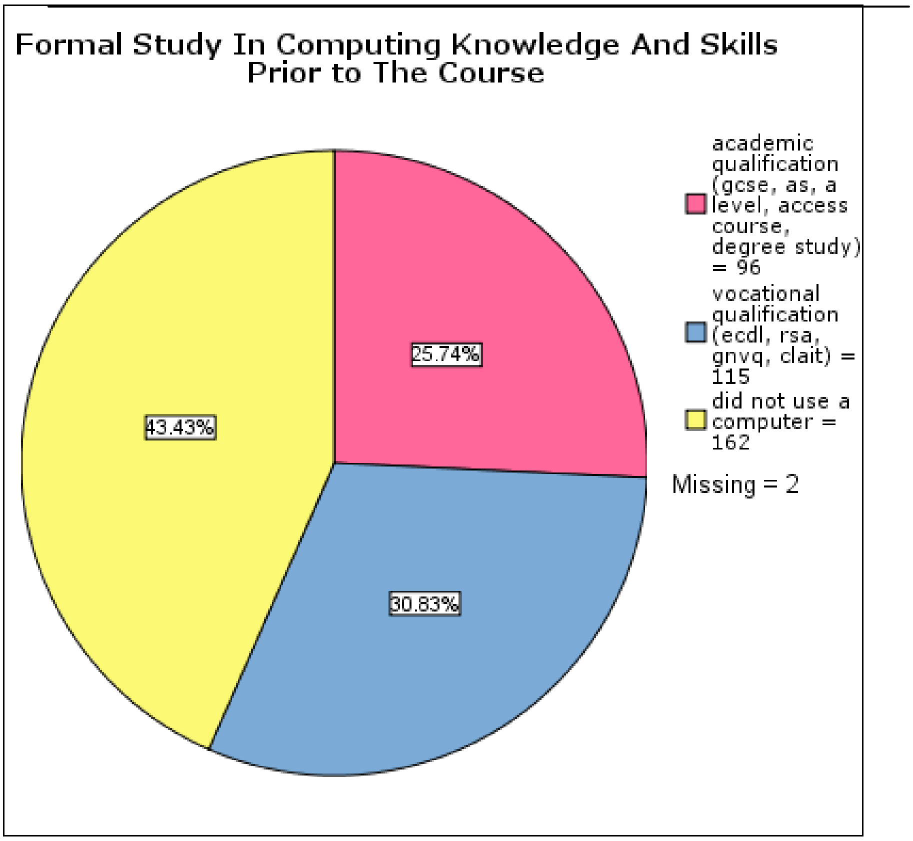
Figure 17



4.2.3 Formal study undertaken in computing knowledge and skills

Figure 18 (See page 212) reflects the level and type of formal learning in computing knowledge prior to commencing a Nursing course. 43% (162) of the cohort indicated that they had no formal study in computing knowledge and skills prior to the course. 25% (96) had gained an academic qualification ranging from GCSE to computer studies at degree level. 30% (115) had undertaken a vocational course. These were validated by organizations such as the European Union and the Royal Society of Arts.

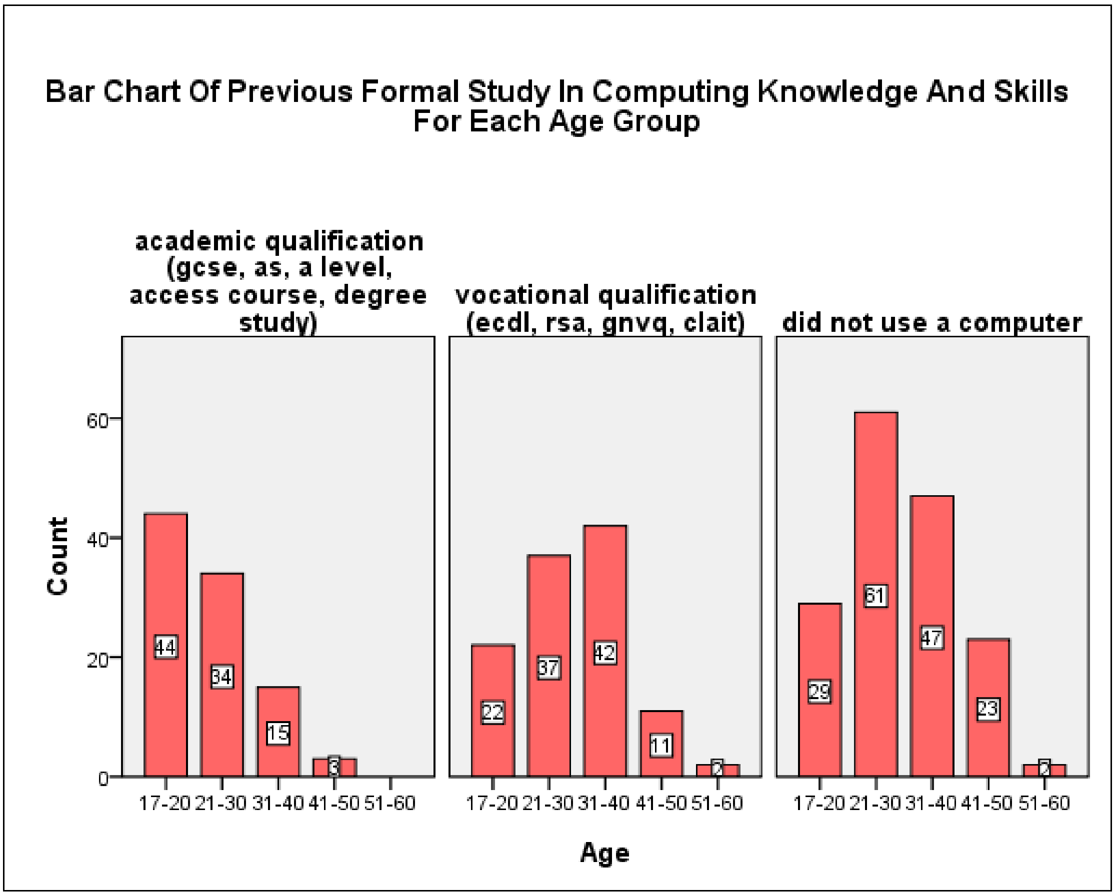
Figure 18



4.2.4 Previous formal study categorized by age groupings

Figure 19 (see page 213) reflects the responses to previous formal study categorized by age groupings. Students between the ages of 21 – 30 years at 22 (5.87%) and 31 - 40 years at 37 (9.95%) and 42 (11.29%) respectively, had accessed formal study in the use of a computer through a vocational route. 44 (11.8%) students in the youngest category of 17 -20 years, stated that they had undertaken an academic route of study compared to 34 (9.14%) 15 (4%) and 3 (.81%) of students for the other age groups. The highest figure in the chart is for the number of students in the 21 – 30 years age group at 61 (16.14%) who stated that they had not used a computer in any previous formal study.

Figure 19



The key points from these data were that the cohort was predominantly female and made up of first and second year undergraduate student nurses. A wide range of responses were given to the categorical variables of age, previous computing experiences, formal computing qualifications, access to and reason for use of a computer at home. The largest population within the cohort were in the second youngest 21-30 years age group. The data showed that the majority of student nurses used the computing facilities in the School of Nursing and most had access to a computer at home.

4.2.5 Histograms

Figure 20

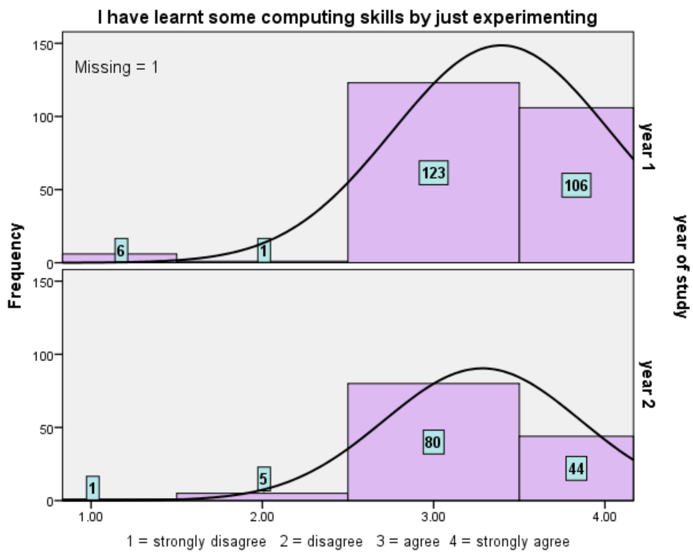


Figure 20 shows the frequency of distribution for student nurses' opinions on learning computing skills through experimenting. The lowest scores are disagree for year 1 (n=1) and strongly disagree for year 2 (n = 1). The highest scores are agree for year 1 (n= 123) and year 2 (n=80). Both histograms are negatively skewed.

Figure 21

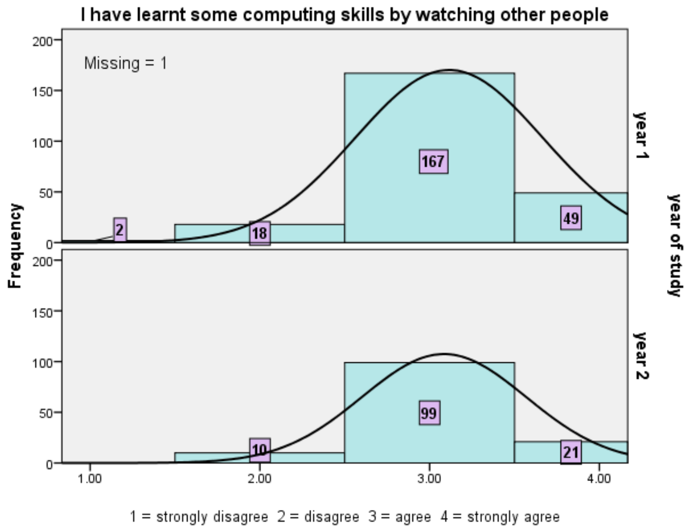


Figure 21 shows the frequency of distribution for opinions on learning skills by watching other people. The highest scores are agree for year one (n=167) and year two (n=99). The lowest scores are strongly disagree for year one (n=2) and disagree for year two (n=10). Both histograms reflect a normal distribution curve.

Figure 22

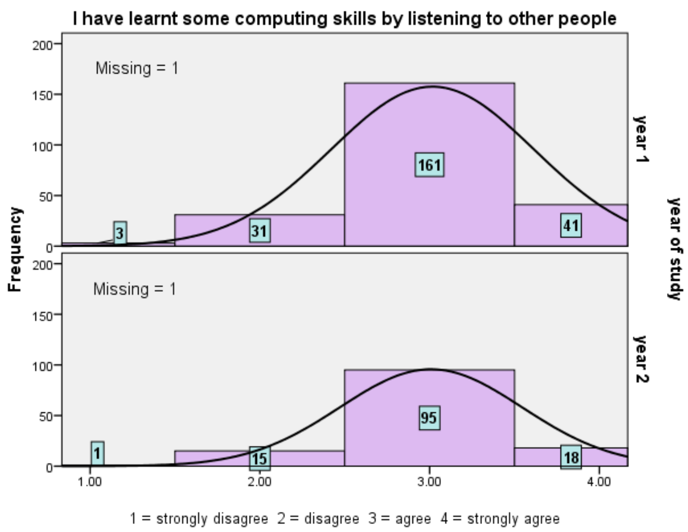


Figure 22 shows the frequency of distribution for opinions on learning computing skills by listening to others. The highest scores are agree for year one (n=161) and year two (n=95). The lowest scores are strongly disagree for year one (n=3) and year two (n=1). Both histograms reflect a normal distribution curve.

Figure 23

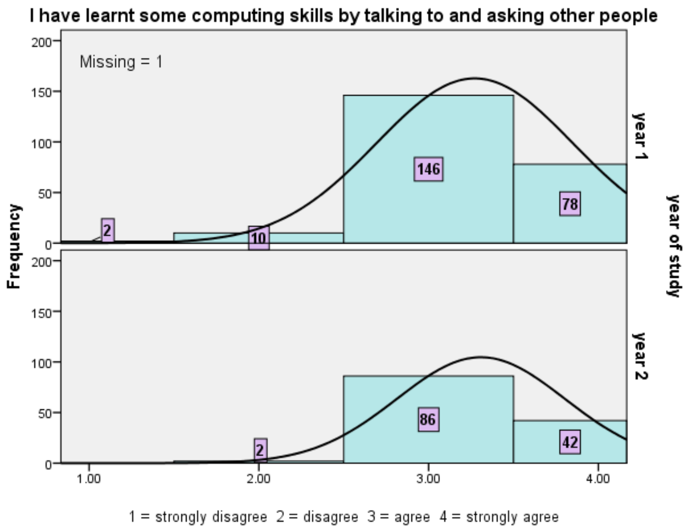


Figure 23 shows the frequency of distribution for opinions on learning computing skills through talking to and by asking others. The highest scores are agree for year one (n=146) and year two (n=86). The lowest scores are strongly disagree for year one (n=3) and disagree for year 2 (n=2). Both histograms are negatively skewed.

Figure 24

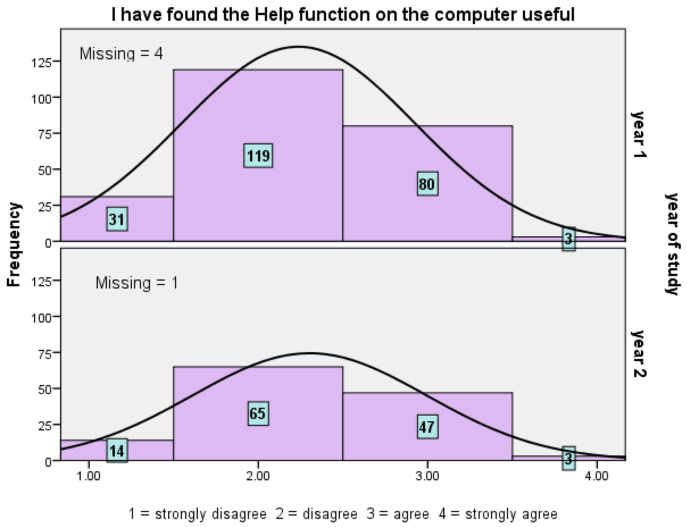


Figure 24 shows the frequency of distribution for opinions on the usefulness of the computer Help function. The highest scores are disagree for year one (n= 119) and year two (n = 65). The lowest scores are strongly agree for year one (n=3) and year two (n=3). Both histograms reflect normal distribution curves.

Figure 25

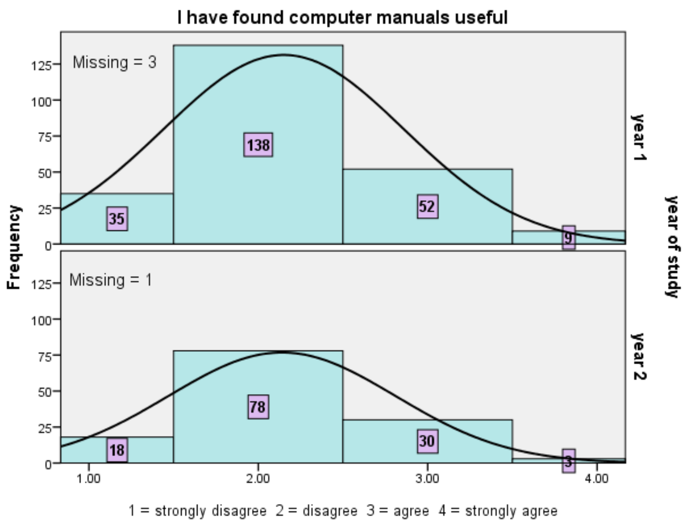


Figure 25 shows the frequency of distribution for opinions on the usefulness of computer manuals. The highest scores are disagree for year one (n=138) and year two (n=78). The lowest scores are strongly agree for year one (n =9) and year two (n=3). Both histograms reflect normal distribution curves.

Figure 26

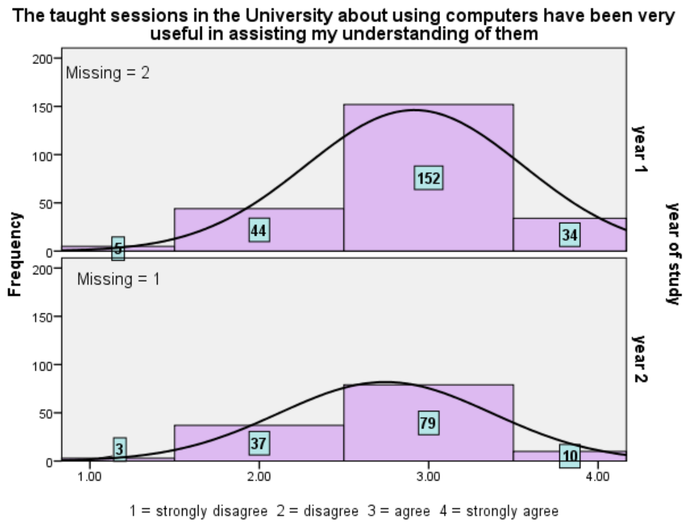


Figure 26 shows the frequency of distribution for opinions on the University's taught computing sessions. The highest scores are agree for year one (n=152) and year two (n=79). The lowest scores are strongly disagree for year one (n=5) and year two (n=3). Both histograms reflect normal distribution curves.

Figure 27

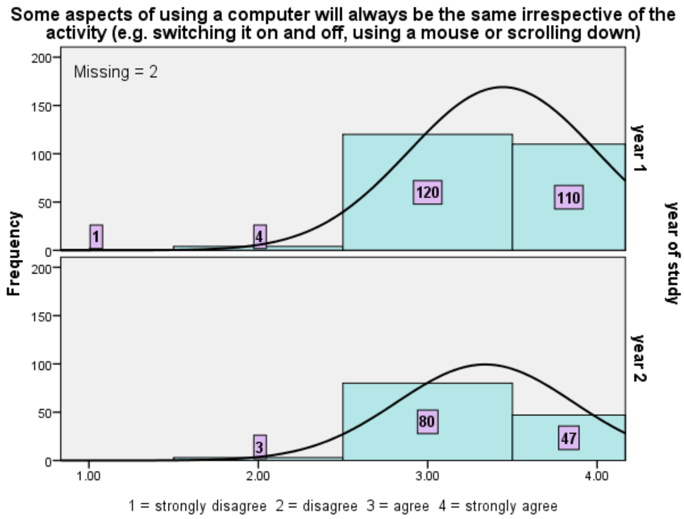


Figure 27 shows the frequency of distribution for opinions on some aspects of the computer will always be the same irrespective of the activity. The highest scores are agree for year one (n=120) and year two (n=80). The lowest scores are strongly disagree for year one (n=1) and disagree for year two (n=3). Both histograms are negatively skewed.

Figure 28

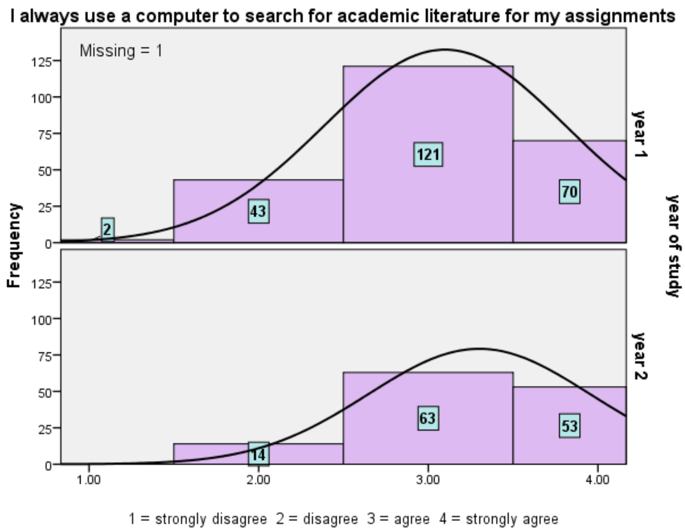


Figure 28 shows the frequency of distribution for opinions on using a computer to search for academic literature. The highest scores are agree for year one (n=121) and year two (n=63). The lowest scores are strongly disagree for year one (n=2) and disagree for year two (n=14). Year one histogram is a normal distribution curve. Year two histogram is negatively skewed.

Figure 29

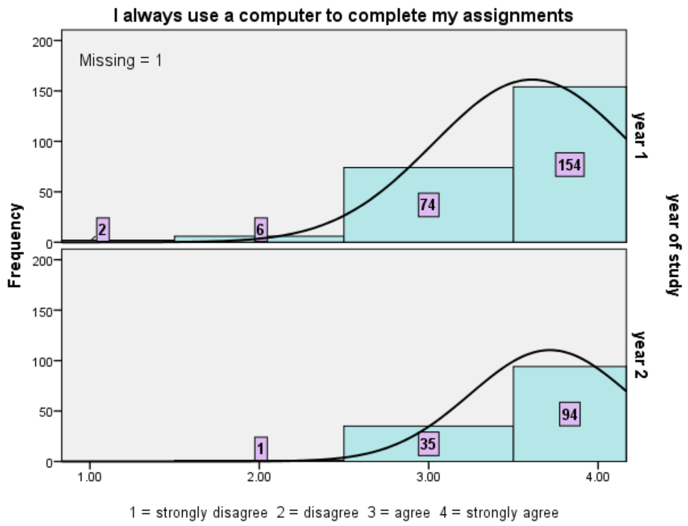


Figure 29 shows the frequency of distribution for opinions on using a computer to complete assignments. The highest scores are strongly agree for year one (n=154) and year two (n=94). The lowest scores are strongly disagree for year one (n=6) and disagree for year two (n=1). Both histograms are negatively skewed.

Figure 30

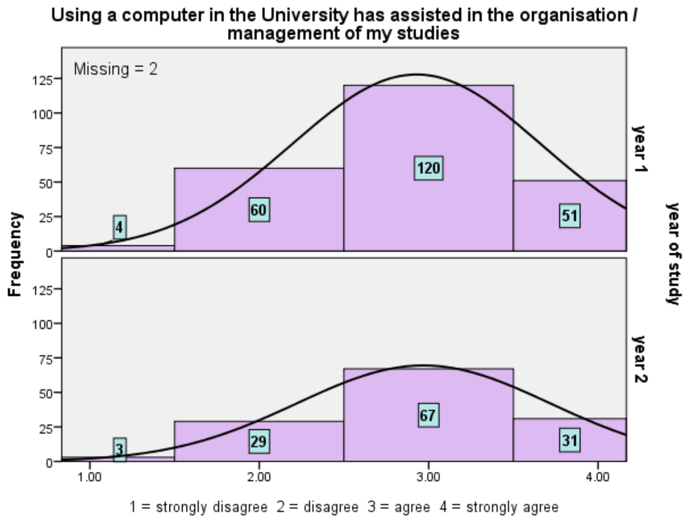


Figure 30 shows the frequency of distribution for opinions using a computer has assisted in the management and organisation of studies. The highest scores are agree for year one (n=120) and year two (n=67). The lowest scores are strongly disagree for year one (n=4) and year two (n=3). Both histograms reflect a normal distribution curve.

Figure 31

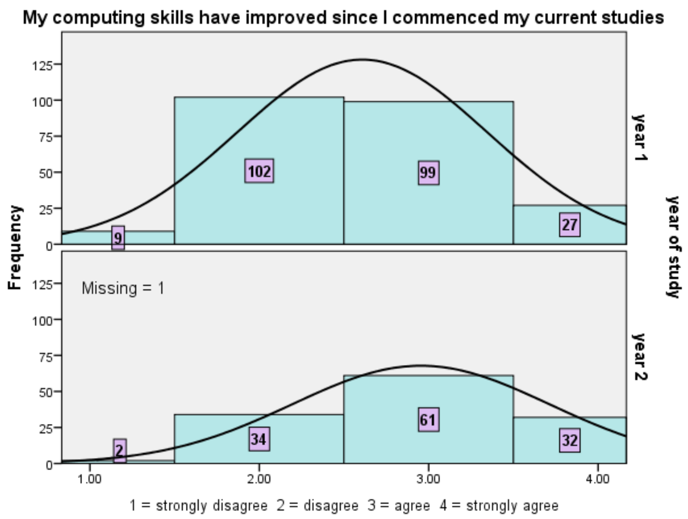


Figure 31 shows the frequency of distribution for opinions improvement in computer skills since commencement of nursing studies. In year one the highest score is disagree (n=102) followed by a similar figure for agree (n=99). In year two the highest score is agree (n=61). The lowest scores are strongly disagree for year one (n=9) and year two (n=2). Both histograms reflect a normal distribution curve.

Figure 32

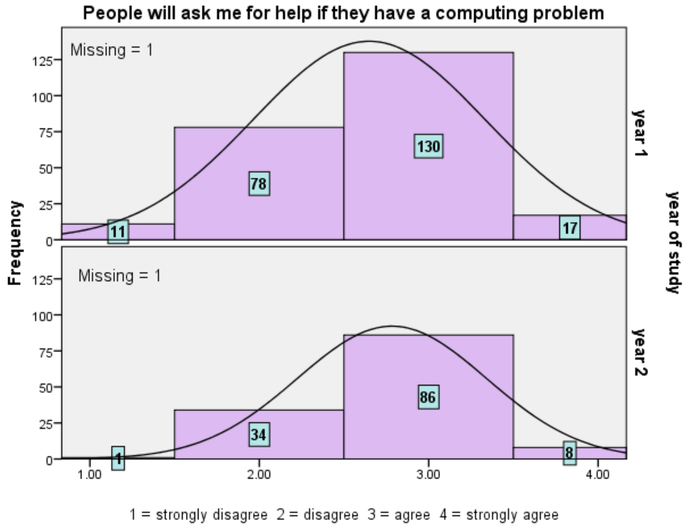


Figure 32 shows the frequency of distribution for opinions on being asked for help by others if they have a computing problem. The highest scores are agree for year one (n=130) and year two (n=86). The lowest scores are strongly disagree for year one (n=11) and year two (n=1). Both histograms reflect a normal distribution curve.

Figure 33

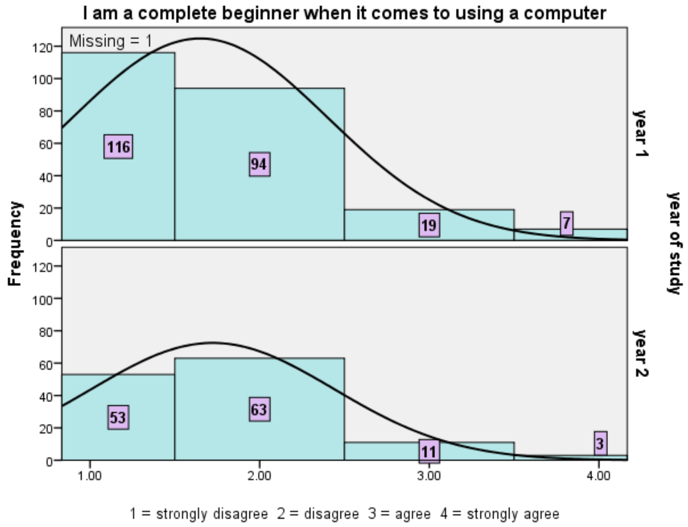


Figure 33 shows the frequency of distribution for opinions on being a complete beginner when it comes to using a computer. The highest scores are strongly disagree for year one (n=116) and agree for year two (n=63). The lowest scores are strongly agree for year one (n=7) and year two (n=3). Both histograms are positively skewed.

Figure 34

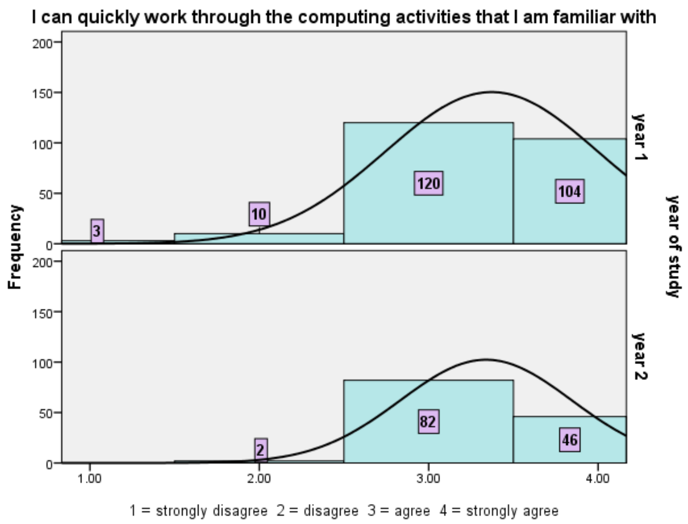


Figure 34 shows the frequency of distribution for opinions on being able to work quickly through computing activities that are familiar.

The highest scores are agree for year one (n=120) and year two (n=82). The lowest scores are strongly disagree for year one (n=3) and disagree for year 2 (n=2). Both histograms are negatively skewed.

Figure 35

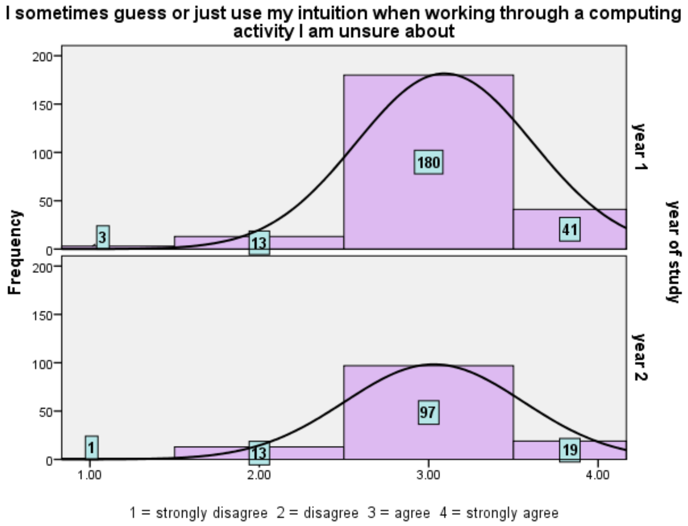


Figure 35 shows the frequency of distribution for opinions on guessing or using intuition when working through a computing activity. The highest scores are agree for year one (n=180) and year two (n=97). The lowest scores are strongly disagree for year one (n=3) and year two (n=1). Both histograms reflect a normal distribution curve.

Figure 36

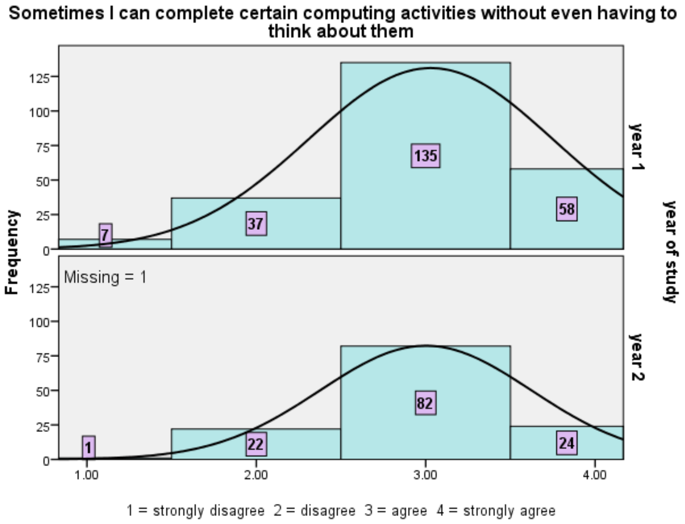


Figure 36 shows the frequency of distribution for opinions on being able to complete certain computing activities without having to think about them. The highest scores are agree for year one (n=135) and year two (n=82). The lowest scores are strongly disagree for year one (n=7) and year two (n=1). Both histograms reflect a normal distribution curve.

Figure 37

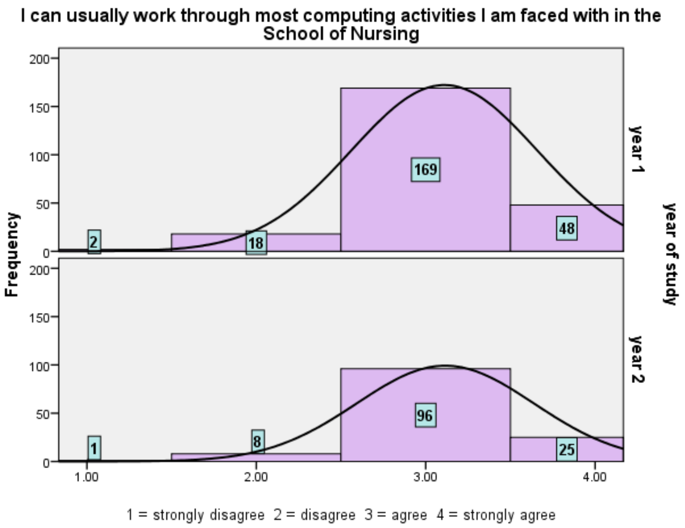


Figure 37 shows the frequency of distribution for opinions on being able to work through most computing activities in the School. The highest score are agree for year one (n=169) and year two (n=96). The lowest scores are strongly agree for year one (n=2) and year two (n=1). Both histograms reflect a normal distribution curve.

Figure 38

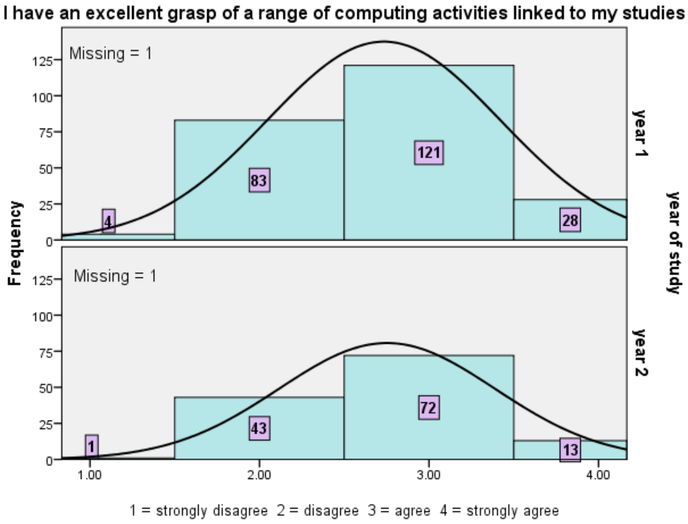


Figure 38 shows the frequency of distribution for opinions on having an excellent grasp of computing activities related to nursing studies. The highest scores are agree for year one (n=121) and year two (n=72). The lowest scores are strongly disagree for year one (n=4) and year two (n=1). Both histograms reflect a normal distribution curve.

Figure 39

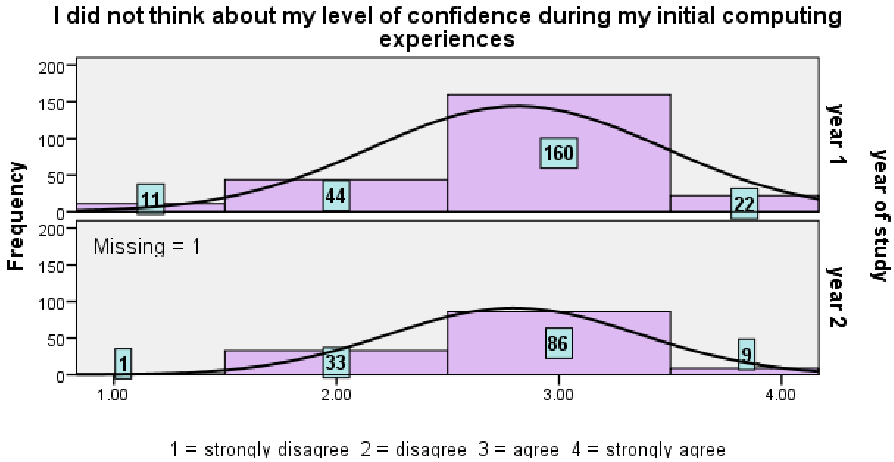


Figure 39 shows the frequency of distribution for opinions on not thinking about level of confidence during the initial computing experiences. The highest scores are agree for year one (n=160) and year two (n=86). The lowest scores are strongly disagree for year one (n=11) and for year two (n=1). Both histograms reflect a normal distribution curve.

Figure 40

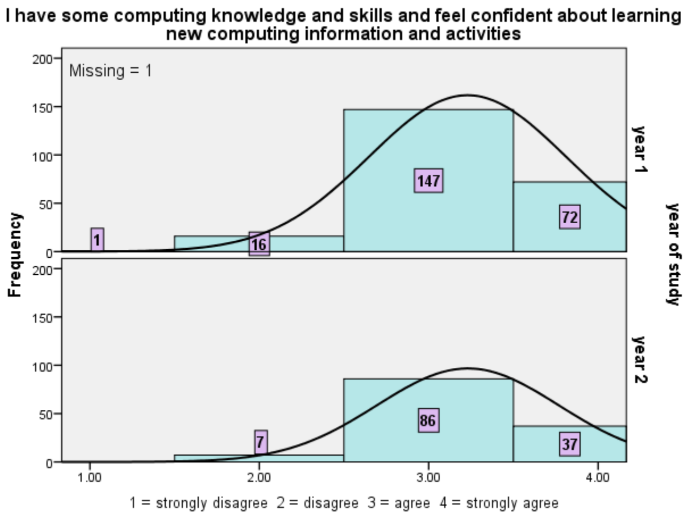


Figure 40 shows the frequency of distribution for opinions on having some existing computing knowledge and skills and feeling confident about learning new computing information and activities. The highest scores are agree for year one (n=147) and year two (n=86). The lowest scores are strongly disagree for year one (n=1) and disagree for year two (n=7). Both histograms are negatively skewed.

Figure 41

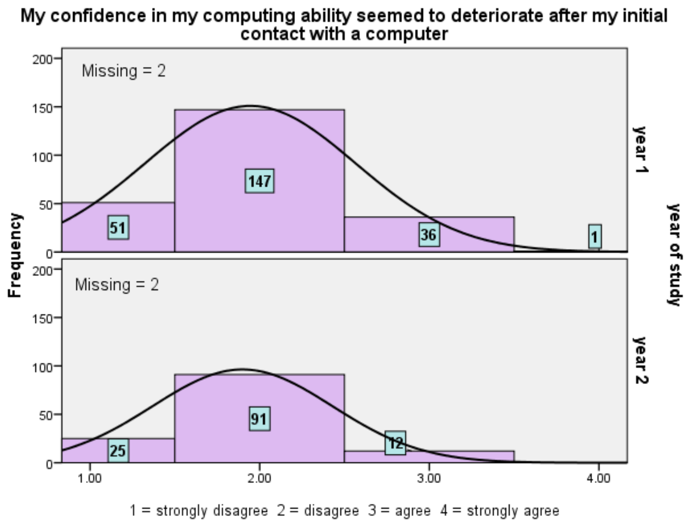


Figure 41 shows the frequency of distribution for opinions on deterioration in confidence after initial contact with a computer. The highest scores are disagree for year one (n=147) and year two (n=91). The lowest scores are strongly agree for year one (n=1) and agree for year two (n=12). Both histograms reflect a normal distribution curve.

Figure 42

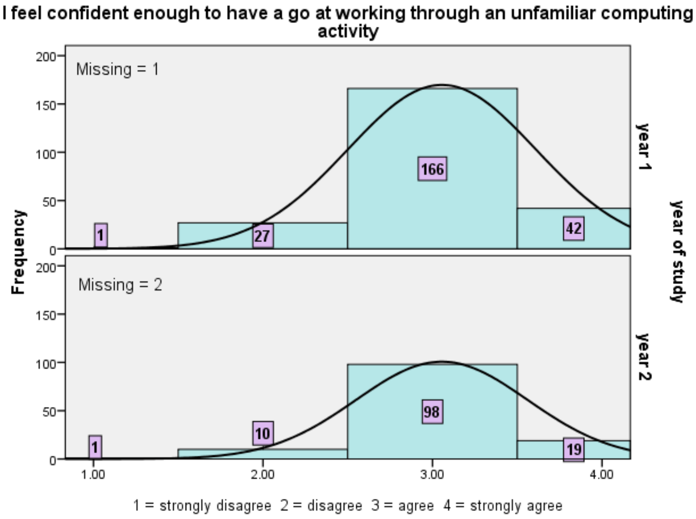


Figure 42 shows the frequency of distribution for opinions on feeling confident enough to have a go at working through an unfamiliar computing activity. The highest scores are agree for year one (n=166) and year two (n=98). The lowest scores are the same for strongly disagree (n=1). Both histograms reflect a normal distribution curve.

Figure 43

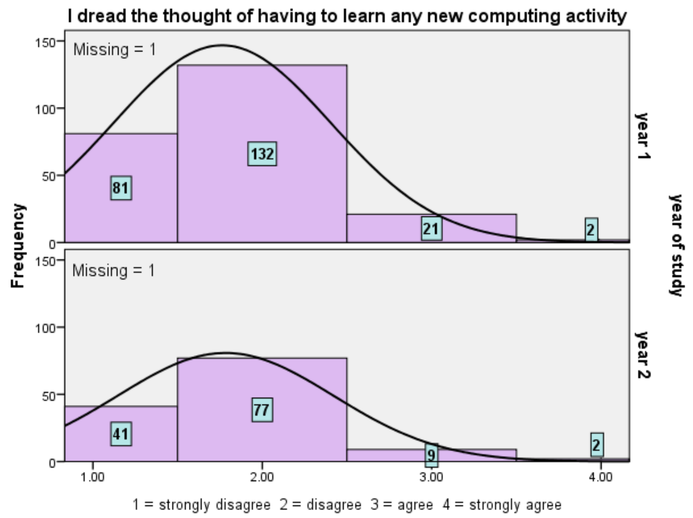


Figure 43 shows the frequency of distribution for opinions on dreading the thought of having to learn any new computing activity. The highest scores are disagree for year one (n=132) and year two (n=77). The lowest scores are the same for strongly agree (n=2). Both histograms are positively skewed.

Figure 44

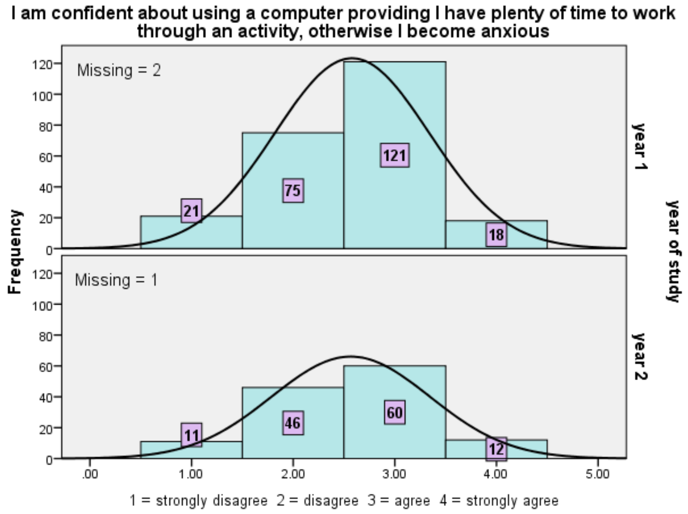


Figure 44 shows the frequency of distribution for opinions on feeling confident to work as long as there is plenty of time. The highest scores are agree for year one (n=121) and year two (n=60). The lowest scores are strongly disagree for year one (n=21) and strongly agree for year two (n=12). Both histograms reflect a normal distribution curve.

Figure 45

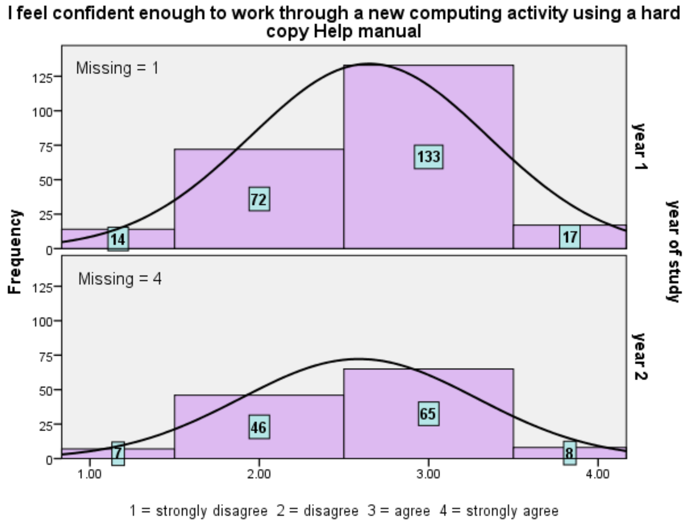


Figure 45 shows the frequency of distribution for opinions on feeling confident enough to work through a new computing activity using a hard copy Help manual. The highest scores are agree for year one (n=133) and year two (n=65). The lowest scores are strongly for year one (n=14) and year two (n=7). Both histograms reflect a normal distribution curve.

Figure 46

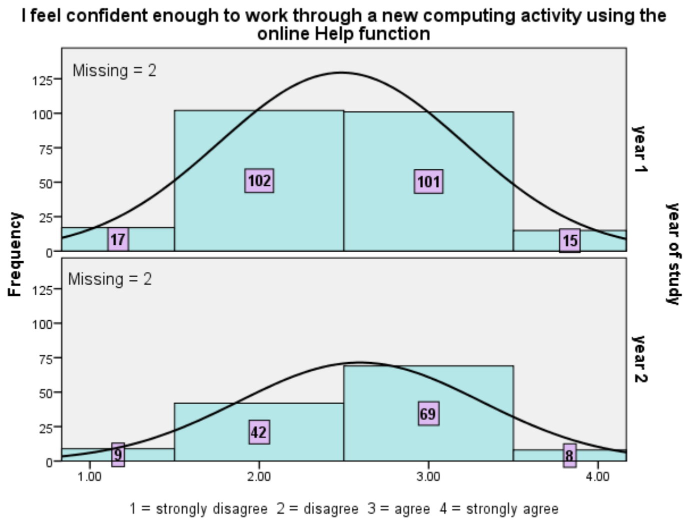


Figure 46 shows the frequency of distribution for opinions on feeling confident enough to use the online Help function. The highest score for year one is disagree (n=102), closely followed by agree (n=101). The highest score for year two is agree (n=69). The lowest scores are strongly agree for year one (n=15) and year two (n=8). Both histograms reflect a normal distribution curve.

Figure 47

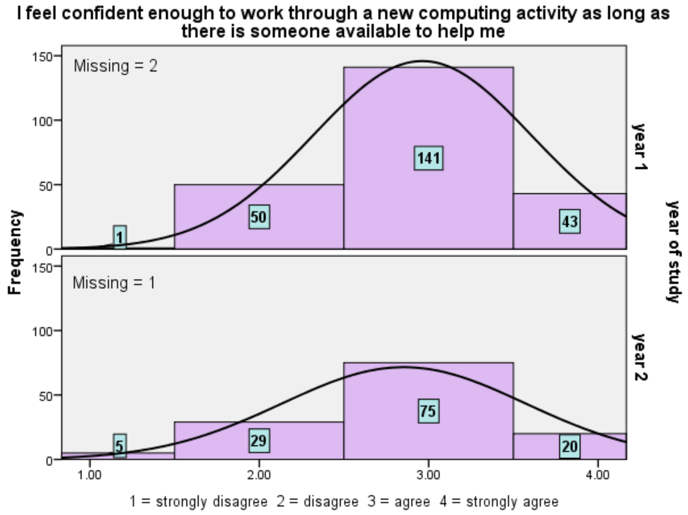


Figure 47 shows the frequency of distribution for opinions on feeling confident enough to work through a computing activity as long as there is someone available to help. The highest scores are agree for year one (n=141) and for year two (n=75). The lowest scores are strongly disagree for year one (n=1) and year two (n=5). Both histograms reflect a normal distribution curve.

Figure 48

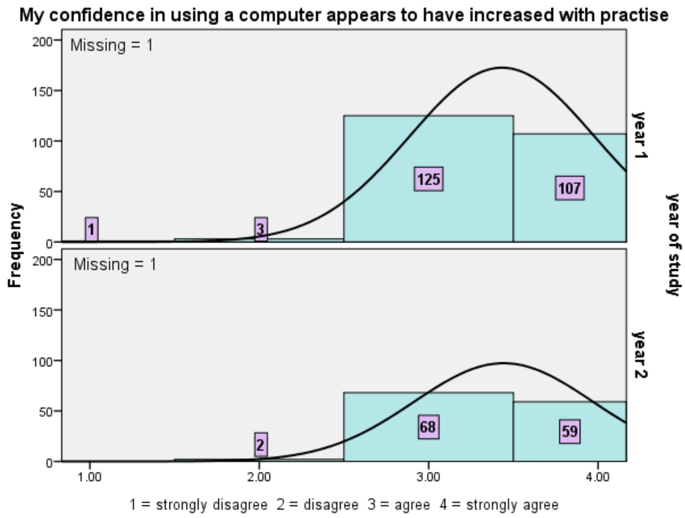


Figure 48 shows the frequency of distribution for opinions on confidence using a computer increasing with practice. The highest scores are agree for year one (n=125) and year two (n=68). The lowest scores are strongly disagree for year one (n=1) and disagree for year two (n=2). Both histograms are negatively skewed.

Figure 49

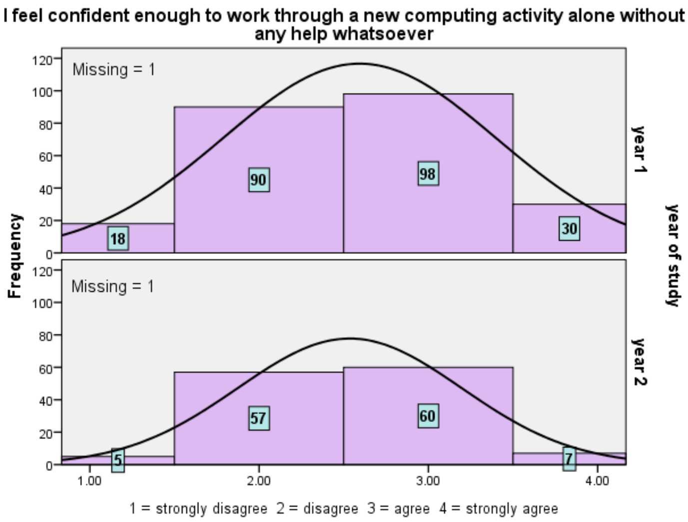


Figure 49 shows the frequency of distribution for opinions on feeling confident enough to work alone without any help. The highest scores are agree for year one (n=98) and year two (n=60). These are closely followed by disagree for year one (n=90) and year two (n=57). The lowest scores are strongly disagree for year one (n=18) and year two (n=7). Both histograms reflect a normal distribution curve.

Figure 50

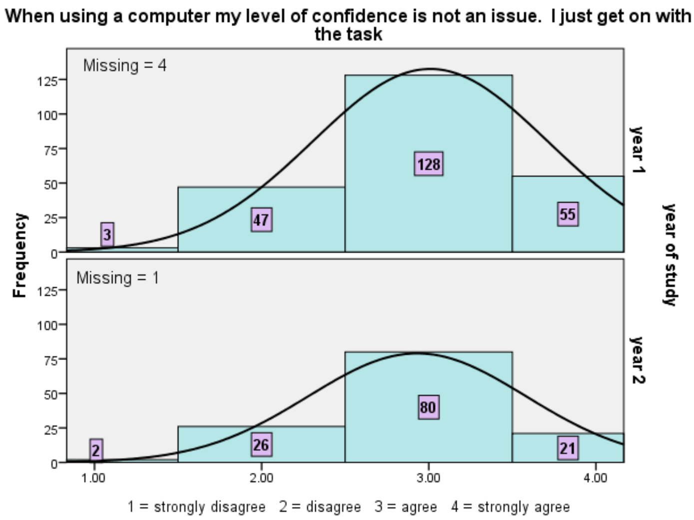


Figure 50 shows the frequency of distribution for opinions on confidence not being an issue and just getting on with the task. The highest scores are agree for year one (n=128) and year two (n=80). The lowest scores are strongly disagree for year one (n=3) and year two (n=2). Both histograms reflect a normal distribution curve.

Figure 51

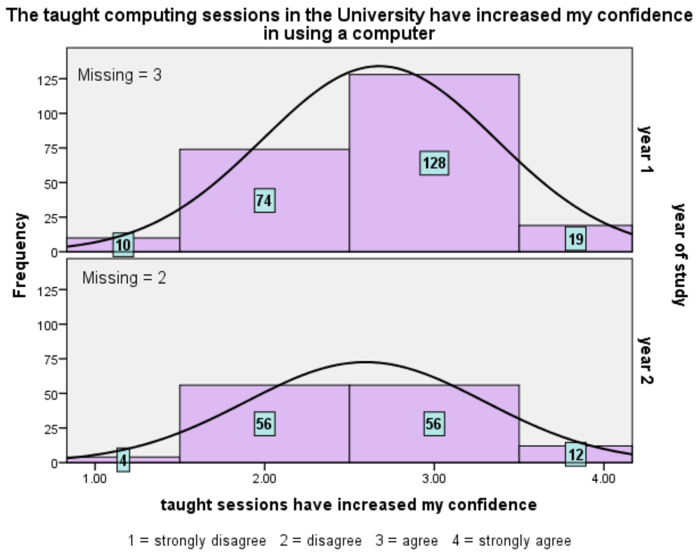


Figure 51 shows the frequency of distribution for opinions on the taught computing sessions in the University increasing confidence. The highest score for year one is agree (n=128). The highest scores for year two are the same for disagree and agree (n=56). The lowest scores are strongly disagree for year one (n=10) and year two (n=4). Both histograms reflect a normal distribution curve.

Figure 52

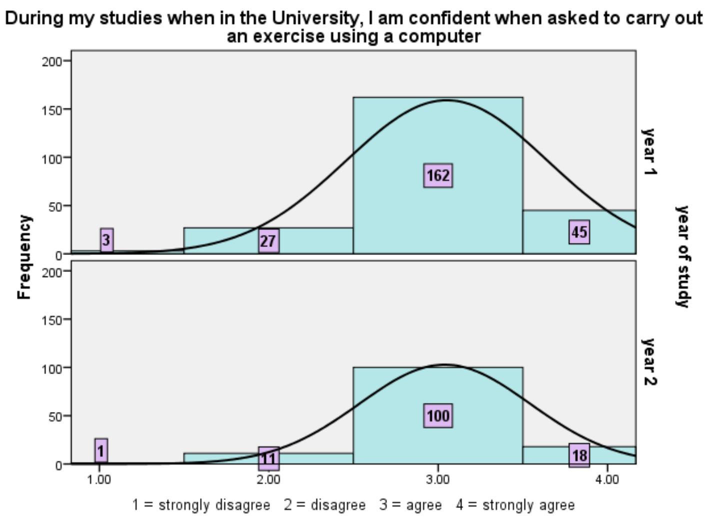


Figure 52 shows the frequency of distribution for opinions on being confident when asked to carry out a computing exercise in the University. The highest scores are agree for year one (n=162) and year two (n=100). The lowest scores are strongly disagree for year one (n=3) and year two (n=1). Both histograms reflect a normal distribution curve.

Figure 53

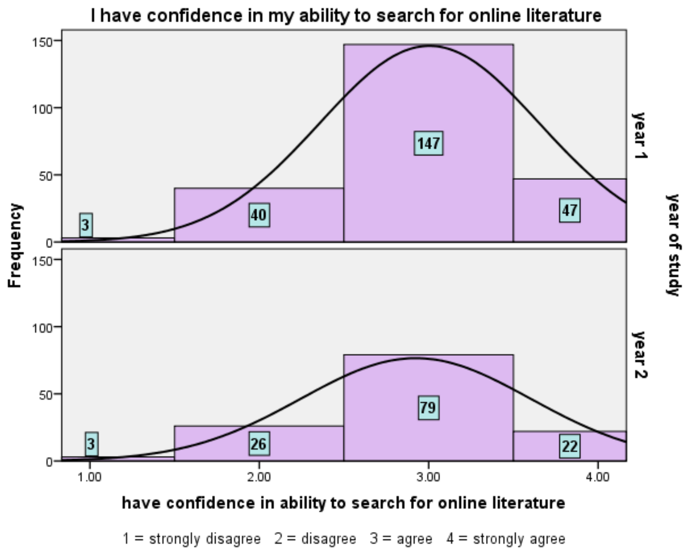


Figure 53 shows the frequency of distribution for opinions on having the confidence to search for literature online. The highest scores appear are agree for year one (n=147) and year two (n=79). The lowest scores are the same for strongly disagree (n=3). Both histograms reflect a normal distribution curve.

Figure 54

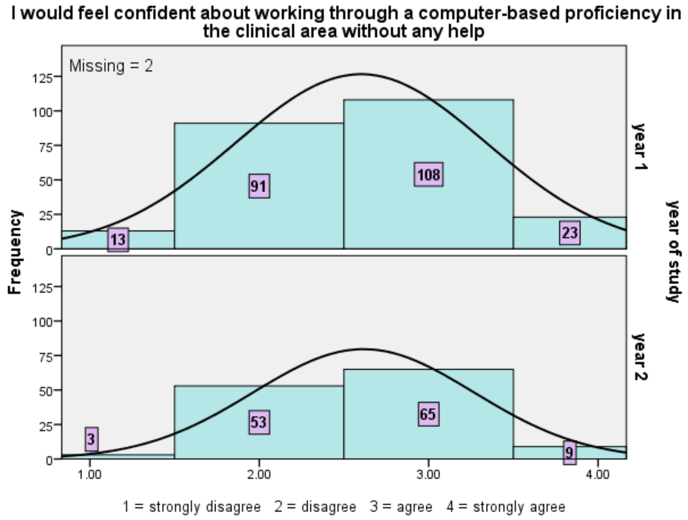


Figure 54 shows the frequency of distribution for opinions on feeling confident enough to work on a computer-based proficiency in the clinical area without any help. The highest scores are agree for year one (n=108) and year two (n=65). The lowest scores are strongly disagree for year one (n=13) and year two (n=3). Both histograms reflect a normal distribution curve.

Figure 55

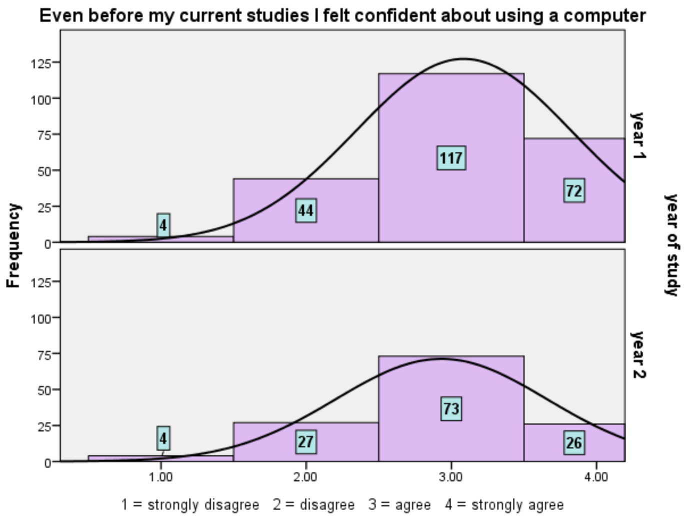


Figure 55 shows the frequency of distribution for opinions on feeling confident as a computer user before current studies. The highest scores are agree for year one (n=117) and year two (n=73). The lowest scores are the same for strongly disagree (n=4). Year one histogram is a negative skew. Year two is a normal distribution curve.

Figure 56

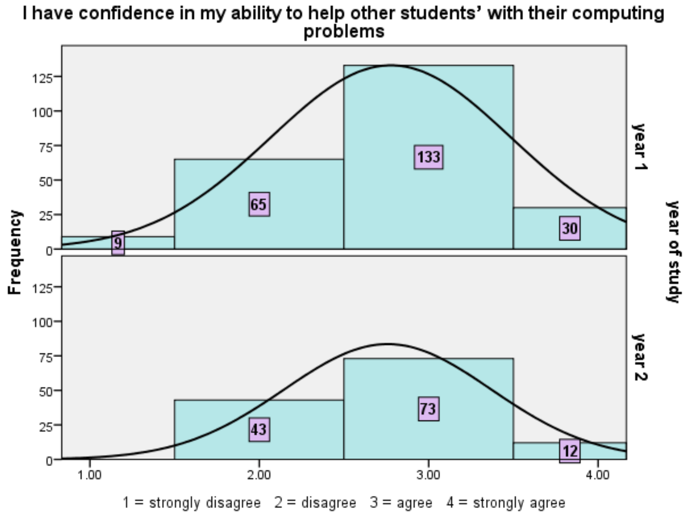


Figure 56 shows the frequency of distribution for opinions on feeling confident enough to help other students with their computing problems. The highest scores are agree for year one (n=133) and year two (n=73). The lowest scores are strongly disagree for year one (n=9) and strongly agree for year two (n=12). Both histograms reflect a normal distribution curve.

Figure 57

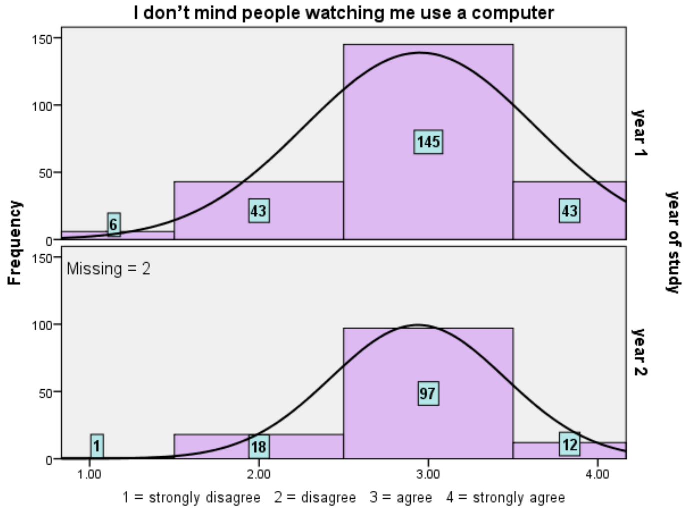


Figure 57 shows the frequency of distribution for opinions on not minding when watched whilst using a computer. The highest scores are agree for year one (n=145) and year two (n=97). The lowest scores are strongly disagree for year one (n=6) and year two (n=1). Year one scores for disagree and strongly agree are the same (n=43). Both histograms reflect a normal distribution.

Figure 58

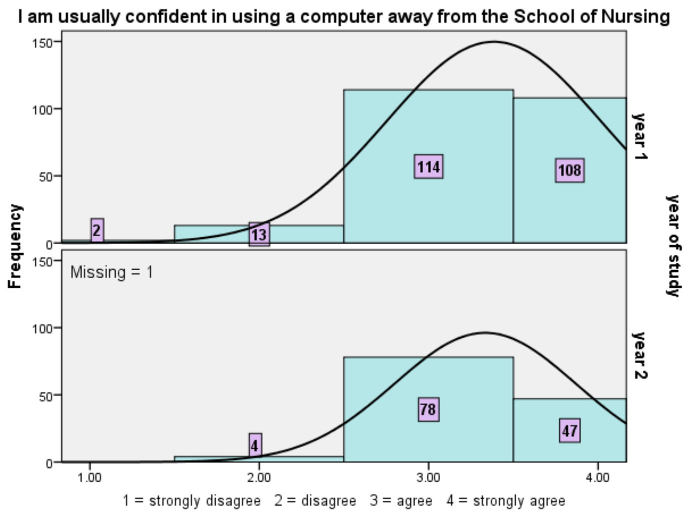


Figure 58 shows the frequency of distribution for opinions on being confident when using a computer away from the School. The highest scores are agree for year one (n=114) and year two (n=78). The lowest scores are strongly disagree for year one (n=2) and disagree for year two (n=4). Both histograms are negatively skewed.

4.2.6 Overview of the histograms

The histograms confirmed that the majority of the cohort was competent and confident as computer users. The normal distributions reflect the extremes of low and high levels of competence and confidence. The distributions for time, structured support and collaborative learning show that students recognize these as beneficial. This data will be referred to in the discussion chapter.

4.3 Principal Components Analysis

4.3.1 Distribution of the data - R-matrix correlations

Pearson Correlations in the R-matrix were examined to see if there was any relationship between the competence and confidence items. The aim was to produce variables that show reasonable but not perfect correlation. For this data the determinant was 2.04 = 0.000204. This was greater than the parameter value of 0.00001.

The output from the one-tailed significance of the coefficients showing the direction of the relationship between the variables revealed that a number of values were >.05 for the competence statements showing some correlation. For the confidence statements most of values were significant =.000 showing a good correlation.

Examination of the R matrix did not reveal any evidence of multicollinearity (highly correlated variables) or singularity (perfectly correlated variables). However the values at the intersections of each row and column around the confidence statements were significantly higher than those for the competence statements. The R-matrix was scrutinized at the intersections between the pairs of discrete variables for competence and confidence, followed by checking the one-tailed significance test to identify the direction of their relationship. Typical of a large sample size (Field, 2009) the R-matrix showed a number of small correlations, <.3. However many of the intersections met Field's (2006) criteria of correlation >.3 and a significance test of <0.05. These were evidence of substantial, but not perfect correlations and showed if the direction of the relationship is positive or negative.

4.3.2 Reliability of PCA

The average of the communalities was estimated.

Let 29.202 / 40 = .730

This average was above the recommendation by Field (2009) of 0.7. (See Tables 8 to 12 for the communality values, pages 253-261) and showed that the components were explaining the original data. Inspection of the KMO showed a value of .875 which according to Field (2009) was classified as great. Likewise inspection of all KMO values for individual variables revealed the lowest =.512 and the highest = .957. The majority of the KMO values were >.7, which is well above the satisfactory limit of >.5. At .000 Bartlett's Test was significant, an indication of correlation between variables. Notoriously sensitive, this result was therefore treated with caution. Inspection of the anti-image matrices showed very small partial correlations between the variables as negative values. This was indicative of a good model of correlations between the variables.

4.3.3 Factor extraction

Initially setting the eigenvalues using Kaiser criterion >1, gave 10 components and explained 59.715% of the cumulative variance. Implementing Jolliffe's (2002) recommendation of setting the eigenvalue at .7 resulted in 17 components and explained 74.9% of the cumulative variance. At .8, with 40 variables, 16 components were retained explaining 73% of the cumulative variance. The Total Variance Explained table (See Appendix 16) lists the eigenvalues and the corresponding linear component, before and after extraction and after rotation. The components were sorted in decreasing order of importance representing the decreasing variance.

The first 5 components contained 44.7% of the total information in the original data. Component 1 explained 23.518% of the variance. There was a sharp decrease to component 2 explaining 7% of the variance, closely followed by components 3 and 4 explaining 4% and 3.6% respectively. Components 5,6,7 and 8 explained over 3% each of the variance. The eigenvalues and components from 6 up to and including 16, explained small amounts of discrete variance. Together they totalled 28% of the variance (See Appendix 16). There were a number of high loadings in components 6 to 16. The high loadings were indicative that the variable was a pure measure of the component (Tabachnick and Fidell, 2007). Competence was the dominant variable in components 6,7,8,12,14 and 15. Confidence was the dominant variable in components 9,10,11,13 and 16.

4.3.4 The Scree Test and Parallel Analysis

Inspection of the Scree plot (See Figure 59) showed a substantial slope at the fifth factor followed by a stable plateau. Reliability of the Scree Test was confirmed by the high sample size, the majority of communalities = >.7 and several variables with high loadings on the first 5 components. The strength of the communalities and rotation outcome will be discussed at a further point. A comparison of the simulated data in the Monte Carlo Parallel Analysis (See Table 7, page 245) with the actual eigenvalues gave five components as exceeding the Criterion Values from Parallel Analysis. This was confirmation of the visual evidence in the Scree plot.

Figure 59 The Scree Plot

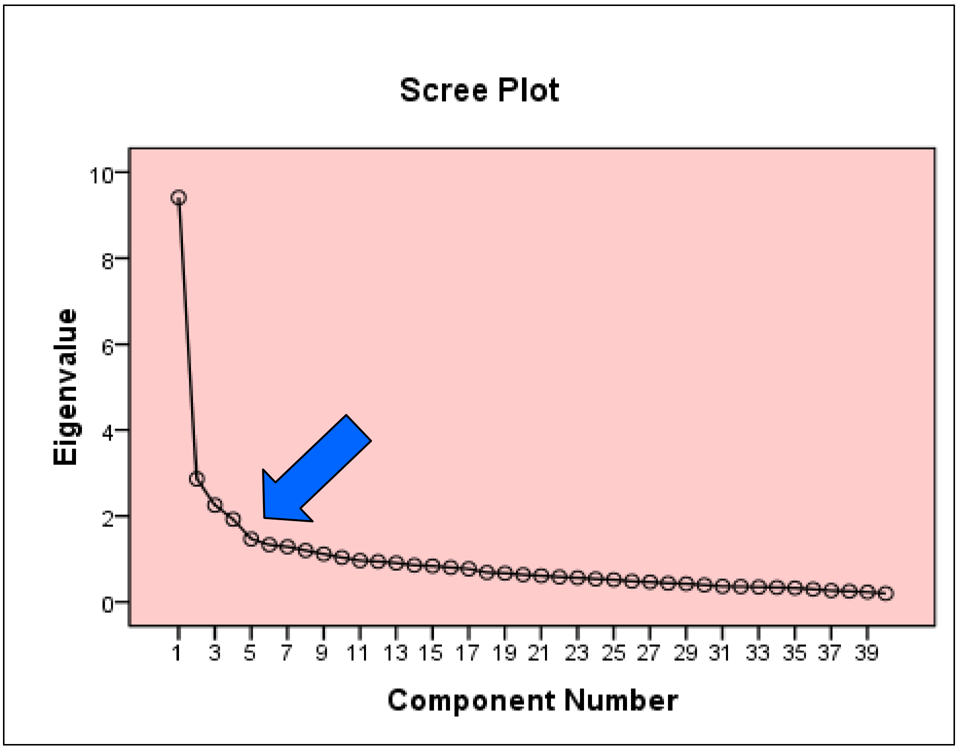


Table 7 Monte Carlo Parallel Analysis

Component Number	Actual Eigenvalue From PCA	Criterion Value From Parallel Analysis	Decision
1	9.407	1.6789	**Accept**
2	2.861	1.6039	**Accept**
3	2.252	1.5484	**Accept**
4	1.925	1.4928	**Accept**
5	1.467	1.4461	**Accept**
6	1.332	1.4057	**Reject**
7	1.286	1.3655	**Reject**
8	1.200	1.3294	**Reject**
9	1.118	1.2951	**Reject**
10	1.038	1.2597	**Reject**
11	.963	1.2293	**Reject**
12	.944	1.1987	**Reject**
13	.909	1.1701	**Reject**
14	.855	1.1420	**Reject**
15	.841	1.1122	**Reject**
16	.803	1.0856	**Reject**

4.3.5 Rotation

With a cohort size of 375, a factor loading suppression point of .298 was selected to improve interpretation. This effectively removed all loadings from the component matrix <.298. Oblique rotation using direct oblimim was requested for two reasons. The first reason was because it allowed correlations among the components, important in the anticipation of a relationship between competence and confidence based on the findings in the literature and secondly, it measured the unique relationship between the component and the variable. The output in the Component Matrix (See Appendix 17) showed that before rotation, unsurprisingly the majority of variables loaded highly onto the first component. The outputs for an oblique rotation are the pattern and structure matrices (See Appendices 18 and 19).

4.3.6 Pattern matrix

The factor loadings of regression coefficients in the Pattern Matrix (See Appendix 18), showed the behaviour of the direct oblimim method and the unique contribution of each variable to a specific component. The output shows that loadings <.298 were suppressed. There appeared to be a tendency for fewer variables to contribute towards the component estimates. There were a number of substantial correlations across the 16 factors. Some variables loaded with a negative sign onto the component, indicating a relationship in the opposite direction to the positive (de Vaus 2002). The loadings for the initial items on the first five components = >.71, confirmed the suitability of an oblique rotation.

Tables 8 to 12 (See pages 253-261) show the loadings of the components. The five components relating to this cohort of students were: confidence, peer support and learning, confidence and specific computing actions, taught provision and finally confidence in ability to use hard-copy resources. Although the first component had the highest loading on a confidence statement, the greatest loadings for components two to five were dominated by competence statements. The highest loadings in each component have been highlighted in purple. An Independent Sample T Test was conducted on each component.

4.3.7 Structure matrix

Inspection of the Structure Matrix (See Appendix 19) showed that the columns which define the components had several high and a substantial number of low variables. The rows which defined the variables had only one high value. This was favourable towards an oblique simple structure as each variable loaded highly onto just one component (Thurstone, 1947). The core advantages of a simple structure over a complex structure lies in interpretation of the factors, ontologically meaningful for competence and confidence. The output met the criteria for a simple structure as there was one high value in each row and several high and many low values in each column.

4.3.8 Application of Cronbach's Alpha to the resulting components

Application of Cronbach's to the Competence Items revealed potential problems with the scale consistency. A check of the Inter-Item Correlation Matrix highlighted a number of items with negative values. These appeared to be associated with the categories of supporting resources, learning and level of cognition. Further inspection showed that the negative items appear to have a correlation with those where reverse scoring has been applied. Paradoxically four items in the Confidence category were reversed coded with a Cronbach's alpha coefficient = .708, compared to three items in the Competence category with a Cronbach's alpha coefficient = .615. For Confidence, the scores in the Inter-Item Correlation Matrix appear to be generally higher than those for Competence.

4.4 Component characteristics

Based on the magnitude of the associated eigenvalues, the visual evidence of the Scree Plot and the Monte Carlo Parallel Analysis the first five components (See Tables 8 to 12, pages 251-259) were retained and explored. Examination of the residual components did not reveal anything significant.

4.4.1 Component One: Opinions about computing confidence

With just one exception (Can work through most SoN computing activities), variables related specifically to confidence loaded onto the first component. Communalities were all >.6, indicating a significant amount of shared variance within the variables. The loading values of individual variables showed the unique contribution of each one onto the component. The first component contained five items loaded from .299 to .810, ranging from poor to excellent. This component appeared to explain the original data. Cronbach's alpha = .829 with the negative statement and without the negative statement = .529.

For the T-Test year of study was the categorical variable and the factor regression score for opinion about confidence for this component was the dependent variable. As the significance value

= .812, equal variances were present, confirming no significant difference in the mean scores for opinions about confidence, between first and second year students. This was further confirmed by Eta squared = .0002 showing a very small magnitude in the differences in these means.

Table 8 Component 1: Opinions about computing confidence

Statements	Component 1 Loadings	Communality
Have a go at working through an unfamiliar activity	.810	.775
Dread the thought of having to learn any new computing activity	-.532	.697
Am confident when asked to do a new computer exercise	.503	.706
Can work through most SoN computing activities	.416	.651
Confidence not an issue. Just get on with the task	.299	.658
Eigenvalues Total % of variance explained	23.518%	
Cronbach's alpha 'Dread the thought of having to learn any new computing activity.' Cronbach's alpha without the negative statement	.829 .510	
Independent-samples T-test regression factor 1	Year 1 mean	-.135
	Year 1 standard deviation	1.019
	Year 2 mean	-.135
	Year 2 standard deviation	.971
	Significance value	.812
	Eta squared	.0002

All values significant at $p<.05$; Values <.298 have been suppressed.

4.4.2 Component Two: Opinions about peer support and preferred learning styles

Variables related to peer support and learning preferences and styles loaded onto the second component. Communalities were all >.6 indicating significant shared variance. This component explained a reasonable amount of the original data. The loading values of individual variables showed the unique contribution of each one onto the component. The second component contained four items loaded from .386 to .811, ranging from good to excellent. Cronbach's alpha = .590 but with the low loading removed = .643. For the Independent samples T-Test year of study was the categorical variable and the factor regression score for this component, opinions about peer support and preferred learning styles was the dependent variable. As the significance value = .878, equal variances were present, confirming no significant difference in the mean scores for opinions on peer support and preferred learning styles, between first and second year students. This was further confirmed by Eta squared = .0001 showing a very small magnitude in the differences in these means.

Table 9 Component 2: Opinions about peer support and preferred learning styles

Statements	**Component 2 Loadings**	**Communality**
Learnt skills by listening to others	.811 Competence	.709
Learnt skills by watching others	.629	.727
Learnt skills by talking to and asking others	.576	.668
Computer has assisted in management of studies	.386	.739
Eigenvalues Total % of variance explained	7.152%	
Cronbach's alpha	.590	
Cronbach's alpha without 'Computer has assisted in management of studies.'	.643	
Independent-samples T-test regression factor 2	Year 1 mean	-.654
	Year 1 standard deviation	1.029
	Year 2 mean	-.241
	Year 2 standard deviation	.912
	Significance value	.878
	Eta squared	.0001

All values significant at $p<.05$; Values <.298 have been suppressed.

4.4.3 Component Three: Opinions about using computer 'Help' functions

The third component indicated correlations between confidence and ability to use computing tools such as the Help function. Communalities at >.8 indicated a high amount of shared variance. This component accounted for a high amount of the original data. The loading values of individual variables showed the unique contribution of each one onto the component. The third component contained two items which loaded as .842 and .885. At >.8 these were both excellent. Cronbach's alpha = .765 For the Independent-samples T-test year of study was the categorical variable and the factor regression score for this component, opinions about confidence and computer help functions was the dependent variable. As the significance value = .204 equal variances were present, confirming no significant difference in the mean scores for opinions on peer support and opinions about confidence and computer help functions, between first and second year students. This was further confirmed by Eta squared = .004 showing a very small magnitude in the differences in these means.

Table 10 Component 3: Opinions about using computer 'Help' functions

Statements	Component 3 Loadings	Communality
Have found the computer Help function useful	.885	.841
Feel confident enough to work using online Help function	.842	.821
Eigenvalues Total % of variance explained	5.631%	
Cronbach's alpha	.765	
Independent-samples T-test	Year 1 mean Year 1 standard deviation Year 2 mean Year 2 standard deviation Significance value **Eta squared**	-.522 1.010 -.522 .995 .204 .004

All values significant at p<.05; Values <.298 have been suppressed.

4.4.4 Component Four: Opinions about taught provision

The fourth component identified high negative loadings for pedagogical issues and didactic sessions on using a computer. Communalities were all >.7. This component also explained a significant amount of the original data. The loading values of individual variables showed the unique contribution of each onto the component. The fourth component contained three items loaded from -.332 to -.895. These ranged from poor to excellent and all loaded negatively. Cronbach's alpha = .684. For the Independent-samples T-Test year of study was the categorical variable and the factor regression score for this component, opinions on taught provision was the dependent variable. As the significance value = .420, equal variances were present, confirming no significant difference in the mean scores for opinions on taught provision, between first and second year students. This was further confirmed by Eta squared = .002 showing a very small magnitude in the differences in these means.

Table 11 Component 4: Opinions about taught provision

Statements	Component 4 Loadings	Communality
University taught computing sessions useful	-.895	.789
Taught sessions have increased my confidence	-.879	.799
Computing skills have improved since commencing studies	-.332	.764
Eigenvalues Total % of variance explained	4.812%	
Cronbach's alpha	.684	
Independent-samples T-test	Year 1 mean	-.407
	Year 1 standard deviation	.985
	Year 2 mean	-.407
	Year 2 standard deviation	1.036
	Significance value	.420
	Eta squared	.002

All values significant at p<.05; Values <.298 have been suppressed.

4.4.5 Component Five: Opinions about using hard copy Help manuals

The fifth component appeared to indicate a relationship between level of confidence and using a hard-copy Help manual. All communalities were >.7. This component explained a reasonable amount of the original data. The loading values of individual variables showed the unique contribution of each onto the component. The fifth component contained three items which loaded from -.376 to .828. These ranged from poor to excellent with a negative loading on the lowest item. Cronbach's alpha = .200 and with the low loading removed = .554.

For the Independent-samples T-test year of study was the categorical variable and the factor regression score for this component, opinions about hard-copy help manuals and being able to complete a computing activity without thinking was the dependent variable. As the significance value = .915, equal variances were present, confirming no significant difference in the mean scores for opinions on taught provision, between first and second year students. This was further confirmed by Eta squared = .00003 showing a very small magnitude in the differences in these means.

Table 12 Component 5: Opinions about using hardcopy Help manuals

Statements	Component 5 Loadings	Communality
Have found computer Help manual useful	.828	.787
Feel confident enough to work with hardcopy Help manual	.642	.765
Sometimes complete without thinking	-.376	.712
Eigenvalues Total % of variance explained	3.668%	
Cronbach's alpha with 'Sometimes complete without thinking.' Cronbach's alpha without 'Sometimes complete without thinking.'	.200 .554	
Independent-samples T-test	Year 1 mean Year 1 standard deviation Year 2 mean Year 2 standard deviation Significance value **Eta squared**	-.947 1.048 -.218 .931 .915 .00003

All values significant at $p<.05$; Values <.298 have been suppressed.

4.4.6 Geometric interpretation of the components

Figure 60 (See page 261) is a cross section (not to scale) of a geometrical representation of the first five components using an oblique rotation showing the relationship between each component and its variables. The loadings have been placed to approximately represent the figures in Tables 8 to 12 (See pages 251-259). Higher loadings are the furthest away from the origin. The lowest loadings are the nearest to the point of origin. As the diagram is showing the first five components, the space has five axes and five dimensions and each observed variable is positioned by five co-ordinates. The clusters illustrate the closeness of the variables and the shared variance between them in addition to their size.

The oblique rotation allowed the components to correlate. This showed where the variables correlated with one component through indirect correlation with another component. Using the guidance of Tabachnick and Fidell (2007), the highest loadings farthest away from the point of origin on the X and Y axes were indicative of a strong correlation between the five components.

Figure 60

Geometric Interpretation of First Five Components with Oblique Rotation

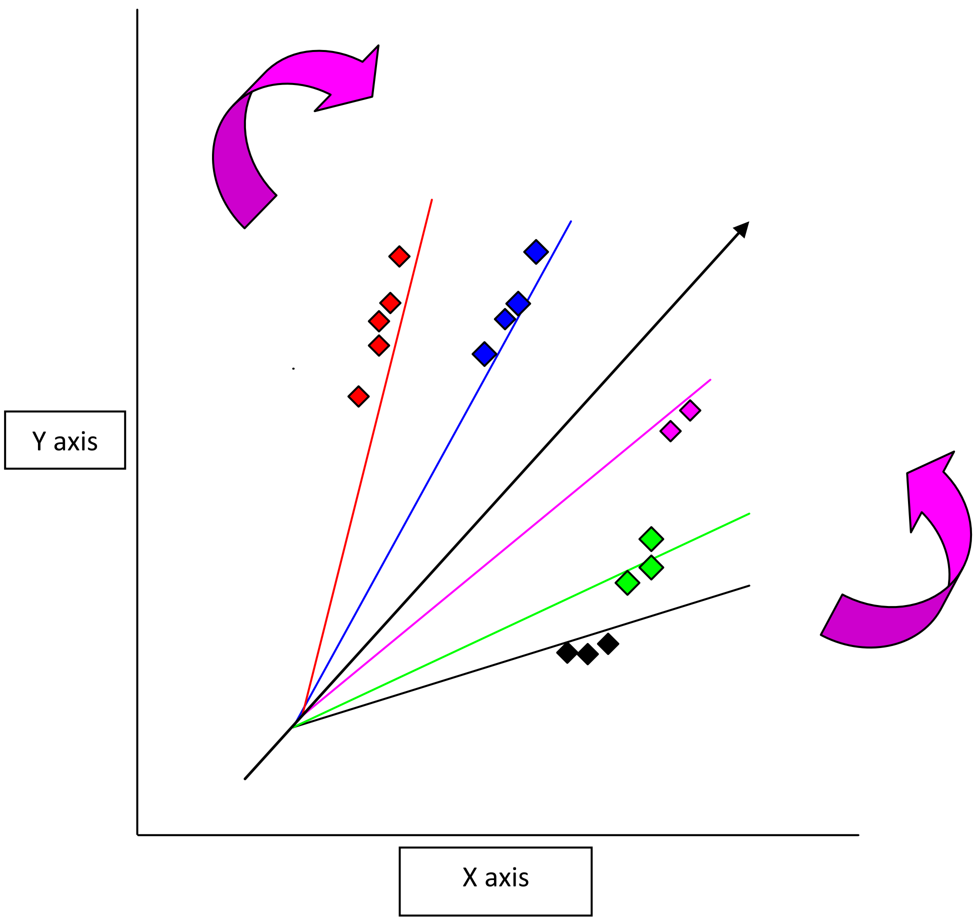
____ = level of confidence

____ = peer support

____ = confidence and ability to use computer Help function

____ = dissatisfaction with taught provision

____ = confidence and using a hard-copy Help manual



4.5 Summary of the results

A Principal Components Analysis was conducted on 40 items, from a sample of 375 students of nursing, using a direct oblimim (oblique) rotation. At .875, the Kaiser-Meyer Olkin (KMO) measure of sampling adequacy was classed as great. Therefore the sample size at n = 375 was highly satisfactory for Principal Component Analysis. Bartlett's Test of Sphericity $X2$ (780) = 5.389, p = <.001, was an indication that correlation between items were well defined for a Principal Components Analysis. Eigenvalues set at .8 gave 16 components.

To improve the distinction between components, items with loadings <.298 were suppressed. Inspection of the Scree Plot and the data generated in Parallel Analysis confirmed 5 components as significant. Components 1 to 5 totalled 44.7% of the variance in the original data, whilst components 6 to 16 totalled 28% of the variance. Of the 16 components, 10 broadly reflected competence and 6 broadly reflected confidence. The first five components gave a mix of variables for competence and confidence, though confidence had a higher representation. The average of the communalities = .73. This was above the baseline parameter of .7 as recommended by Field (2009). The communalities explained a significant amount of the original data. The direct oblimim rotation yielded an interpretable simple structure. With one notable exception in the fifth component all of the scales exhibited acceptable levels of internal consistency as measured by Cronbach's alpha coefficient. Independent-samples T-tests were conducted using the regression scores for the five components as the dependent variable. The categorical independent variable was year of study and this was divided into first and second year students. The aim was to see if there was a statistical difference in the mean scores for the two groups. All of the results revealed no statistical difference between first and second year students across all five components. Frequency data were presented as histograms.

Statistical power in the study was dependent on the number of subjects completing and returning the questionnaire. As 375 students returned the questionnaire, statistical power was met. The statements on competence and confidence as ordinal or rank order variables were constructed to reflect the beliefs and the real experiences of the students for computing competence and confidence. This may have contributed towards the acceptability of the questionnaire by 98% of the original volunteer student participants. This was a high response rate and may also have accounted for the low numbers of unanswered questions. The results indicated that the questionnaire had reasonably satisfactory reliability and validity and that the dataset was robust and representative of the subjects studied.

4.6 Limitations of the first study

There were a number of limitations in the study. Although the total number of participants met the criteria for a Principal Components Analysis, at just over 18% of the population for first and second year student nurses the findings should be treated with caution. Multiple intakes across academic semesters meant that it was likely that there would be different levels of competence and confidence within each year of students. Some reflections were made on the content of the questionnaire. Exploration of the categorical variable of gender and links with competence and confidence was discarded on the grounds of the predominance of female students. In relation to previous formal study related to computers, the questionnaire did not ascertain when this activity was undertaken.

The length of time between completing previous study and commencing nursing might have had a bearing competence and confidence as a computer user. Additionally students often undertake voluntary work as part of their personal development before commencing nursing studies and it is feasible that computer-related activity would have occurred in this area. A question on this issue would therefore have been relevant. The choice of an ordinal scale was made because of its transient and infinite qualities. However this creates subjectivity as simultaneous replicated research may have different outcomes. The scale was designed to measure current competence and confidence levels and was unlikely to remain stable over a period of time.

Speculation on the cause and effect of the number of negative covariances in reliability testing for competence concluded in the following. The original item construction was based on a review of relevant literature. The questionnaire framework was designed to collect information about a diverse range of variables. Unsurprisingly then the item covariances were a combination of positive and negative. This had an impact on the overall Cronbach's alpha coefficient for Competence.

Principal Components Analysis summarizes the variance in the constructs of competence and confidence. However it cannot claim to be definitively measuring these constructs. Albeit a method for simple identification and classification PCA has a reputation for being arbitrary. Several variables may provide the same information and some which appear to be of significance provide no useful information at all. Decisions on Eigenvalue cut-off points were arbitrary, with a risk of discarding substantive components.

The Scree Plot was used to examine the most substantial drop in the size of eigenvalues. Although the outcome was confirmed in other findings, the pattern of eigenvalues after the drop was ambiguous in its appearance.

The choice of rotation was oblique. This decision was based on the literature review that there was likely to be a relationship between competence and confidence. Examination of the R matrix and the components before rotation were indicative of this relationship. The oblique rotation and positioning of the clusters confirmed this correlation. However some of the discarded components close to zero may have produced a solution similar to that in an orthogonal rotation. Finally the relationship between the individual questions and the components is empirical. There is no underpinning theory about which statements should load onto which components. A different group of students or, even this cohort at another time during their studies, may provide responses which would give different loadings.

This section of has presented the results and findings from the first study using Principle Components Analysis. The findings from the major analyses influenced the conduct of the second study.

Study Two

4.7 The characteristics of the participants.

This section describes the group who took part in the second study (Total number of students filmed = 19). Questionnaire data were collected from the new population of first and second year student nurses between January and April 2011. Only 9 out of the 15 students in the new group completed and returned the questionnaire, representing a response rate of 60%. Therefore in addition to the original group of four, the following descriptions relate to just 13 students.

The age distribution of the students was: 17–20 years = 3, 21-30 years = 5, 31–40 years =3, 41-50 years = 2. The group was consisted of 3 males and 10 females. Year groupings were: year 1 = 7, year 2 = 2 and year 3 = 4* (*The four students from the original cohort were in year 1 when they completed the questionnaire, so this figure represents their academic year at the time of the second study).

6 students identified that they had not used a computer in their previous activity. 5 students stated that they had undertaken formal study in computing knowledge and skills. 1 student had a

formal academic qualification at GCSE level whilst 4 students had completed vocational computing courses. 1 year 3 student had not used a computer in his previous activity, but held ICT qualifications for ECDL, NVQ 2 using Information Technology and City and Guilds Application Programming. All 13 students had access to a computer at home and used the School of Nursing, Midwifery and Physiotherapy's ICT resources.

The methodology chapter set out the selection criteria for the second study group. This was based on their responses to four questions which were selected because they represent the types of behaviours that learners might engage in when working through a computing activity.

I have learnt some computing skills by watching other people.'

'I have learnt some computing skills by listening to other people.'

I have learnt some computer skills by experimenting.'

'I have learnt some computing skills by talking to and asking other people.'

The responses of the 4 year three students divided neatly into pairs reflecting the homogeneous extremes of Strongly Disagree and Strongly Agree. As the new cohort (n=9) did not complete the questionnaire until after the activity the decision was made to organize then into heterogeneous groupings. However their responses showed that they felt competent and confident as computer users and might account for why they volunteered for this activity. Only 1 student disagreed with 'I have learnt some computing skills by watching other people' and just 2 students disagreed to 'I have learnt some computing skills by listening to other people'. Otherwise the responses were agree or strongly agree to these and the other questions 'I have learnt some computer skills by experimenting' and 'I have learnt some computing skills by talking to and asking other people.'

4.8 The emergence of the second level protocols and themes

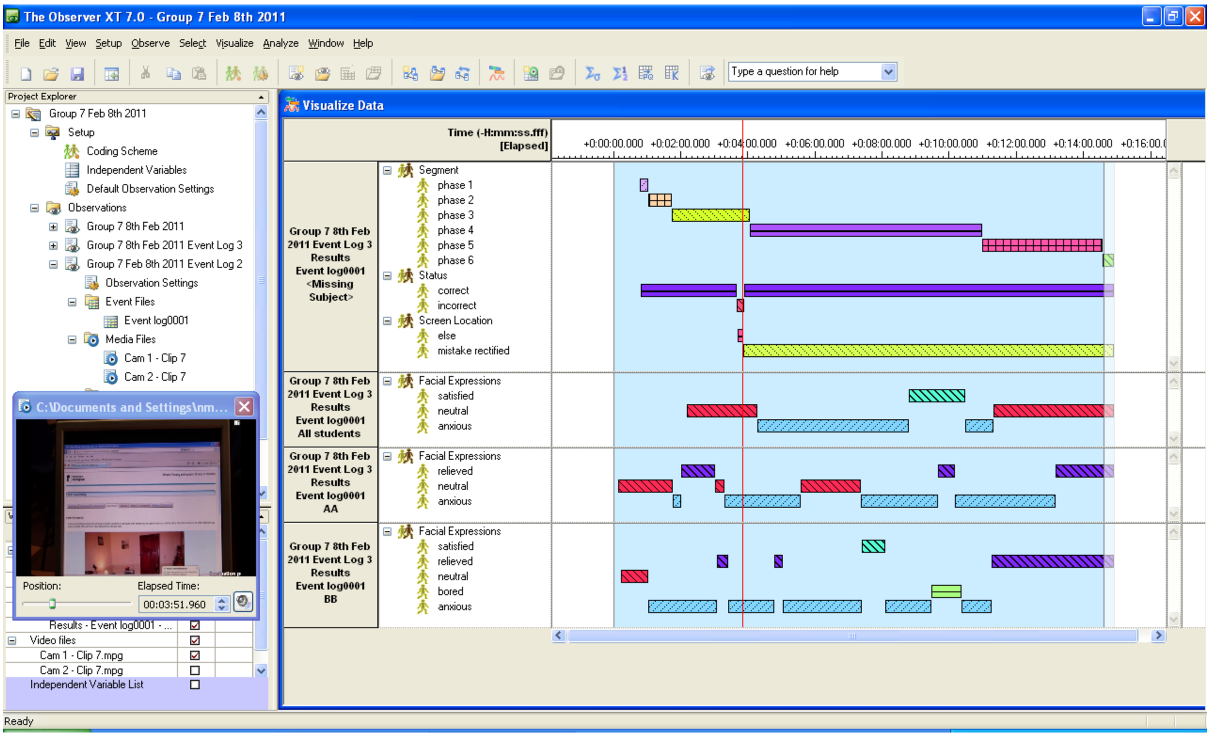
This section has been organised to show the output from The Observer XT. The transcribed narrative for the themes of competence and confidence is the second level of protocols and appears directly after the Visual Analysis. Individual outputs of the Visual Analyses for all groups (See Figures 61-67 pages 271-290) display a timeline of the Protocol Segments showing:

- phases 1 – 6 of the RLO
- the status of the participants whether correct or incorrect
- the range of facial expressions used by each group whilst working on the task
- the nature and occurrence of an error and when it was rectified

In groups where errors occurred, the timeline has been placed on that point and the accompanying screen shows the phase of the task. Facial Expressions have been logged for individual participants and then for the students as a group using the heading 'All Students'. Although the 'All Students' timeline appears as a continuum, it should be read only at the point where facial expressions change en mass and the participants all give the same instant response to a specific situation. In the visual analyses (See Figures 61-67, pages 271-290) Visualize Data screen for each group), the window posting 'Missing Subjects' is showing what is happening as the phases of the task, status and screen location section, irrespective of who is doing it. The red line running through the Visualize Data screen reflects a specific time point in the log.

4.9 Output for description of behaviours and concurrent commentary

Figure 61 Group one (Homogeneous Strongly Disagree)



4.9.1 Group one verbal protocols

Competence Theme	Confidence Theme
AA "Right let's put that address in." BB "Then we want to go to Living Room 2?" AA "No read the introduction first." BB "Then go to Living Room 2 which we've seen at the top. It's got Tabs." BB "It's just clicking on the mouse and seeing what it highlights. I can only find three. Does it tell you how many you should find? No?"	BB (Reading the task guidance sheet). "State aloud how many Hotspots you have found. So it's (possibly referring to the cursor) over the photo AA "Yeah I'm happy with that." AA (responding to FT asking What are you thinking?) "I'm quite confident with this bit. At the moment." BB (Reading the screen instructions aloud). "Click a number in the grid to see the clue

AA "We haven't got to complete all of it have we?" (Referring to the crossword) AA (Looking for the Community crossword puzzle. "I don't know where that is. I can't see any way of finding out where it is" BB "No. It's not on the Tabs is it. It doesn't highlight it. Shall I press Next and see where it goes?" BB "So we just click off that then and that's gone. I'd be really nervous about doing this if I needed evidence to say that I'd done it or something for later on as it kinda just disappears." AA "Also I feel a bit lost in what we've done and what we've not done. I like to see it being ticked off as I've done it." BB "I'm not very clear as to where to go AA "Try activity and see where to go." BB "Click on a number and see if it brings a question up." BB "That's not right. It doesn't fit." AA "Why is it not fitting?" BB "Transferring. We've got it but not...." AA "In the right order." BB "I must admit I've got a habit of... when you press Enter I tend to use the keyboard quite a lot. You can't do that with this. You have to actually press the Enter button. You don't have to move your hands away." AA "It would be good if we could put it in here....do you know what I mean BB "What you mean physically writing it in yourself to see if it fits? Instead of going 1-2-3-4-5." Jabbing a finger towards the screen as she counts. "Just press Hints." BB "We need to do question 6 so I'm assuming that if I click on that.... Ah yeah I can see you can skip to question 6. That looks quite easy." BB "So again you've got to click off it. You know some you can press Finish at the bottom AA Go back to University page BB "I'll go back to Introduction AA "I wouldn't do that BB "Oh here you are look. There's a Tab there that says Home." AA "I'd click on the University of Nottingham."	AA "I'm confused again now." BB "I thought there'd be questions." AA "I haven't got a clue. What do you think?" BB "I'm not very good at things like this." BB "It seems quite easy to use, the software (Response to FT asking "How are you feeling?) BB "A bit nervous now cos I don't know how to do it AA "I'm still feeling quite confident cos I can read it on the laptop but like AP says I'm a bit confused about what to put in." BB "Yeah the software I can use. I'm confident with that but I'm not very confident with this task." AA "I'm feeling overwhelmed as there is quite a lot to do." In response to FT asking "What are you thinking?" BB "I feel a bit unsure now."" AA"I feel quite unsure cos I don't know what I have done and what I have not done." BB "Yeah cos I've just clicked on X so by clicking on X I've just deleted it. So I don't feel it's been saved even though I've done it. So I'd be worried I'd have to go back and do it again.

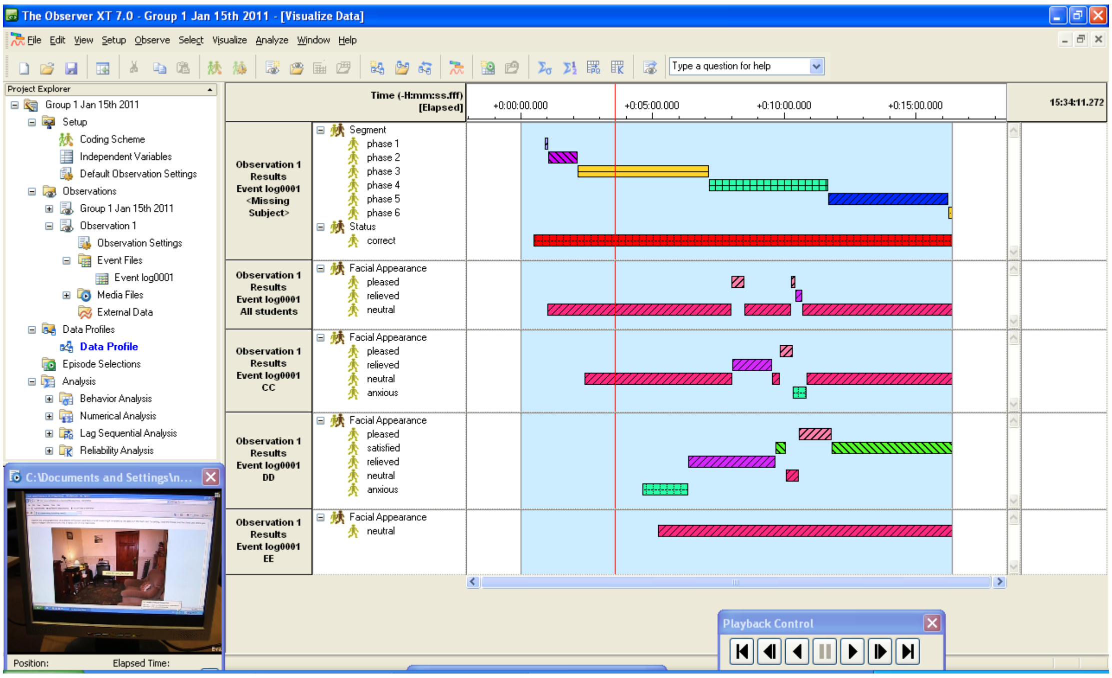
Points to the top of the screen." BB "You'd click on the top? I'd click on the RLO Home, but we want to go to the Portal don't we so you're right. Can I press that first?" AA "Yeah if you want to." BB "To take us back to the RLO page and then click."	

Two third year students represented the Homogenous Strongly Disagree category. The coloured visual analysis (See Figure 61, page 271) shows elongated blocks representing the anxious expressions. These were broken with shorter blocks showing relief and neutral expressions. The overlapping pattern of anxious expressions between the students suggests that they did not seem to offer and receive much support from each other. At 10 minutes BB's facial expression was boredom whilst AA's expression was relief. The time taken to work through the task was 14 minutes and 54 seconds. Phase 1 (mauve segment) was the shortest and both students had a neutral expression. Phase 4 (purple segment) took 5 minutes and 50 seconds to complete during which time both students were anxious. The group visual analysis shows how this expression changed to satisfied near completion of phase four. The total number of verbal protocols made by the two participants was 88 and the number of verbal protocols extracted for the themes of competence and confidence was 48. The total number of times asked "What are you thinking or, "How are you feeling?" was 4. The protocols in the Confidence column reflect mainly uncertainty. The inflexions in voice dynamics at the ends of sentences suggested trepidation, negotiation and the need for confirmation that the right decision had been made, especially when giving instructions to each other.

These were the only participants to make a comment about the non-availability of a mouse. The film clip revealed evidence of some reluctance by both students to take charge of and use the laptop, resulting in both AA and BB operating the keyboard. Examination of the film showed that this was always a light touch followed by a swift withdrawal of hands away from the keyboard. Throughout the task the laptop was positioned on the table in between the two participants. Neither participant appeared to want to take sole responsibility as the computer user.

The verbal protocols in the Competence theme appeared to show some familiarity with using a computer and words such as "Tabs, mouse, highlights and keyboard." When asked "What are you thinking?" some of the comments were negative about the usability features of the Re-usable Learning Object. This was therefore re-articulated as "How are you feeling?" The visual analysis reveals that just one mistake was made during the task, during phase 3 whilst searching for the Hotspots. This error was quickly corrected. The corresponding commentary in the Confidence column reflects uncertainty and their recorded facial expressions showed much anxiety at this point for each individual student.

Figure 62 Group two (Heterogeneous)



4.9.2 Group two verbal protocols

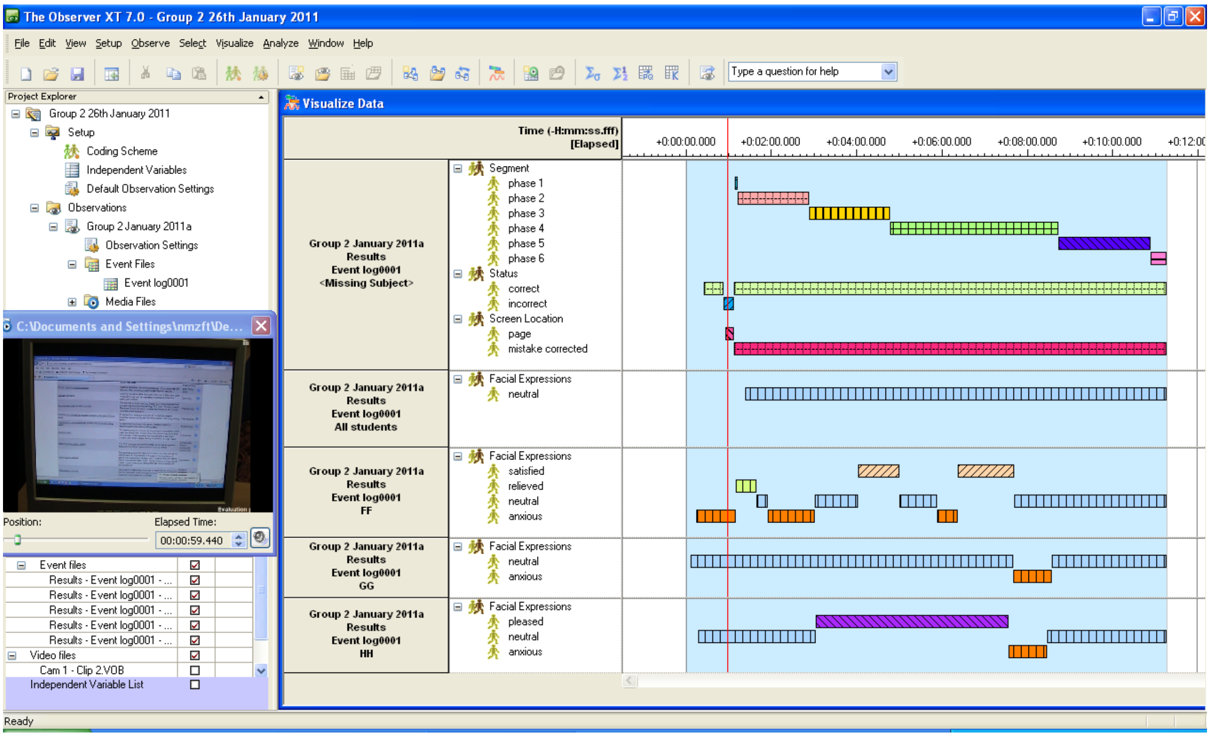
Competence Theme	Confidence Theme
CC "You need to go up to the top. Don't need to type it all in again." (Referring to warm-up) EE "Just put SNMP." DD "Just scroll down a bit." Has made some minor adjustments to the screen revealing more information." CC "Need to move the cursor around." Responses to FT asking what are you thinking? CC "It's quite straightforward really. CC "We'll be looking for hazards in the Home." DD "Try hints again." Moves the cursor quickly to the relevant area on the screen.	CC ""I wouldn't say that I feel unsure. Ehm I quite confident and I know what the picture is, once you've identified what a hotspot was." DD "A bit unsure." CC "When you think about it, it's quite straightforward." CC "I feel quite confident now." EE "I'm glad I'm doing it." CC "For someone who'd never looked at a computer, they'd be sat here forever." EE "Ooh you're right." (A response to a correct answer) DD "Ooh that's clever" as an acknowledgment of one

DD "Yeah try that one. So we're doing one across then." DD "Is that spelt right." CC "Well it'll tell you if it's not." CC "I'd take a guess that it is in Activity." DD "Well we've had more experience with computers." EE "When you think of your first response, you do not come away from that, I'm right means I'm right." DD "Assume and take a guess. I think this is right." CC "We need to go to 'Find the quiz' now." EE "It's trying to test you. It's not giving us simple things	of the other participants. EE "Clever." They have got the answer right. DD "We did alright."

This group of three year one students took 16 minutes and 23 seconds to complete the task. The total number of verbal protocols was 77 for the three participants. From this 23 verbal protocols were extracted for the themes of competence and confidence. When asked "What are you thinking?" comments were about mainly about nursing and the usability features of the RLO. Similar responses were given to "How are you feeling?" and "What are you thinking personally?" The question was changed to "How are you feeling about using a computer?" Hence the number of times that feedback was asked for was 8. Each participant made a contribution towards the activity and they all appeared to be supportive of each other with occasional acknowledgments such as "Ooh that's clever." Interestingly they did not make eye contact with each other whilst working through the task but stared at and talked towards the computer screen, often leaning forward. The visual analysis (See Figure 62, page 275) shows that this group did not make any errors during the activity even though the range of facial expressions for CC and DD covered pleased, relieved, neutral and anxious. DD was anxious at the outset, but the pattern of expressions for this student reflects relaxation and settling into the activity. Only DD showed a satisfied expression at one point. CC and DD's expressions reflected a number of changes across the range when the group were working on phase 4 which took over 4 minutes to complete. EE maintained a neutral expression throughout the activity. Her protocols reflected a high level of cognition and higher order technical commentary as a computer user. She made a number of suggestions which were acted upon.

Overall the verbal protocols for competence suggest that this group resorted to experimenting when uncertain. The Visual Analysis for CC and DD shows changes in facial expression at the end of one phase and the beginning of another phase. Anxiety re-appeared when uncertainty was stated and when asked what they were thinking and how they were feeling. The comment "What are you thinking?" appeared to raise the profile as a reminder about their anxiety. Interestingly the Status Protocol Segment for correct and incorrect shows their error-free status throughout the task. This was not acknowledged until completion when DD stated "We did alright." When chatting together about the nursing element of the RLO some relaxation was evident. The visual analysis shows this as a group neutral phase. They appeared to be comfortable talking about nursing practice based on their own experiences, rather than giving concurrent thoughts related to confidence and competence.

Figure 63 Group three (Heterogeneous)



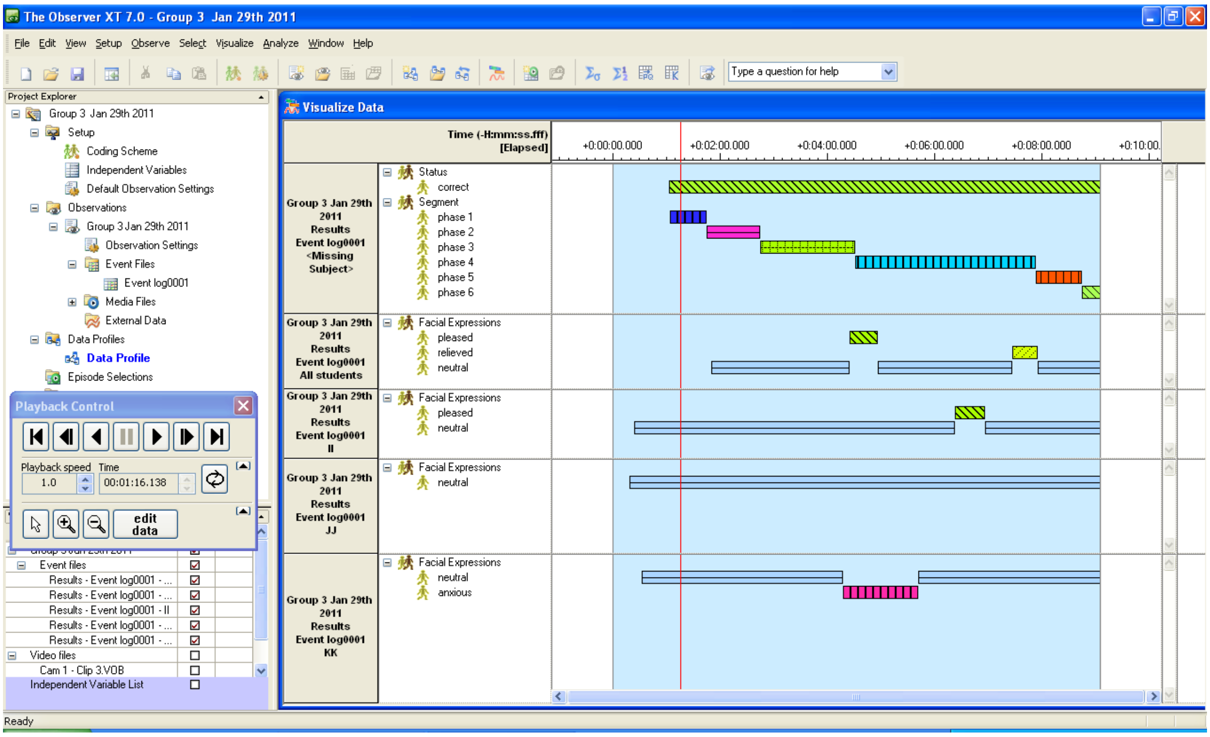
4.9.3 Group three verbal protocols

Competence Theme	Confidence Theme
GG "We don't need to do all that. Leave it there and then put in the end bit." HH "Click on School RLOs and go down to it." GG "Just go to Tabs." GG "That's got hotspots. That's where you should scroll and then click on it." FF "It's just finding it. We should have read the whole script to start with rather than doing it bit by bit." GG "Try a shorter one." HH "Try number three. Wide open care. Oh God. Click on hint." FF "Let's do number four." FF "It's easy to find but then again we have got the link." HH "But then we'd be working through it. We know all of it." FF "Activity do you think?"	FF "Oh God Sorry" Is typing and has pressed the wrong key. FF "Well personally I don't know if it's just me but I don't like reading off a screen. I find it..... I have to print things off." HH "It like blurs... plays with your vision doesn't it?" FF "I get quite agitated when I'm sat at a laptop for too long. GG "I'm quite confident." HH "I think it's quite easy to deal with. It's not as if it's difficult." GG "Working the controls are fine. It's the Crossword that is hard." FF "I can't think under pressure." FF "Transfer. One across? It doesn't fit." Looking at a clue "In charge. My mind's gone blank now." GG "Not feeling too confident right now." HH "Thick." This is a response to FT asking "How are you feeling?" HH "You're working with comrades now."

This group of three second year students took 11 minutes and 15 seconds to work through the task. 20 verbal protocols for the themes of competence and confidence were extracted from a total of 61. The total number of times they were asked "What are you thinking?" or "How are you feeling?" was 4. The output in the visual analysis shows that just one mistake was made right at the beginning of the task, when the wrong page was accessed whilst searching for the RLO. This error was quickly corrected by FF who had positioned herself in front of and operated the keyboard. The opening section of the film shows the group smiling at each other and this was a good reflection of the camaraderie between them throughout the activity. When FF made a typographical mistake, HH made a supportive comment to negate FF's anxiety "You're amongst comrades now." This was logged as a confidence protocol. At the same time GG was pointing out the instructions to FF.

The competence verbal protocols for all participants appear to reflect suggestion and experimentation. The verbal protocols in the Confidence theme show fluctuating levels of self-belief, with apology following error. When chatting together the group appeared to enter a neutral phase (See Figure 63, page 278) as a group but in contrast as individuals when making a comment, they displayed different facial expressions. The coloured visual analysis for FF reflects range of visual expressions as satisfied, relieved, neutral and anxious, in spite of being correct for the majority of the task. The anxious expression was borne out in her protocols which reflected her opinion of using a laptop. GG displayed neutral and anxious. The quietest of the group, the protocols from her commentary were advisory about the direction of the task and how to complete it. HH's facial expressions were pleased, neutral and anxious. The anxious expressions reflected by GG and HH appear towards the end of the phase 4 which took the longest to be completed. Up until this point HH appeared pleased with the progress the group were making. FF's anxiety from the outset appeared to be picked up by the other two students as they progressed through the task.

Figure 64 Group four (Heterogeneous)



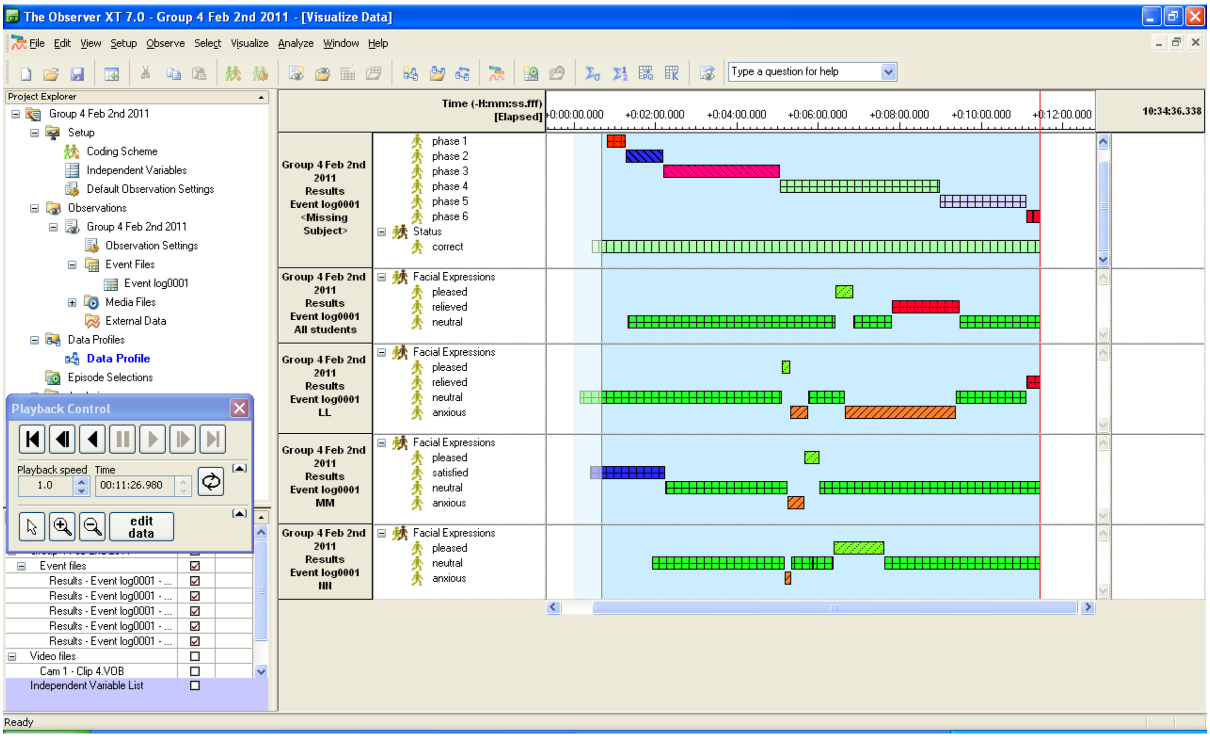
4.9.4 Group four verbal protocols

Competence	**Confidence**
KK "We are just reading the instruction." JJ "Right are we going to type in that?" Looking at the task sheet." KK "Whereabouts on the page is it? What we are looking for?" KK "Now we've got to find the Hotspots." JJ "What's a Hotspot?" KK "It might tell us on that bit there." JJ "We need to go to Living Room 2. That was quite easy to find." KK "Need to go to the drop-down menu." II "You can use the Tabs at the top." JJ "Ah we've got to move the mouse." (referring to cursor) JJ "So there's a door when we click on door." II "We just clicked on the door and it told us the purpose of the door being highlighted." "We've found three so far." (Hotspots) II "So now we need to go to the Community Crossword." KK "I wonder if that's the same thing? Community Crossword and Community experience? We could probably give it a go." KK is looking for the Community Crossword. "Oh God where's that?" II "It might be under Activity." KK "Maximize that so we can see." Points to the screen. II (Looking at a clue) "Risk?" KK "I'll try it." JJ "Is that right?" Working on the Crossword. KK "Shall we try it?" II "Is there no way we could check it?" Working on Crossword they all laugh when they get the answer wrong.	II "I'm not any good at Crosswords." KK "That's not easy." II "Complete any three? We'll be here all day." II "Get it." Punches the air as they have a correct answer. JJ "I hate waiting." The URL is loading

KK "Well that wasn't right." II "Right we need to close the programme. and return to The University of Nottingham homepage." KK "We can just click on the X can't we?" JJ "No we have to return to the homepage. What we typed in, in the first place."	

This group of three first year students took 9 minutes and 6 seconds to work through the task. 31 verbal protocols for the themes of competence and confidence were extracted from a total of 47. The total number of times they were asked "What are you thinking?" was just 1. The output in the visual analysis (See Figure 64, page 281) shows the status as correct in all phases. A neutral expression is predominant throughout the task, with one episode of anxiety for KK during phase 4 which took the longest time to complete. The group visual analysis shows they were all pleased when this section was completed. The protocols in the Competence theme reflect collaboration, strong navigation, instructional knowledge and technical skills, suggesting experimental capabilities. The protocols in the Confidence theme reveal some uncertainty. Two points in the visual analysis show changes in the students' facial expressions as pleased and relieved when nearing completion of specific phases.

Figure 65 Group five (Heterogeneous)



4.9.5 Group five verbal protocols

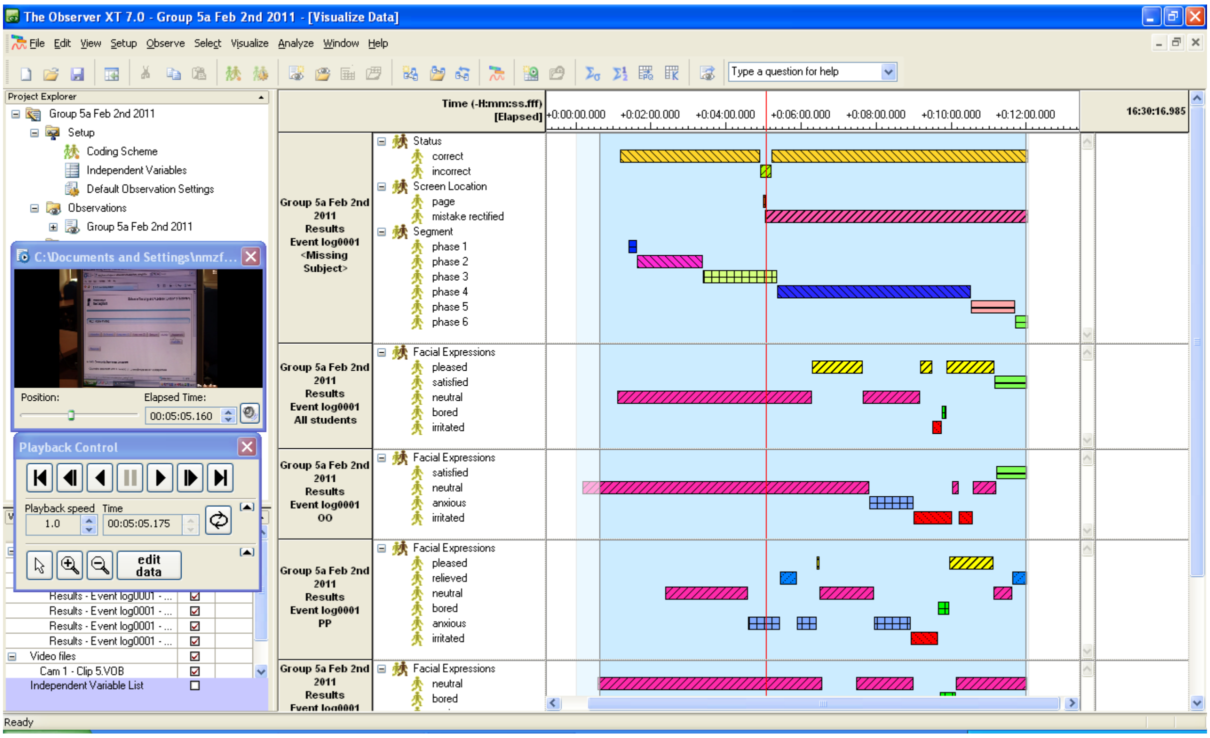
Competence	Confidence
LL “Shall I read the Web address?” LL “Scroll down and then Home Visiting.” NN “What’s a Hotspot?” MM “If you click onto it, the mouse turns into a hand.” LL “That confused me.” (Referring to the cursor clicking onto a hand in the Hotspot). MM “This is the cursor and if you click over it, it turns into a hand LL (Referring to the Hotspots) “Does it say how many we have to find?” LL "Press that and put it on the floor. Sorry I call that the floor." (Appears to be describing placing the cursor on the bottom of the screen). NN "Oh wow." Looking at the content on the screen	LL “I’m amazed at how fast I’ve read that. I’m normally quite slow.” FT "How are you feeling." LL"I'm finding it daunting. I can't do this at all."" NN"I think we're working quite well as a team LL "I would lean more on you guys cos I don't have clue." In response again to FT asking how are you feeling LL “Elated. We have found the Crossword.” NN “Yeah but now we have got to do it and I’m not great...” MM “I don’t know how to work it.” LL “I just look at that and now I’m finding the whole thing daunting.” LL “You see. You now with these kinds of things my head

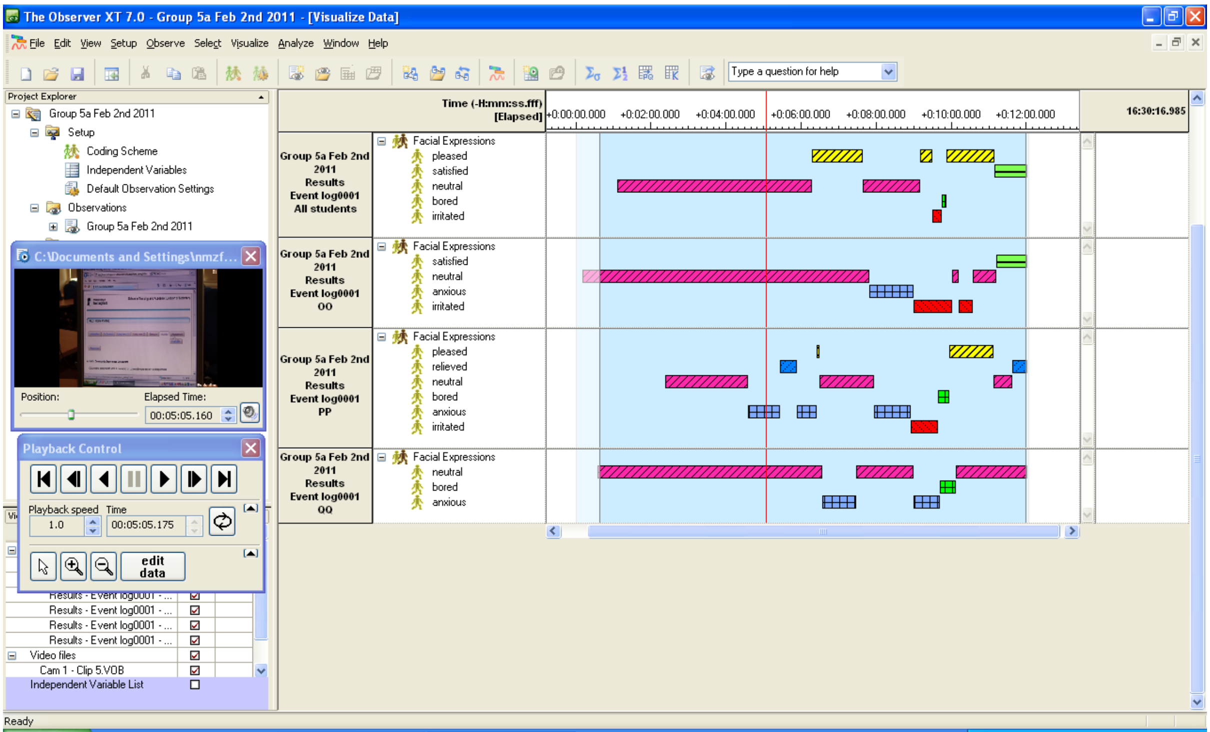
LL "Yeah all these technical terms." NN (Referring to the Hotspots) "Well that's three we've got. Door, television and fireguard." LL "Well we've found the Hotspots." NN (Referring to the crossword) "Look you're going to have to come down the page. Where's the clues?" MM "DO you click on....Ah Brilliant." Has clicked on a letter and found a clue. MM (At the end of the task) "It just wants us to go back doesn't it?" LL "It doesn't want us to log out does it?"	goes blank." NN (Referring to phase 6 in the RLO activity) "That's my problem. I never read instructions properly." LL to NN when she has solved a Crossword clue. "This is your forte." LL "Sorry I'm a bit slow. I've just had to read it twice. NN "Read what twice?" LL "The question. Sorry." NN "OK. You're alright."" MM "I think I'm going to quick for everyone actually." NN "No you're not." LL "It's me. I read that twice. I thought I'd got it but wanted to make sure. In tests 'n stuff I take absolutely ages." MM "No probs darling." LL "Bless you. Right then close the programme."

This group of three first year students took 11 minutes and 26 seconds to work through the task. 38 verbal protocols for the themes of competence and confidence were extracted from a total of 65. The total number of times they were asked "What are you thinking?" was 4. On one occasion the group appeared to be so completely absorbed in the task to the extent that they simply responded to "What are you thinking?" with a simple "OK." So a further reminder was given as "Don't forget to tell me what you are thinking." The output in the visual analysis shows the status as correct in all phases (See Figure 65, page 284).

Collectively as a group when reading silently or considering a possible answer their facial expressions are neutral. The faces of all 3 students show anxiety at different points in phase 4. The following segments reflect a positive shift as they work through the task with LL and NN showing neutral and MM showing pleased. The verbal protocols in the Confidence theme reveal a high level of emotional support, kindness and friendship amongst this group of participants. The protocols in the Competence theme reflect a strong navigation and instructional knowledge and skills.

Figure 66 Group six (Heterogeneous across 2 windows)





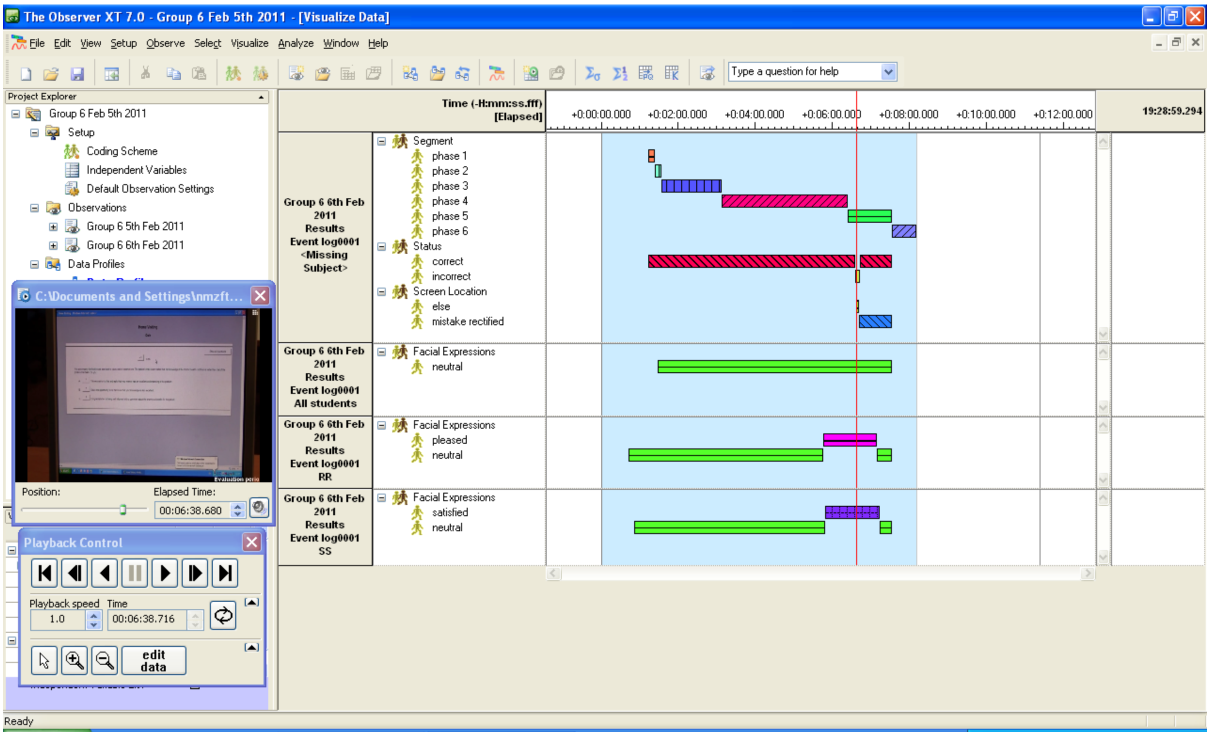
4.9.6 Group six verbal protocols

Competence	Confidence
OO We’ve got to find the URL for the School of Nursing and then put in that." Then slowly reads the URL OO “We need to click on the School RLOs, scroll down and go into Home Visiting." QQ (Leans towards the screen and whispers to PP) "You've missed one." PP “I need to scroll back up.” OO “Do we have to complete the whole assessment?” PP ""It doesn't show a hand does it? It stays as an arrow." (Is referring to the sensitized Hotspot areas). QQ “Could we not make it smaller so it fits on the screen in one.” QQ “Now we need to go to Living Room 2.” PP “No that's not it. Press next see if that takes us there. No we're in the bedroom." “They are on the wrong page in the task) PP “There we are look. Activities." (They have corrected the error). PP “Shall I press Next or shall I go back up.” QQ (Referring to the crossword). “Click on Hint. No that’s cheating.” PP (Referring to the crossword) “Well we’ve got ‘em all wrong anyway.” QQ (Referring to typing a letter in the crossword puzzle) "You've got to put something into your box." PP "No." OO (Referring to phase 5 of the task) “Well we’ve got that one then.” PP "If we just delete half of that Web address and then click enter. The top box."	FT "What are you thinking?" QQ "I'm thinking I'm glad she is working the computer." PP “The computer’s not hard to use. It’s the other....The computer’s pretty self explanatory.” FT "How are you feeling?"" CC "Confused."" OO "A bit out of our depth. I don't know much about anything." PP (Talking to SJ) “Yeah a good guess.” PP “It’s really annoying having to keep scrolling up and down.”

For this group the visual analysis is presented using two windows. This group of three first year students took 12 minutes and 3 seconds to work through the task. 21 verbal protocols were extracted from a total of 73. The total number of times they were asked “What are you thinking?” was 3. The group made one error in phase three (Finding the Hotspots, the safety hazards in the Rooms) and this was quickly rectified. For the group as a whole (See ‘All students’ line in Figure 66 page 287), the visual analysis shows the range extending between pleased, satisfied, neutral, bored and irritated The range of expressions for OO was neutral, anxious, irritated and satisfied. PP was the only participant to display the whole range of facial expressions, but significant parts of the timeline show her as being bored, anxious and irritated. QQ revealed neutral, bored and anxious facial expressions. The majority of the timeline shows her with a neutral expression. PP was the first student to show an anxious expression during phase 3, followed by QQ and OO respectively during phase 4.

The verbal protocols for this group show a mixture of understanding what needs to be done but some uncertainty in the execution of the task, albeit that just one error was made. For all students as individuals and as a group the behavioural range opens up at circa 5 minutes into the task, near to the point of the error. The verbal protocol “Well we’ve got ‘em all wrong anyway” appeared reflect a low point in the proceedings. The decision was made to rescue the participants as they appeared to be at a standstill. The corresponding facial expressions were clearly negative showing bored for PP, anxious for QQ and OO was irritated. The comment "If you want to move on to the next part of "the activity then you can." was welcomed with "Thank you" and Great" from all three students. Facial expressions at this point quickly changed to pleased for PP and neutral for OO and QQ. Interestingly the individual timelines for all three participants show a significant dip down to a negative expression and then an upward curve near the end of the task. OO completed the task with a satisfied expression, PP looked relieved and QQ appeared to have a neutral expression.

Figure 67 Group seven (Homogeneous – Strongly Agree)



4.9.7 Group seven verbal protocols

Competence	**Confidence**
RR"We can use that search tool." RR "Well we've got the address." SS "We need to go onto School RLOs." SS "So now we've got to find the Hotspots. The cursor should turn to a hand." RR "Scroll around. You should find one Hotspot." SS "The notes come up but it doesn't turn to a hand." SS "So we've found three Hotspots. Let's go to the Community crossword." SS "Click on a number to find the clue." RR "Go for number three. That's nice and short." SS (Referring to the crossword puzzle) "If we put Caps lock on, it seems to give you all the clues." SS "There we are. It's good how it puts it in." (Referring to the Hints option in the crossword puzzle) SS (Looking at a clue and states the answer aloud). "Hygiene. Just type it into the box. Is that how you spell hygiene?" SS "We can click on check to see if they are right." They have completed three words." RR "Oh dear" SS "That's because we have only completed three words." (Is referring to the feedback in the crossword.) SS "That seems simple enough. Now the quiz." RR "We've got to do Question 6. What's that about? It's not clear. That moves us to the next question." SS "Yeah we need Question 6."" (They are looking at the wrong question). RR "Go back to question 6" (They have quickly corrected the mistake). SS "Close the programme. What about this Home Page? Will that take us back? Just click on University of Nottingham and that will take us straight back."	RR "It's all very easy up to now." SS "Yeah that's OK."

Two students representing the Homogeneous Strongly Agree category in the first study volunteered to take part in the second study. For their activity the total number of number of verbal protocols was 36 from which 22 were extracted. The time taken to work through the task was 8 minutes 11 seconds. From the outset the protocols in the competence category show that their approach was clinical and businesslike, giving specific directions to each other. Although both were third year students they had not met before because of being in different cohorts and branches of nursing. However they worked smoothly and seamlessly through the activity irrespective of being strangers. Facial expressions (See Figure 67, page 290) were mainly neutral with an occasional change of expression of pleased for RR and satisfied for SS. Their focus appeared to be totally on completing the task.

The Competence theme illustrates the use of language in the RLO and Information Technology nouns and adjectives such as "search tool" "caps lock" and "click". Neither student gave reinforcement when they completed each phase and nor were they fazed by the mistake which was quickly corrected. This is confirmed in the Confidence theme with just two protocols relating to personal feelings. They did create an impression of working together as a team, formulating ideas and engaging in fluent commentary as they completed each part of the task. With a time of circa 8 minutes this pair completed the task quicker than any other group.

4.10 Group timings

Table 13 (See page 295) shows the time taken by each group to complete the activity. The task timing was set as a guide for the participants. The Homogeneous groups finished first and sixth respectively. Group 7, the Homogeneous group of year three students who indicated a high level of competence and confidence in the survey, finished first completing the task in 8 minutes and 11 seconds. In contrast Group 1 the Homogeneous group of two third year students who identified with a low level of competence and confidence, completed in 14 minutes and 54 seconds finishing sixth. The overall time difference in completion between the fastest and the slowest was 8 minutes and 12 seconds, showing that Heterogeneous Group 2 took twice as long as Homogeneous Group 7 to work through the task.

For the Heterogeneous groups, timings ranged between 9 minutes and 6 seconds and 16 minutes and 23 seconds giving a spread of 7 minutes and 17 seconds between the fastest and the slowest groups. In addition to Group 7, only Group 4 comprising of three first year students, completed the task within the allocated time of ten minutes. The second year students, Group 3, finished in 11 minutes and 15 seconds. The average completion time for the Heterogeneous groups was 12 minutes and 10 seconds. The average completion time for all groups was 11.8 seconds.

Table 13 Group timings

Group	Characteristic	Time	Finishing Position
7	Homogeneous Strongly Agree	8 minutes 11 seconds	1
4	Heterogeneous	9 minutes 6 seconds	2
3	Heterogeneous	11 minutes 15 seconds	3
5	Heterogeneous	11 minutes 26 seconds	4
6	Heterogeneous	12 minutes 3 seconds	5
1	Homogeneous (Strongly Disagree)	14 minutes 54 seconds	6
2	Heterogeneous	16 minutes 23 seconds	7

4.11 Number of total and extracted verbal protocols

A total of 447 statements were recorded in the seven Event Logs. From this total, 203 verbal protocols were extracted as these comments related to computing competence and confidence. Table 14 (See page 297) shows the total and extracted number of verbal protocols for each group. The Strongly Disagree Homogeneous group have more than twice the number of total verbal protocols at 88 than the Strongly Agree group at 36. In the Heterogeneous groups the highest and lowest numbers of total verbal protocols are in group two and group four respectively.

For competence and confidence verbal protocols the Strongly Disagree Homogeneous Group has the highest number at 48 and the Heterogeneous Group 6 has the lowest number with 21. The second lowest appears against the Homogeneous Strongly Agree with 22.

Table 14 Total and extracted number of protocols for each group

Group	Total Number Of Protocols	Final Extracted Number Of Protocols For Competence And Confidence	Number of Competence Protocols	Number of Confidence Protocols	Positive confidence	Negative confidence
1 (SD)	88	48	32	16	2	14
2	77	23	13	10	8	2
3	61	23	12	11	2	9
4	47	31	26	5	1	4
5	65	38	18	20	8	12
6	73	21	15	6	2	4
7 (SA)	36	22	20	2	2	0
Total	447	206	136	70	25	45

4.12 The emergence of the initial themes from the second level of protocols

The outcome of the parsimonious filtering activity can be seen in Table 15 (See page 299) identifying the initial themes to emerge from the second level of protocols from each group. These were organised as competence, confidence, teamwork, usability and nursing. Further refining and defining removed the descriptors of teamwork, usability comments about the RLO and Nursing language. Characteristics that reflected the participants' cognitive engagement with the activity and their reasoning skills and affective responses were bracketed as competence and confidence.

Together these themes capture the different topics covered by the students whilst working through the task. The purpose of this table is to show that students discussed issues that were directly and indirectly related to the activity.

Table 15 Initial themes emerging within the seven groups

Theme / Group	Competence	Confidence	Teamwork	Usability	Nursing Language
1	√	√	√	√	√
2	√	√	√	√	√
3	√	√	√		√
4	√	√	√		√
5	√	√	√	√	√
6	√	√	√	√	
7	√	√	√	√	

4.13 Limitations of the second study

Researcher presence may have had an influence on the students' commentary and actions and the outcome of the study, albeit that preparation had pre-empted this situation. These 'stage-managed' conditions may not have been an entirely accurate reflection of what would normally happen between small groups of students working together through a computing activity. Lifting protocols out of sequence and setting them into themes created isolated trajectories and did not entirely reveal the rich dialogue between the participants. Although Protocol selection was grounded in understanding of competence and confidence from the literature, it was possible that this process could have been subjective, based on researcher deduction and opinion.

4.14 Conclusion

This chapter has set out the results for two sequential studies using Principal Components Analysis and Protocol Analysis. The quality of the results reflected both the advantages and disadvantages of mixed methods cited in the previous chapter. The advantages for these results from using mixed methods were the consequential links between the components in the first study and the decisions related to the activity and what was observed in the second study. The results in the second study reflected the component loadings of confidence, competence, peer support and preferred learning styles and opinions on working through an online activity. Circumstances led to the necessary recruitment of a new group and this challenged the intentions for a seamless mix through the same cohort. Both studies conducted in isolation may have given an equally strong set of individual results. However together they presented width and depth of detail about a group who have received limited attention as computer-users. In the next chapter the findings from each study are followed by a synergy of their combined outcomes. This work precedes a set of recommendations for nurse education and practice.

Chapter Five

Discussion and Recommendations

5.1 Introduction

This chapter discusses the combined results from the two studies investigating competence and confidence in student nurses as computer users. The chapter commences with a summary of the work undertaken. This is followed by a synthesis of the combined findings. A number of recommendations are made to help students develop their computing competence and confidence.

The opening chapter identified how the increasing use of ICT in nurse education and health care, requires student nurses to be competent and confident as computer users during and after their studies. A review of the literature revealed varying outcomes for this learner group, especially in those studies that used a mixed methods approach. These studies showed that student nurses have different kinds and levels of ICT skills, knowledge and experiences. Previous studies have reported on the observable and cognitive characteristics for computing competence. There appears to have been a tendency to discuss these phenomena as separate entities or as a consequence of ICT exposure and end user status.

This research aimed to convey the importance of a study on study nurses. This is a group of learners that in comparison with others has been under-explored. This was also reflected in the workforce development for their professional counterparts. However there are significant implications for teaching, learning and professional nursing practice, if computing competence and confidence are not recognized, understood and managed properly. The choice of approach was a mixed methods study through survey by questionnaire and direct observation using concurrent think-aloud aloud with protocol analysis. Data from the first study influenced the framework of the second activity. The first set of results identified a strong relationship between computing competence and confidence. The use of PCA showed the points where they overlapped as information about their characteristics and the direction of the relationship. The second study showed at what point these phenomena might emerge and be seen. Complex in their presentation, these phenomena revealed a number of features about student nurses' as computer users.

The results from the first study showed that most students reported satisfactory levels of competence and confidence, with a minority who find this environment challenging. The observational activity confirmed these initial findings. A small number do not do well as computer users, to the extent that they appear miserable and afraid. These findings support the rationale to create an optimum level of competence and confidence that all students can achieve. I show how student nurses can work towards this optimum level by setting out the conditions for its achievement and guidelines to help them realize their potential. A number of recommendations are made for individual and collaborative work between nurse education and practice. The final section identifies how this work has made a significant contribution to an area of research that is relevant and important, but does not have an established profile.

This study is unique in its examination of the source and the multiple directions of competence and confidence. It has unpacked discrete and interconnected features of computing competence and confidence in student nurses that may have always been present, but not investigated by previous studies. The combinations of PCA and think-aloud with protocol analysis have not been used previously to investigate this area. ICT research using mixed methods is relatively new and the methodology discussion adds to the emerging body of understanding in this area.

Study One

The purpose of the first study was to answer the research question: **What is the nature of the relationship between competence and confidence in computing skills in nursing students?** With the sub-question of: In what types of tasks and circumstances are these observable?

5.2 Themes emerging from the Principal Components Analysis and the histograms

Four themes emerged from the PCA. These themes were influenced by the type and the strength of variables that loaded onto the components. Together they reflect the multidimensional qualities of competence and confidence. The latent phenomena emerging from the PCA gave answers to the sub-question **'In what types of tasks and circumstances are these observable?'**

5.2.1 Theme 1 Student nurses' working independently as computer users

Theme 1 is about student nurses being able to work independently as computer users. The loadings on the first component (See Table 8, page 251) showed that the student nurses felt confident and competent about using a computer for their studies. Being presented with an unfamiliar task seemed to be an unremarkable occurrence. These loadings concur with White and Le Cornu's (2011) description of digital residents. Given that 90% of the cohort used the University's ICT facilities and 99.2% had access to a computer at home, 47% and 25% used a computer in their post-16 studies and in previous paid work respectively, the emergence of this latent detail is unsurprising. These loadings reflect previous studies (Ammenwerth, et al., 2004; Oroviogoicoechea, Elliott and Watson, 2006; Berglund et al., 2007; Garrat and Klein, 2008; Kuosmanen et al., 2010; Windle et al., 2011) and contrast with previous studies citing student nurses' preferences for an instructivist approach and their reluctance to work independently (Koch et al., 2010; Moule et al., 2010). The loadings also suggest that student nurses who recognized their transferable computing skills would cope with learning about ICT and learning using ICT. This finding concurs with competence as the ability to use previous knowledge and skills in order to make progress (Lozano et al., 2012).

Previous research has shown that students can work efficiently and effectively as computer users (Ammenwerth, et al., 2004; Oriviogoicoechea, et al., 2006; Berglund et al., Garrat and Klein, 2008; Kuosmamen et al., 2010). The loadings concurred with this literature, but crucially also showed that strong competence and confidence seem to be a combination of interactive and progressive characteristics. A number of histograms show the individual characteristics of competence and confidence as beliefs in what one can do (See Figures 34, 37, 38, and 50, pages 223, 225, 226, 234). These are movement and completion as “beliefs in one’s capabilities to organize and execute the courses of action required to manage prospective situations” (Bandura, 1986, p.2), adaptability and flexibility in performance and being able to resolve familiar problems in unfamiliar contexts (Sen, 1985; Nussenbaum, 2006). This theme is showing how students’ reflect their level of self-efficacy. They are able to deal with a computing issue using the best solutions known to them, comparable with Slatter (1990) and Winterton et al. (2006). Both identify the use of optimum skills and knowledge from immediate and previous experiences.

It appears that students will review their previous computing experiences in order to develop further knowledge and skills. This cyclic behaviour is then repeated with subsequent experiences and may explain the presence of the following loadings. 'I can work through most School of Nursing activities' and 'Confidence is not an issue. I just get on with the task.' These variables are showing that repetition equates to recognition which in turn assists completion.

This theme has shown that competence and confidence have interchangeable characteristics and are influenced by previous and current experiences. It has also shown that it is possible to observe the progression and direction of competence and confidence using a range of phenomena. These are essential assessment criteria for student progression (NMC 2007; 2008).

5.2.2 Theme 2 Peer support and interconnected personal learning experiences

This theme is about peer support and interconnected personal learning experiences. The loadings in the second component, the high and medium cluster in the geometrical representation (See Figure 60, page 261) and the individual histograms (See Figures 21-23, pages 215-216) confirmed that students benefit from listening, watching and talking when working through a computing activity. These reflect the interconnected element as the mutual sharing of time, ideas and support. The Independent-samples T-test showed no statistically significant difference in the mean scores for first and second year students on the factor regression scores for the first five components. This was unexpected because the assumption was that the year two students might have been more adept at developing social learning networks for computer-related activity. Irrespective of study year, they could be transferring skills from other experiences, as found elsewhere (Belk, 2013; Jia, 2013; Shah, 2013). They seemed to be comfortable with sharing ideas, listening to others and observing activities. The findings support previous studies showing the importance of social engagement, peer support and performance as influential on ICT learning (Gilbert, 1996; Butterfield and Metcalfe, 2006; Dangwal et al., 2006; Farrell et al., 2007; Bond, 2010; DH, 2011; HEFCE, 2011; Todhunter et al., 2012).

Bowman's (1999) take on confidence as the courage to take action may also explain why students responded favourably to working together. They were using the language and behaviours related to the computing task, but did not appear to be fazed when some aspects were unfamiliar, because of the safety of the group situation. These findings align with the recommendations of peer groups and social learning arrangements for ICT implementation in Higher Education (QAA, 2011).

5.2.3 Theme 3 The usefulness of online and paper Help manuals

This theme represents the loadings on components three and five and the histograms (See Figures 45-46, page 231) for the usefulness of online and paper Help manuals. The negative loading within the fifth component for 'Sometimes complete without thinking' was affirmation of the positive loadings for supporting consultation resources. This is showing that students welcome different kinds of support even when they are competent and confident. This theme reflects previous studies and policy direction on blended learning approaches (Bond, 2009; Holley and Oliver, 2010; QAA, 2011).

A consequence of consultation with online and paper resources is that student nurses are exposed to the language or nomenclature of ICT (Moule et al., 2011). These experiences may help them to become familiar with different ICT products and the skills to follow ICT instructions. This kind of exposure cannot be underestimated given the cited range of ICT activities used to support and enhance patient care care (Berglund et al., 2007; Garrat and Klein, 2008; Fejtová et al., 2009; MacKenzie and Ashtiani, 2011).

This theme shows that in choosing to consult with supporting resources, the student nurses were recognizing their limitations as computer users. They are also using resources other than human interaction. Berman's (2006) definition of confidence applies here as it links to cognitive judgement and maintaining presence of mind. In sum this is not panicking if it is not possible to 'sometimes complete without thinking' (See loading for component five, page 261). The courage to attempt change (Berman, 2006), when applied to student nurses is their courage to use the online and paper manuals to resolve their ICT queries. The competence element is the balance between mastering the skill and the ability to reflect using cognitive judgment as defined by Keen (1992) and Short (1984, p.201). "Mastering particular things is not the same as possessing certain qualities". These definitions are relevant as they identify the underpinning knowledge and skills that are required in order to complete the ICT task.

5.2.4 Theme 4 The influence of taught provision on computing competence and confidence

This theme reflects the negative loadings on the fourth component. Inspection of the geometric arrangement for component four (See Figure 60, page 261) gave high and medium negative loadings for the taught provision. Other factors were influencing the views on taught provision, for example, students' positive responses to using online and paper copy resources and working in small informal groups. The histograms do show students' favourable responses to the taught provision (See Figures 26 and 51, pages 218 and 235). This could an indication of students' awareness of the benefits of alternative support systems. This important finding reflects the shift towards selection where students will choose and manage their own ICT learning (Grudin, 2013). Crucially these observations give a different perspective to the sub-question 'In what types of tasks and circumstances are these observable?' The dematerialization of human interaction (Belk, 2013) and the use of CALs (Sheridan et al 2008; Cant and Cooper, 2010; Chambers, 2010; (Morente, Morales-Asencio and Veredas, 2013) removes the direct teaching process. The taught component occurs through online feedback and feed-forward.

Together these themes came from the underpinning latent characteristics from the PCA and concurred with a number of previous definitions and studies. No single definition of competence and confidence could be applied to the overall findings. Examination of the structure matrix showed that different items came into play with each component of competence and confidence. This equated with Thurstone's (1947, p.58) "Just as we take it for granted that individual differences in visual acuity are not involved in pitch discrimination, so we assume that in intellectual tasks some mental or cortical functions are not involved in every task. This is the principle of simple structure or simple configuration in the underlying order for any given set of attributes."

Thurstone's interpretation means that not all aspects of competence will be involved each time someone is competent and not all aspects of confidence will be involved each time someone is confident. This explained the presence of different variables for confidence and competence in the components and possibly reflected the different kinds of experiences that students bring with them as computer users.

This body of information gave some important information about computing competence and confidence. These were about where, when and how student nurses might address their competence with

ICT and how they managed confidence feelings when presented with a computing challenge. Students also identified which resources were useful. In sum the study cohort were broadly stating that they were competent and confident as computer users. However confidence emerged as dominant in the largest component, so a key task for the second study was to find out why this might be the case. To conclude this section, these themes answered the first research question showing the presence of a relationship between competence and confidence. The answer to the sub-question and the examples of tasks and circumstances where these could be observed were:

- Students' responses to working independently, problem solving skills and completing a computing task
- Their responses to using hard copy and online Help resources
- Their behaviours and actions in group work
- Their preferences for blended learning approaches
- Their responses to the taught provision

The themes gave good indication of the circumstances where computing competence and confidence could be seen directly and indirectly. These findings endorsed the preliminary plans and decisions for the second explanatory study.

Study Two

5.3 The emerging issues from and dimensions of the Protocol Analysis

The purpose of the second study was to answer the research question:

"If there is a relationship, is it possible to identify where under-confidence and over-confidence have an effect on competence?" With the sub-question of: What does it look like?

5.3.1 Visual analyses and protocols

Having scrutinized the individual groups and presented the commentary and behavioural evidence, the visual analyses and verbal protocols were then re-examined. This was to see if it was possible to pick out a range of confident and under-confident behaviours in the groups (See Figures 61-67 and sections 4.9.1–4.9.7, pages 271-293). The visual analyses identified as Segments and Status show where under-confidence and over-confidence might have had an effect on competence. Previous studies have discussed the influence of error on confidence (Compeau and Higgins, 1995; Moule et al., 2010) so the first task was to ascertain those groups that did not make any errors. A review of the visual analyses showed that groups two, three, four and five did not make any errors whilst working through the task (See Figures 62 63, 64 and 65, pages 275, 278, 281 and 284). Groups' one, six and seven made just one mistake (See Figures 61, 66 and 67, pages 271, 287 and 290). These can be seen in the visual data screen where there is a break in the elongated blocks labelled Correct. This switches to Incorrect and changes back once the problem has been resolved.

The new subjects were treated as the heterogeneous group but ordinal data from their survey responses appeared to be skewed towards the homogeneous characteristics of a high level of computing competence and confidence. Examination of their verbal protocols and the visual analyses disputed this finding. Their outputs revealed mixed levels of confidence in groups and individuals within the groups. The homogeneous groups followed form. The outputs showed a high level of computing confidence and competence for the homogeneous strongly agree group and the opposite for the other homogeneous group (See Figures 61 and 67, and Sections 4.9.1 and 4.9.7, pages 271-293).

5.3.2 Confidence

Groups two, four and seven contain individuals who worked through the task with a predominantly neutral expression (See Figures 62, 64 and 67, pages 275, 281 and 290). The visual analyses for groups four and seven showed similar flat tracings of mainly neutral, albeit that there were clear differences in commentary. The verbal protocols for group two indicate that they were feeling confident about the task (See Figure 62).

The verbal protocols for groups four and five (See Figures 64 and 65, pages 281 and 284) show that they were immersed in the task, chatting informally and making suggestions about the activity, showing some similarity to Dangwal et al.'s (2006) subjects. Group five openly demonstrated support for each other (See section 4.9.5, page 284) giving positive reinforcement when correct or uncertain. This appeared to influence their approach to the task and seemed to address any anxiety. Their approach represented the loadings in component two (See Table 9, page 253) and the benefits of working through a computing task by watching, talking, listening and experimenting. Group seven, the strongly agree homogeneous pairing, appeared to take a very formal professional approach towards the task (See section 4.9.7, pages 291-293), reflecting the pinnacle in the Dreyfus and Dreyfus (1986) model. Their visual analyses (See Figure 67, page 290) represented the loadings in component three (See Table 10, page 255) and being able to work efficiently and effectively using a computer and the online support systems. Similar to group five they were clearly at ease working together albeit as two strangers.

There appeared to be a greater range of facial expressions from individuals rather than groups. The group outputs (See the line for 'All Students' in each group's Visual Data screen) for the majority of groups reflected neutral facial expressions when working together. This appeared to suggest some positive attributes from group engagement. Individuals interact, bounce ideas and become absorbed through working together. Confidence is more likely to emerge through the contact with others. These kinds of experiences assist in learning about and learning using ICT. Crucially these and previous findings for group arrangements help student nurses to learn how to make and discuss ICT-practice decisions (Johnson, et al., 2013; Morente et al., 2013). Together these visual analyses and verbal protocols are indicative of confident behaviour and reflect the opinions of self-confidence in the first study.

5.3.3 Under-confidence

In contrast, the visual analyses for groups one, three and six show facial expressions as neutral at the beginning of the task. Anxious expressions appeared well before any errors (See Figures 61, 63 and 66, pages 271, 278 and 287). The protocols for groups three and six appeared to show some initial anxiety before they settled into the task. Group one's verbal protocols appeared to reflect a high level of anxiety with much of the dialogue being instructive. This was the antithesis of the NMC's (2008, p.3) "skills and ability to practise safely and effectively without the need for direct supervision." Small errors had a negative effect on these groups, albeit that their visual analyses show them to be competent as computer users.

The visual output for group six reflects the full inventory of facial expressions and these fluctuations are matched by the content of their verbal protocols. Groups two and three did not make any errors, but their facial expressions show a mix of anxiety and relief (See Figures 62 and 63, pages 275 and 278). With the exception of the strongly agree homogeneous subjects, some level of anxiety was apparent in individuals in the other groups. Table 14 (See page 297) shows that five groups had more negative than positive verbal protocols for confidence, albeit that their visual analyses showed errors being quickly corrected. Together these visual analyses and protocols are indicative of under-confidence and largely dissimilar to the findings in the first study.

5.4 Timings and completion of the task

The timings for the groups (See Table 13, page 295) appeared to show a connection between the number of verbal protocols and the time taken to complete the task. Based on this evidence it could be cautiously reasoned that the groups with a high output of verbal protocols appeared to take longer to complete the task. For some groups, the act of concurrently thinking-aloud appeared to slow down the time taken to complete the task. These findings partly concurred with those of Cotton and Gresty (2006) whose subjects did not always complete the task. An alternative explanation is that time should not be an issue. The opportunity to work at a measured pace in safe conditions is more conducive to learning than speed and completion. These types of experiences have been shown to develop familiarity, knowledge and confidence (Jia et al, 2013).

5.5 Discussion of the overall findings from the Protocol Analysis

The evidence above illustrates the labile nature of computing competence and confidence in this group of student nurses. However the prevalent feature in the under-confident groups and individuals was fear of getting it wrong. These findings contradict the single direction model of novice to expert (Dreyfus and Dreyfus, 1986)and the combination of performance adjectives by Winterton et al. (2006). This study has shown that not everyone benefits from small informal group arrangements. Other studies report on preferences for solitary working, influenced by internet access, location and time to learn at one's own pace (Rye, 2010; Giannokos and Viamos, 2012; Belk, 2013; Shah, 2013). A unique feature of this study is that it was possible to identify where and also why under-confidence affected competence at different points in most of the groups. Under-confidence was more prevalent than over-confidence and manifested as a combination of:

- Looking anxious
- Lots of changes in facial expressions
- Verbal expressions of self doubt
- Stating when incorrect
- Being very quiet
- No real acknowledgment of being correct

- A reluctance to take action
- Waiting for someone else to take action
- A reluctance to touch the equipment
- Blaming the technology
- Some eloquence in the use of computer-related language, but this was undermined by all of the above

In contrast highly confident students were not immune from computing errors. A further unique feature of this study is being able to show high confidence and different levels of competence as a combination of:

- Reading the task activity aloud in a clear and audible voice
- Neutral expression
- Acknowledgment of being incorrect and then thinking aloud about resolving the problem
- No dialogue about feelings
- Spontaneous contact with the keyboard
- Making suggestions
- Supporting others
- Using time for thinking and problem solving
- Eloquent when talking about the computing element of the task
- Eloquent when talking about the specific features of the RLO
- Confident in the use of the equipment

These findings appear to suggest that student nurses draw on and use a combination of social, collaborative and emotional dimensions when working through a computer activity. The cited studies from the previous chapters represent research that has identified the value of social engagement (Salanova et al, 2013; Punamäki et al, 2009) collaboration (Skues and Cunningham, 2012) and emotional status (Feng et al, 2013). The following section explores the flexible and interactive features that students displayed, under the heading of each dimension. These are the sudden and incremental changes in confidence that affect competence and vice versa.

5.5.1 Social dimension

The social dimension acknowledges the individual characteristics that each participant displayed. Some individuals identified with strong IT skills, some students appeared to take a facilitative role and some offered instruction, whilst others gave unconditional pastoral support. These behaviours were similar to those reported on by Dangwal et al. (2006). The student nurse who operated the keyboard was not always the IT expert. Their skill and knowledge appeared to reflect general pragmatic qualities as pioneers, willing to try irrespective of the consequences. These behaviours suggest a blend of Bandura's (1986) and Berman's (2006) models of self confidence. This is a sequence of thoughts and actions brought about through group interaction. The student commences the activity with the belief that they will be able to organize, manage and carry out the computing task with encouragement from the others in the group (Bandura's (1986) model). This followed by physical contact with the computer showing the courage to take action (Berman's (2006) model).

Significantly, the characteristics presented at the beginning and during the task were offered and accepted without challenge. Assuming the role of their choice, students appeared to engage in an informal trade-off. They appeared to recognize the benefits of utilizing and sharing each other's expertise as a safe way to work. These roles enabled task progression. Unsurprisingly this approach to working and learning was familiar to the groups, because of how teaching and learning activities are organized in the University.

The intersection between under or over-confidence having an effect on competence, appeared to be the point at which one or more of the individual characteristics of supporter, pioneer, instructor, pioneer or facilitator either increased or decreased. When students appeared to step out of their adopted role, the activity within the task either slowed or stopped completely and anxiety ensued. These under-confident behaviours echoed previous findings (Gresty and Cotton, 2003; Ballatine et al., 2007). In contrast, confident behaviour was seen as strong decision making skills. The effect was a switch from anxiety to relief. This concurs with other studies showing the ability of the user will influence how equipment is used (Agosto and Abbas, 2011; Dede, 2011; Jung, 2013).

These points suggest a number of things. First there is a need for an interactive mix of knowledge and skills. Second the willingness of individuals to support and be supported, suggests that successful IT activity in small groups is dependent on social processes. Third these observations were indicative of a point of contact between the social dimension and the second component in the PCA. These were that computing competence emerges through watching, experimenting, listening and talking in small learning groups.

5.5.2 Collaborative dimension

The collaborative dimension was the combination of being together and mutual engagement as both are necessary for collaboration. The features of collaboration were sharing content knowledge, demonstrating skill and suggesting solutions. Being able to work as an individual and as a group member appeared in the first and second themes in study one. The students had indicated that they felt confident enough to work alone, but also liked learning through listening, watching and talking. Other studies report on being individual whilst interacting with others (Ammenwerth et al., 2004; Kuosmanen et al., 2010; Feng et al, 2013).

Where under-confidence had an effect on competence, this could have been influenced by thoughts and comments on other areas such as nursing. The number of discarded protocols bears testimony to this and the difficulty at times in getting students to focus on computing competence and confidence. During the recordings I felt that computing competence and confidence appeared to be competing with other domains. None of the studies reviewed indicated if their subjects tried to bypass or avoid the computing task by referring to a dissimilar subject, but this could be possible. A potential parallel is in the findings of Eva et al. (2012), whose subjects adopted a false confidence to hide their true feelings about the computing activity. In sum the students in my study were feeling under pressure and tried to mask their real feelings.

It was possible that for some groups under-confidence only surfaced when these other thoughts evaporated. This implies that informal subconscious working, not giving too much thought to being right or wrong when collaborating with others, might be a positive influence on confidence. This was certainly evident in the first study in the loading on the first component, 'Confidence is not an issue. I just get on with the task' (See Table 8, page 251), but opposed in the negative loading for ‘Sometimes I can complete certain computing activities without having to think about them’ on the fifth component (See Table 12, page 259).

It also suggests that any thought processes interfered with task performance and is supported by previous findings (Cotton and Gresty, 2006). The points where concurrent think-alouds appeared to be related to collaborative suggestion and experimentation showed neutral facial expressions for the majority of students. At these points the students appeared to use a curiosity-driven approach, working informally at their own pace. Although the RLO task was predetermined, the learning style was exploratory and communal.

Setting a familiar task with the objective of generating confidence and competence commentary produced mixed results in the heterogeneous groups. Across all groups seniority and previous experience did not naturally equate to better computing competence and confidence. In the warm-up I stated that accuracy and good performance were not important. In spite of this reassurance, actual and potential error had a negative effect with some subjects showing under-confidence from the outset. The students were clearly not comfortable with this environment, confirming previous findings (Kenny, 2002; Ragneskog and Gerdner, 2006; Feng et al,2013).

In contrast for the Homogeneous (Strongly Agree) group, problem solving and correcting errors did not have any significant effect on their confidence or competence. Their behaviours appeared to resemble that of experienced nurses working in a critical or emergency health care situation demonstrating reflection, decision making skills, effective action and unremarkable neutral expressions. These responses reflect strong computing competence and confidence, transferable between academic and clinical contexts (Bandura, 1986; Slatter 1990; van den Brink et al 2005; Winterton et al, 2006; NMC, 2007; MacKenzie and Ashtiani 2011; Lai et al, 2013).

Interestingly in the Heterogeneous groups, the behaviours displayed by the students seemed to reflect latent phenomena of positive or negative reactions to computers. These were those entities that were hidden, but surfaced when required. They did not seem to think too much about the activity whilst they were collaborating. It was only when they were right or wrong that a reaction occurred. This follows the form described by Butterfield and Metcalfe (2006). They describe the positive and negative reactions that individuals display when they think they are going to be correct or incorrect.

The homogeneous pairings followed the expected form. For this group plus the Group 4 students, the ICT activity was unremarkable. In contrast the collaboration between the Strongly Disagree group and student PP in Group 6 (See page 236) reflected some anticipation of failure.

5.5.3 Emotional dimension

Emotional dimensions were the presence of behaviours related to confidence, with expertise and cognition taking a secondary role. This dimension emerged because the observations clearly reflected both positive and negative emotions. The opening chapter identified the importance of students having positive experiences as computer users (Kuosmanen et al,2010; Todhunter, Hallawell and Pittaway, 2012, Feng et al, 2013). Emotional support and the manner of the engagement, for example purposeful kindness and encouragement appeared to have a positive influence. This was evident in the verbal protocols for Group 5 (See page 232) and shows how the group were at ease and openly supported one another. The activity appeared to be secondary to the group dynamics. For this group the priority seemed to be the mutual emotional support. This important finding suggests that some small groups of students working on an unfamiliar ICT activity will do better if there is reciprocal emotional support as recommended in policy directives (DH 2012).

The importance of this recommendation cannot be overstated. Anxiety generated from task error appeared to ricochet between some students, suggesting that they did not appear to be offering each other emotional support. The facial expressions of these individuals suggested a dip in confidence just before and just after the point the mistake occurred. This can be seen in the visual analysis for Group 1 (See pages 2271-272) where they made a small error in phase three. This mistake was quickly resolved, but there was no real evidence of emotional support and the event clearly had an impact on their confidence. They seemed to work as two individuals.

It was possible that some students were pre-occupied with making a mistake, even before it happened and this had an impact on the other members of the group. This can be seen in group 3 where FF was anxious at the outset (See pages 226-227). The visual analysis for students GG and HH shows how they too become anxious. This negative response shows that sometimes peer group activity might not always be conducive for ICT learning and concurs with favouring isolated working practices (Shah, 2013). This finding justifies the reasoning for the provision of blended learning approaches (Bond, 2009; Holley and Oliver, 2010). Equal attention should be given to the behavioural, communication, cognitive and technical elements. All have been shown to be an important component of ICT in patient care (Pirnejad et al., 2008; Collins et al., 2011, Johnson et al, 2013).

The verbal comments of some subjects appeared to reflect under-confidence by proxy. This was showing anxiety when others in their group made a mistake. This can be seen in the verbal protocols for Group 6 (See page 235) where QQ leans forward to PP and states “You’ve missed one.” The students appeared to be looking for signals and cues from each other as well as considering their own abilities. They were also looking for some cues from the task itself, the absence of which in Group 6 (See page 236) created the ensuing tension and some conflict with the comment from PP “Well we’ve got em all wrong anyway.” This seems to suggest that we are resigned to failure and resort to self preservation. These findings concur with previous observations (Ward et al., 2009; Schedlitzki et al., 2011).

5.6 Synthesis of the combined findings

The purpose of the first two research questions was to find out if there was a correlation between competence and confidence and if under-confidence and over confidence influenced competence. The main findings clearly showed that confidence had a prominent position in the largest component and this was also directly observed in the second study. This section answers the third research question:

Can an optimum level of computing competence and confidence be defined that students on a nursing course should be expected to have?

This section opens with the observable, unobservable and latent phenomena emerging from the findings. These inform the circumstances that trigger computing competence and confidence. The characteristics of the student nurse who works using an optimum level of competence and confidence reflect professional ICT requirements (NMC, 2007). This is followed by a self-assessment tool that students could use to determine their competence and confidence. Specific guidelines for working with students of different abilities reflect the importance of a bespoke approach to support them individually. Discussion on the implications for practice reflects the essential nature of ICT knowledge and skills. A number of recommendations for theory and practice delivery are made. Dissemination of the findings and further research ideas precede the conclusion

5.7 Examination of observable, unobservable and latent phenomena

The following section will analyze the discrete and transitive appearance of individual observable, latent and unobservable phenomena, apparent in student nurses as computer users. Observable phenomena were those entities that could be directly seen such as facial expressions. Unobservable phenomena were those elements that were not and never can be visible to the naked eye such as thought processes. Latent phenomena are things that are initially hidden, but can be externalized, such as realization of being correct. In this discussion I am showing how these characteristics manifest and what happens when they do.

5.7.1 Observable phenomena

This section sets out the types of tasks and circumstances that reflect the observable phenomena in the two studies. The first point relates to how the groups dealt with the task. My findings have shown that competent and confident students will break down a computing task into small chunks. The protocols for the Homogeneous (Strongly Agree) group and groups two, four and five contain evidence of this. For example, in group two as:

CC “We'll be looking for hazards in the Home."

DD “Try hints again.” Moves the cursor quickly to the relevant area on the screen.

DD “Yeah try that one. So we’re doing one across then.”

And in group four as:

JJ “We need to go to Living Room 2. That was quite easy to find.”

II “So now we need to go to the Community Crossword.”

And in group five as:

LL “Scroll down and then Home Visiting.”

These findings suggest that confident students recognize the value of using a measured and methodical approach towards ICT activity.

The next observable phenomena relates to control of emotions. Here I am showing that control of emotions can be a positive influence on performance and completion of the task. This is confirmed by in the frequencies for the question 'My level of confidence is not an issue. I just get on with the task.' (See Figure 50, page 234). Some groups and individuals who were confident appeared to recognize this. When exposed to uncertainty they were composed, methodical and made undemonstrative suggestions about the task.

My findings have also shown that confident computer users do not dwell on their mistakes. This was evident in study two where confident students irrespective of whether they were right or wrong voiced their knowledge and demonstrated their skills. This was without any prompts, similar to the subjects in Dangwal et al.'s (2006) study. These participants were very vocal and revised their approach through direct consultation with each other. This can be seen in the protocols for the Homogeneous (Strongly Agree) group and groups two, four and five When assessed against the Latin definition *competere* (Savolainen, 2002), competence translates as groups of students being capable of stating that they are experiencing computing problems, but feel confident about rising to the challenge, irrespective of the outcome. Here I am showing the benefits of groups containing individuals who make mistakes, but do not dwell on them. I am also making the point that these students are potential champions for those who are not as competent and confident.

Computer users who approach their ICT studies in this vein make mistakes, but deal with them. This was observed where the groups vocalized reasoning and problem solving skills, getting things right and wrong. These groups experienced success and setbacks, but regarded them as unremarkable and just a small component of the larger activity.

The next observable phenomenon was that in all of the groups except the Homogeneous (Strongly Disagree) group, individual stronger students took the lead, but these were necessarily the ones with the strongest ICT skills. This was seen in Student EE (group two). Her neutral visual analysis output and examples from her protocols for competence and confidence "Just put in SNMP", "It's trying to test you," "Ooh you're right" and "Clever" reflects some computing prowess, but more leadership. This was someone who is able to reassure her peers using encouragement and praise. Here I am showing how leadership skills are important in this context. This was also observed in a protocol for HH (group three) who stated "You're working with comrades now." Further confirmation of this can be seen in the frequency distribution data for the question 'I am confident when helping other students with their computing problems' (See Figure 56, page 238).

The following observable phenomena relates to human group interaction. Group five (LL,MM,NN) were observed as displaying a blend of anxiety, being relieved and being pleased. Their protocols include comments that reflect mutual support which clearly helped to alleviate their anxieties. As a result the group appeared to have a good experience. My work is showing that when attention is paid to the human interaction aspects of ICT, students are more likely to have positive experiences. The interpretation of confidence as "mental constructions of experience" is applicable (Levine and Donitsa-Schmidt, 1998, p.128) because through support and repeated positive experiences, any memories of anxiety will fade.

In the next point I show how problem solving increases knowledge, and understanding of the ICT interface. This was evident in some of the extracted protocols.

DD "Is that spelt right."

CC "Well it'll tell you if it's not."

CC "I'd take a guess that it is in Activity."

DD "Well we've had more experience with computers."

EE "When you think of your first response, you do not come away from that, I'm right means I'm right."

DD "Assume and take a guess. I think this is right."

KK “Shall we try it?”

II “Is there no way we could check it?”

Working on Crossword they all laugh when they get the answer wrong.

KK “Well that wasn’t right.”

In contrast the students in the Homogeneous (Strongly Disagree) group did want to make mistakes, even though being correct was not a requirement for the activity.

BB "I'll go back to Introduction

AA "I wouldn't do that.

Here I have shown that students will make progress if they know and recognize the skills of reasoning and problem solving. This concurs with other research showing how recognition and use of problem solving skills helps to close the gap between being a basic and an expert user (Kennedy et al, 2010; Jia et al, 2013). This is not a new phenomenon. Cotton and Gresty (2006) identified students who did not seem to know how to use problem solving skills, preferring didactic instruction. The paradox here is Dangwal et al.’s (2006) young subjects’ lack of experience did not deter them from experimenting and problem solving with the computer interface.

5.7.2 Unobservable phenomena

This section sets out examples of the circumstances for unobservable phenomena. These entities remain invisible, but it is possible to make a deduction about them through other means.

The first unobservable phenomenon is about displaying inner fear. The Homogeneous (Strongly Disagree) group and students in group three (FF and HH) voiced some criticisms of the activity.

AA (Looking for the Community crossword puzzle.

"I don't know where that is. I can't see any way of finding out where it is"

BB "I thought there'd be questions."

FF "Well personally I don't know if it's just me but I don't like reading off a screen. I find it..... I have to print things off."

HH "It like blurs... plays with your vision doesn't it?"

Their visual analyses during these comments show anxious facial expressions. However, the commentary at this point did not reflect anxiety, but a protective layer of criticism to mask fear. Here I am showing that individuals may present as confident, when in fact the opposite may be the case. The histogram for 'I dread the thought of having to learn any new computing activity', offers a contrast to these findings (See Figure 43, page 229). Eva et al (2012) showed how some students may mask their inner fear by behaviour and critical observations.

The next unobservable entity was the periods of silence during the task. The highly confident (Homogeneous Strongly Agree) students did not have a problem with silence. Examination of their combined protocols, visual analyses and timings shows periods without speech, staring at the screen. These silences could have been even longer without my interjection of "What are you thinking?" They did not need to say and do much to complete the task. The silence could have been a pause for thought prior to speech and action as part of the problem solving process. This is borne out in theme two drawing on the second component loadings for the non-verbal silent behaviours of watching and listening. These were shown to be invaluable for the development of computer skills. My findings reflect two things. Confident students feel comfortable with silence. Second, silence was an indicator of thinking because it was punctuated with theoretically precise commentary.

Time is an unobservable phenomenon has been shown to be important for thinking and working. *The Power of Information – putting all of us in control of the health and social care information we need* (DH, 2012), recommends that individuals be encouraged to choose their own ways to think about and work through ICT. The nature of the RLO task and its conditions was designed to help the students decide what should happen next, at their own pace. In sum I am showing that confidence is more likely to emerge if circumstances are calm, steady and supportive and silence is accepted as a normal occurrence during group study.

A further unobservable entity relates to the responses of the highly confident year 1 students in Group 2 who figured out a way through the task without understanding the content.

CC "When you think about it, it's quite straightforward."

CC "I feel quite confident now."

EE "I'm glad I'm doing it."

This is evidence of the group learning about ICT and developing their digital literacy skills through experimenting and is also confirmed in the frequency data for the question 'I have learnt some computing skills by experimenting.' Given their status, the year one learners would not have had prior exposure to some of the content of the RLO. Like Dangwal et al.'s (2006) subjects, the primary focus was to adapt the task to fit their level of understanding. Using the RLO instructions they dissected the task into small actions and worked together. Here I am showing that as long as the task relates to their surroundings, this preliminary work can be used to underpin more advanced digital literacy.

The next unobservable phenomenon is about task classification. CC's comment "When you think about it, it's quite straightforward" shows a classification approach towards the task. This shows how they sorted through the information they felt comfortable with and prioritised the task elements from simple to difficult. Confirmation of this was the absence of nursing nomenclature when dealing with some aspects of the task. This group did not always recognize the terms they were presented with but nevertheless managed to work through the activity. Professional nomenclature in health care has to be learned so rather than pondering over what they did not know, confident juniors tended to designate the time to work on parts of the task that seemed achievable, but not necessarily familiar to them. I am showing that if introduced too late some student nurses may not be able to cope with the combination of learning about and learning using ICT.

5.7.3 Latent phenomena

This section sets out examples of the types of tasks and circumstances that reflect the emergence of latent phenomena. Study two findings have shown that irrespective of year of study student nurses will display multiple role personas. These qualities seemed to be crucial for the success of the activity. The students demonstrated roles related to informatics expert, manager, counsellor, supporter and facilitator. This was especially evident in group five. Their protocols reflect an interaction between the above roles.

LL"I'm finding it daunting. I can't do this at all.""

NN"I think we're working quite well as a team

LL "I would lean more on you guys cos I don't have clue."

LL to NN when she has solved a Crossword clue. “This is your forte.”

Here I am showing the combined qualities of communication, being calm and calming, leading, problem solving, experimenting, and being knowledgeable, demonstrating, reasoning and deduction. All of these underpin the roles of informatics expert, manager, counsellor, supporter and facilitator and are requirements for registration and patient-related ICT.

The next latent phenomena relates to group dynamics and anxious students. The anxious students appeared to display the same reaction irrespective of their progress during the task, with little or no evidence of engaging in the above roles. This was particularly evident in group six whose protocols reflected poor collaboration and limited social and emotional interaction. Here I am showing that when some anxious students are asked to work together in a group formation they will function as individuals. I am also showing that they do not recognize the benefits of interaction or the pooling of strengths. This finding is a direct contrast to the histograms on learning computing skills by watching, listening and talking to others.

The following point is about recognising the need to change approach. Here I am suggesting that the confident students were open to new approaches, willing to experiment and not concrete thinkers. I am showing that these students represent learners who will 'get on with it' only asking for support and supervision as required. In sum confident students are not fazed if they do not entirely recognize what they need to know and do in order to proceed. This was evident in those who made a deduction about their progress, e.g. the protocol from DD, a new first year student in group two, just three months into her studies "Try Hints again....." The latent element is recognizing, making the decision followed by action.

This section has set out some observable, unobservable and latent phenomena that underpin computing competence and confidence. Having examined them individually, I will now show the circumstances that trigger their emergence.

5.8 The circumstances that trigger computing competence and confidence

5.8.1 Confident behaviour and the value of peer support

In the think-aloud task the Homogeneous (Strongly Disagree) and Heterogeneous groups three and six did not display confident behaviour. This was a key finding in Sheikh et al. (2011) reporting on the fear displayed by health care practitioners faced with an ICT activity. Where under-confidence emerged, this seemed to be irrespective of those student nurses' levels of ability and prior experiences. These demonstrations of under-confidence were reflective of Bandura's (1986) global interpretation of confidence. The less confident students behaved according to their *negative beliefs about, rather than their actual level of capability*. Both studies are showing that less confident student nurses appeared to rely on their more confident peers, whether correct or incorrect. My findings have shown that peer support is a great influence on how students participate and learn. Less confident students seem to rely on peer support. In contrast, the Homogeneous (Strongly Agree) and Heterogeneous groups enjoyed the peer interaction. This was seen in groups two and four who displayed confident behaviours in their handling of the computing task. The 'support' characteristic was not one of reliance but as an equal relationship in learning.

5.8.2 Dwelling on emotions

Less confident students appear to use a lot of energy and time considering their emotional status with insidious effects on their academic output and sometimes that of others, even with a successful outcome. The most telling indicator was the comment in Group 6 in the second study "Well we've got em all wrong anyway" when this was clearly not the case. Whilst Eva et al. (2012) show how students will resort to hiding their true feelings Butterfield and Metcalfe (2006) discuss the benefits of highlighting errors and under-confidence. This is in order to be able to make progress. However the under-confident student nurses did not seem to know how to handle or fix their under-confidence. Feng et al (2013) say that groups who display these kinds of emotional characteristics can benefit from blended learning approaches. They cite the examples of direct support, breaking ICT tasks into smaller components and timely feedback and feed-forward. Confident students did not dwell on their emotions.

5.8.3 The difference between being relieved and being pleased because of being correct

Strongly confident students displayed either pleasure or no response when correct. In contrast for the Homogeneous (Strongly Disagree) group being correct was endorsed by relief. This is indicative of an emotional void between pleased and relieved. In order for the relieved group to be pleased this gap needs to be filled, otherwise they will not use ICT products with confidence. This about item specific confidence and what is believed to be correct and how confident an individual is about that belief. For this group learning related to ICT, computers and computing is not a positive experience and their behaviours are indicative of a repeating pattern of reactions. I have shown how students who have low level of confidence are always uncertain when handling computers and take no pleasure in being correct. The use of gaming activities to help students who lack confidence with ICT, shows positive outcomes (Li, Cheng and Liu 2012). A number of early years' studies identify the importance of computing tasks being pleasurable (Higgins, 2005; Siraj-Blatchford and Morgan, 2009; Learner, 2013).

5.8.4 The use of language related to problem solving skills

The Homogeneous (Strongly Disagree) group did not state when they were using problem solving skills successfully. The time line shows where good progress was made. However any success was attributed to luck rather than cognition and deduction. These behaviours and language reflect stage one of the Dreyfus and Dreyfus (1986) model (See Figure 1, page 51). Here novices rely on what they can see and already know but do not exercise any judgement to test the unknown (Dreyfus and Dreyfus, 1986). These students did not seem to recognize the value of talking, watching and listening to each other. This is in direct contrast to the histograms in study one showing how students learn from these arrangements (See Figures 22-25, pages 215-217). These findings strongly suggest that students should be given a range of opportunities to ICT language. Johnson et al (2013) discuss the importance of being able to use ICT language in the health care workplace.

5.8.5 The use of transferable skills and experiences

Student nurses will engage with non-academic ICT products such as mobile technologies and social networks (Moule et al., 2011; ONS, 2011c; Manca and Ranierit 2013), but may not recognize the transferability of these experiences. This was apparent in the Histogram 'Even before my studies I felt confident about using a computer' (See Figure 55 page 237), and the protocols for the Homogeneous (Strongly Agree) group and groups two, four and five in the second study. However the protocols for the Homogeneous (Strongly Disagree) group and groups three and six showed that these students did not draw on their previous computing experiences and knowledge.

5.8.6 Reactions to making mistakes

For some, making mistakes using a computer is unremarkable. The earlier discussion identifies problem solving and learning using experimentation, consultation with texts and the support of others and have been investigated elsewhere (Bennet and Maton, 2010; Cant and Cooper, 2010; Windle, et al., 2011; Giannakos and Vlamos, 2012; Feng, et al., 2013). Theme one showed that errors were regarded as routine and students used the cited resources. This was also confirmed in the protocols for groups two and four. Students were not afraid to make a mistake and correct it.

5.8.7 Assumptions about year group and computing competence and confidence

Expectations that the Homogeneous (Strongly Disagree) group year three students would be more competent and confident than their junior peers was clearly refuted and confirmed in both studies. This important finding gives information about student nurses having mixed abilities irrespective of their progression point. By the first quarter of 2012, 8.12 million (16.1%) adults in the UK had never used the internet (ONS, 2012) and is one explanation for the mixed abilities. The pervasive nature of ICT in contemporary formative education may reflect the abilities of the junior students and the kinds of learning experiences and technologies they have encountered (Twining et al., 2013).

5.8.8 The right mix within student groups

This relates to the group organization in the second study. The Homogeneous (Strongly Disagree) group of students did not give mutual support and displayed limited evidence of suggestion and experimentation. The previous section identified that to create groups of individuals with similar poor levels of confidence, is not conducive for learning. Theme four reflects the negative comments related to taught provision and concurs with previous similar findings about nurse education (Willmer, 2005; Bond, 2009). This also suggests there is value in finding out about preferred personal environments for learning (Manca and Ranierit, 2013) and being able to provide bespoke learning arrangements (Kennedy et al, 2010).

5.8.9 Using knowledge and skills from previous ICT study

It has been shown that ICT study during formative years and beyond does not automatically equate to being competent and confident (Royal Society, 2012). Specific knowledge and skill application from previous study were not evident in the think-aloud activity. Six of the cohort identified previous study at GCSE level, vocational computing courses and learning for ICT qualifications for ECDL, NVQ 2 using Information Technology and City and Guilds Application Programming (See 4.7 The characteristics of the participants). No one in any of the groups referred to their previous ICT and computing experiences whilst working through the activity. This observation concurs with previous studies (Hsu and Wang, 2010; Twining et al., 2013).

5.9 How would we recognize a student nurse who works using an optimum level of computing competence and confidence?

Having set out the conditions, the optimum level of competence and confidence aligns with the NMC's being able to "Interpret and utilise data and technology, taking account of legal, ethical and safety considerations in the delivery and enhancement of care." (NMC, 2007, p.8). This section answers the sub-question of 'How would we know when we had this?' We would know that we have this in the student nurse who:

- Asks when uncertain about a computing activity
- Does not appear fazed when wrong and accepts that mistakes are part of the development process
- Does dwell on mistakes and does not feel overwhelmed or undermined when mistakes are pointed out by others
- Is brave enough to state when they have made an error
- Is prepared to experiment irrespective of the learning conditions and environment
- Refers to online and paper ICT help manuals to assist with a query
- Refers to previous ICT study to inform approach towards current activity

- Can work alone and in small groups
- Shows evidence of helping others irrespective of year of study
- Is able to break down a computing task into small components
- Revisits and use previous experiences to inform their approach to an unfamiliar activity
- Uses a computer to organize and manage their studies for activities such as online literature searches and assignment preparation
- Is able to work with patient-related ICT under supervision
- Exudes a level of unremarkable self-assurance that empowers others to learn and progress

5.10 Would it be possible to develop a self-assessment tool to allow students to gauge whether they were likely to be over or under confident or competent?

The previous section set out an optimum level of confidence and competence. The evidence suggests that student nurses who have these attributes are more likely to have positive experiences when learning about and learning using ICT. All of the above are a combination of observable, latent and unobservable phenomena. Therein lays the problem facing student nurses experiencing difficulties. I have shown that some do not understand or recognize different levels of competence and confidence. Significantly they do not know how to deal with them, irrespective of their previous experiences and abilities. Having shown the optimum level it is necessary to consider some form of self-assessment tool to gauge competence and confidence. Its purpose would be to identify strengths and those areas for development.

A number of factors need to be carefully considered when developing a self assessment tool about competence and confidence. It should be developed with strong reference points to their learning needs and then to the ICT environment. The language within this instrument should be sensitive to circumstances. The uses of adjectives such as beginner or basic, intermediate, advanced and expert have been the subject of much debate and are not always helpful (Sen, 1985; Dreyfus and Dreyfus, 1986; Nussbaum, 2006; Mulder, 2007). Such judgements can be disconcerting. They can be interpreted as personal qualities rather than learning stages.

Also student nurses may have knowledge and skills in some ICT areas and limitations in others. Therefore the self-assessment tool should be applied to specific computer-related learning activities at that time and not their overall computing competence and confidence. It should be simple in its structure. Even with a self-assessment tool students may under and / or over-estimate so a statement asking for honest reflection should be included. Having developed the tool, it would then be the responsibility of the University to provide appropriate resources for its review and maintenance. The infrastructure of promised resources should be available in a timely manner for those students who self-assess as requiring support.

Opportunities to discuss the outcome of the self-assessment should be built into the structure, irrespective of level of competence and confidence. This should include information on University teaching sessions and practice. It would be useful as a monitoring resource to detect any recurring patterns of reactions and behaviours. Feedback and feed-forward would provide education and practice with evidence of progress and those areas that require attention. Students should be advised to keep a log of their self-assessments as this is a good indicator of progress over a period of time. This kind of self-assessment tool is not a solution for low or unrealistic competence and confidence. It should be used as a mapping activity for students to estimate their competence and confidence and for the University to identify the appropriate means of support. The self-assessment tool, its use and effect should be reviewed on a regular basis. Figure 68 (See page 356) is my example of a self-assessment tool that students could refer to.

Figure 68 Self-Assessment Tool For Competence and Confidence

The purpose of this self-assessment tool is to help you to gauge your strengths and limitations with this activity. It is important that you give an accurate reflection as there are a number of resources available to support you both now and at other stages of your learning.

1. Have you worked through this type of activity before? **Yes/No**
2. If you have answered **Yes** then how do you feel about working through it as a student nurse? **Confident / Not Confident**
3. If you have answered **No** then how do you feel about working through it as a student nurse? **Confident / Not Confident**
4. If you have answered **Yes**, then which of the following reflects your personal assessment of your computing skills? **Competent/ Not Competent**
5. If you have answered **No** then which of the following reflects your personal assessment of your computing skills **Competent/ Not Competent**

If you have answered mainly **Competent** and **Confident**, then go ahead and work through the activity. However if you have any queries, online help is available at... Direct help is available at....

If you have answered mainly **Not Competent** and **Not Confident** online help is available at... Direct help is available at...."

5.11 Would it be possible to develop guidelines for working with students who fall into the different categories outlined?

It is apparent that students will present with different skill levels and experiences. Guidelines help facilitators to provide appropriate support. In particular, those who facilitate and / or teach ICT activities need to be aware that under-confident and under-competent students need very clear guidance.

5.11.1 Guidelines for working with under-confident and under-competent students

1. The approach towards this group should be motivational and supportive.
2. There needs to be a balance between getting the student to recognize, but not become absorbed by their situation.
3. Computing activities need to reflect the level of ability and not the academic year. These activities could be presented as different levels of difficulty using stages as a grading format (e.g. stage 1, stage 2 and stage 3). This group should be encouraged to commence with the undemanding activity. The emphasis would be on the learning and skills used.

4. The findings from the think-aloud activity highlighted the value of contact that was immediate, face-to-face, simple in its structure and sensitive to emotional status. Therefore feedback and feed-forward should reflect the positive elements of work followed by solutions to address those areas that require attention.
5. Direct contact for feedback and feed-forward in the first instance could be with identified champions as peer mentors.
6. Discussion points should reflect an honest and genuine appraisal of performance.
7. Opportunities for online help should be considered when the student feels ready to work in this environment.
8. Small task and finish computing activities would enable student nurses to see the outcome of their endeavours and hopefully give a sense of accomplishment. For example, asking students to work through a small Re-usable Learning Object.
9. A glossary of ICT language, terms and computer-related artefacts would be a useful resource for this and the more advanced group.

5.11.2 Guidelines for working with confident and competent students

1. The approach towards this group should be motivational and supportive and encourage experimentation and self-direction.
2. The choice of environment or location such as direct or online should be the student's preference.
3. Similar to the other group, computing activities could be presented as different levels of difficulty using a staged grading format as above. Competent and confident students should be encouraged to revisit rudimentary work in the event of difficulties.
4. The guidelines could include the assignment of advanced computer-based activities beyond the expected capabilities of a student nurse, on the proviso they are for experimental teaching and learning purposes only. The purpose being to explore and address disparities between the computing knowledge and skills of the established practitioner and those of the student nurse. The emphasis would be on problem solving and reflection skills and not the level of achievement
5. Guidelines for this group should include peer support work for less competent and confident students. This would be an opportunity for highly competent and confident student

nurses to develop their own prowess as ICT champions and future mentors.

5.12 Would it be possible to develop guidelines for online Help characteristics that would support learning?

Guidelines for online Help are important because students are required to undertake self-directed, classroom, clinical or distance learning using a computer in different locations. The characteristics for online Help should reflect student nurses as adult learners in a professional context, whilst recognizing their individual needs.

1. The demarcation between learning about ICT and learning using ICT should be set out for students in year one. The purpose would be to find out if there are challenges in either or both at the early stages of the Course.
2. All instructions should be set out in clear and easy-to-read statements using large font. Ambiguity and complex information should be avoided.
3. Online Help should be a phased sequence of activities as recommended in my second study and elsewhere (Giannakos and Vlamos, 2012).

4. Graphical and pictorial information with indicators such as arrows may be preferable to lengthy descriptions (See Todhunter, Hallawell and Pitaway, 2012).
5. It should be possible to return to and repeat work that is challenging without any problems for access and continuation. Entry and exit reference points with a 'Save work' feature will assist students to return to the activity.
6. Search and find information should be relevant and interactive. Feedback on progress and feed-forward with recommendations should be built into the design. This information should consist of positive acclamation of progress to support confidence.
7. The suggestion for the literary style for feedback and feed-forward is that it should be sensitive to the student and conversational rather than instructive. The histograms on watching, talking, listening and experimenting show that student nurses clearly value this kind of interaction.

My example of a conversational style is;

"Well done. You have achieved at.... Your next stage is... Read the guidelines and then attempt the activities within the task, one at a time." Alternatively, "You have attempted the activity, but sections ... and... are incorrect / incomplete. The suggested options are to read the information again and attempt just one activity, before proceeding to the next stage that is incomplete. However if you are finding this activity really difficult or overwhelming, you can obtain direct help from someone in the University by contacting.......”The design principles for online Help should include time and frequency, to give student nurses lots of opportunities to maximize their potential.

5.13 Could better guidelines be developed for practice environments?

The opening chapter identified the frameworks for ICT in higher education and health care giving useful direction for planning and operational activity (DH, 2011; Higher Education Funding Council for England (HEFCE), 2011). These can be interpreted to reflect bespoke arrangements. All guidelines should be developed by the with reference to local University and NMC requirements (NMC, 2001) for the preparation of mentors and teachers and in co-operation with practice. Content guidelines for practice learning could be mapped out against the following:

5.13.1 The NMC proficiency "Interpret and utilize data and technology, taking account of legal, ethical and safety considerations in the delivery and enhancement of care." (NMC, 2007, p.8).

In year 1 practice students could be introduced to the broad concept of ICT and the reasons for computer use health care. Using a question and answer approach, learners could be asked about their knowledge of governance underpinning EHCR activity. The practical element would then be to introduce the student to small and increasing components of the EHCR in the care setting. A computer-based assessment would give some indication of both competence and confidence. Years two and three guidelines should reflect activities that are incrementally more challenging. Examples of good practice are the joint use of ICT between nurses and patients (Fejtová, Figueiredo, Novák et al., 2009; MacKenzie and Ashtiani, 2011) and how EHCR data is communicated at a nursing handover (Johnson, Sanchez, Suominen et al, 2013). For assessment purposes Cotton and Gresty's simple, but effective question "Is it easy to use?" could be reconfigured as "Did you find it easy to use?" (Cotton and Gresty, 2006, p.50). The guidelines should explicitly set out this question at every stage of practice across the Course. Mentors could use this question to give students opportunities for discussion, followed by feedback and feed-forward on their progress.

5.13.2 A clear understanding of the influence of ICT on practice and the important role of the practitioner

The first task would be to establish would be exactly what kinds of ICT are used in the different clinical areas and the circumstances where student nurses would be expected to participate. The second task would be to see if there were any gaps between the computer-based learning resources in practice and those in the University and consider the kinds of resources, teaching and learning that might be required to address any deficits.

5.13.3 Information about accessibility to University resources that would support ICT and computer use in practice areas

This would be an information resource for students, staff and practitioners. A suggested approach is the provision of a small laminated card with useful details that students could carry with them. Alternatively, a spare blank page in clinical documentation could be used by students to add useful information about ICT resources. Also, to highlight any new and useful resources through e-mail system and practice learning links. For example, a cohort of learners could be sent details of resources linked to an area of practice.

5.13.4 Open ICT access to University resources for all practice partners

Practitioners currently have access to the School's online practice learning pages. I would recommend that this access be extended to include other parts of the programme. For example, access to modules that use computer aided learning packages.

5.13.5 Support and assistance for mentor learning

The Department of Health (2012) sets out its plans to educate the workforce as computer users. Therefore it would be useful to know about the local arrangements for professional ICT education for practitioners. Second, if this ICT educational provision accommodates Mentor responsibilities and their support of student nurses as computer users.

5.13.6 Practitioners' competences in the use of ICT and computer-related tools for teaching and learning

The opening section set out the key differences between student nurses and registered practitioners in terms of their differing levels of accountability and responsibility. It would be useful to know at what point is the practitioner deemed as competent to use the ICT for clinical activity and in the teaching of learners.

5.13.7 Access to computing and ICT resources and knowledge that reflect contemporary nursing practice

Joint education and practice workshops could be provided for practitioners as professional update for ICT. These communities of practice workshops could also be used to showcase the University's resources and shared with other providers.

5.13.8 Language and visual aids that reflect the level of teaching and learning

A glossary of terms that are used for computers, computing and ICT would provide practitioners and students with a working knowledge of this environment. For example, the glossary could include details and pictures of relevant objects. A brief explanation identifying their purpose and relevance would support understanding. This structure could then be used as a trigger to assess computing knowledge and skill.

5.13.9 Assessments that reflect the knowledge and skills of the student nurse as a computer user and not the registered practitioner

The differences between student nurses and registered practitioners as computer users were discussed in the opening section. An assessment should reflect the knowledge and skill status of the student nurse as a computer user. The practitioner assessing the student's knowledge and skill must be prepared to expect, recognize and work with the different levels of ability. I would support the idea that students who are competent and confident are can undertake more complex, computing tasks under supervision.

5.13.10 Opportunities to access a range of computer based activities that directly and indirectly support practice

The distinction between ICT, computing and computer-based activities is important as they reflect the different kinds of experiences that student nurses can have. To fulfil the proficiency requirements students should be actively encouraged to work with all of the above, for example electronic off duty and EHCR completion. Mentors could use these different activities to evaluate students' knowledge and abilities. Assessment of a single activity and its function would not give an indication of differing abilities and reactions.

5.14 What are the implications of these findings for practice?

The positive implications of these findings for practice are that most student nurses are graduating as competent and confident computer users, at the point of registration. The problem solving, experimental approach and dialogue observed in the Think-aloud activity appear to indicate that student nurses draw on a wide range of skills to develop their prowess. Given the appropriate kinds of learning experiences that have been sanctioned by practice (DH, 2012; DH, 2011), this development is likely to continue after registration. Importantly these outcomes are indicative of future high standards and safe care delivery.

However the findings have also raised some concerns. The opening chapter identified the time lag between ICT development and its implementation in health care. The distance between innovation and response is crucial. The shorter the time span, the more likely a positive outcome as practitioners will be prepared both to use and support future students with ICT. This is dependent on the good fit between ICT in practice and the teaching and learning in nurse education. The negative implications are that a number of students are graduating, but with mixed abilities as computer users, even at the point of registration. If student nurses do not have computing knowledge and skills to support the relevant NMC practice outcome, then this should be deferred. The student should be encouraged to develop an action plan for their ICT practice learning. However if the practitioner cannot make this informed judgement as an ICT user then this has implications for both patient care and the student learning experience. All registered nurses are required to support and facilitate learning for students. Highly competent and confident practitioners are role models. Students allocated to work with practitioners who have graduated as reluctant computer users may have limited opportunities as computer users and poor quality experiential learning.

5.15 What overall recommendations should be made?

Having defined an optimum level of competence and confidence for student nurses as computer users, the earlier findings support the following recommendations for nurse education.

- Review all didactic taught provision related to computing activity on a yearly basis to accommodate learning needs and technological changes. This recommendation links to the histogram on opinions on the taught environment showing that the students were largely appreciative of the taught ICT element.
- Provide extra tutors to assist in ICT teaching sessions.
- Attach the self-assessment tool to all computing activities.
- Create a link between self-assessment and the provision of classroom support such as extra tutors.
- Create curiosity-driven and incrementally challenging computing activities to support the individual development of computing competence and confidence.
- Provide clear and simple guidelines with pictorial stages for all teaching and learning activities.
- Provide informal drop-in sessions after an ICT teaching session.
- Make sure that informal drop-in sessions and follow-up work have protected time.
- Evaluate ICT teaching and learning activities using quality assured methods.
- Tutors to ask students what kinds of ICT products they are familiar with and would like to use for their studies. This information should be given to the commissioning leads.

- Tutors to use personal tutorial time to ask students about their progress with using computer-related products and what support they would benefit from. Direct students to relevant resources.
- In the classroom identify to students the gains to be had from informal and loose arrangements, both ad hoc and organised by the learners themselves where individuals can contribute as they feel appropriate.
- Ask students to identify their preferred ways of working, such as watching, listening, talking through an issue, experimenting, and working in groups or alone.
- Encourage students to use ICT language to develop familiarity and understanding.
- Provide a glossary of terms and language.
- Create time and encourage students to 'sit back and think about it' as witnessed in the Homogeneous (Strongly Agree) group in the second study. This may help those who feel obliged to show that working only occurs when ICT contact is made such as tapping the keys.
- Create curiosity-driven computing activities such as RLOs that assist in the development of the collaborative, social and emotional skills that underpin computing competence and confidence.

- Create champions from individuals who are prepared to develop their own skills whilst helping others.
- Create champions from the less-confident students who might develop from giving one-to-one support to another learner
- Encourage students to talk about and share their computing strengths, skills and limitations when working together. This was reflected in the histograms for opinions for 'learning by talking, watching and listening. Student nurses appear to value and benefits from this interaction.
- Identify the value of an experimental approach. The skew towards 'Strongly Agree' in the graph 'learning computing skills through experimenting' shows that students are in favour of this arrangement.
- Encourage students to be brave and take risks when undertaking a computing activity to develop their problem solving skills.
- Actively encourage small, medium and really big mistakes in a safe non-patient environment. Explain to the students the positive aspects of learning from making mistakes. Celebrate errors as part of the development process of learning and as a means to manage apprehension and uncertainty.
- Celebrate errors as part of the development process of learning and manage apprehension and uncertainty.

- Seek to mix up different levels of ability when organising group work. The second study shows that a group of less confident students do not work well together.
- Consider providing each student nurse with a mobile technology device such as a smartphone, for study purposes. The provision and use of mobile technologies for learning has been shown to enhance computer skills and knowledge, assist academic activity and workplace preparation (Fuller and Joynes, 2014).
- Find out what kinds of ICT products are used in clinical practice as this may vary between areas. For example, the different software for EHCRs is influenced by commissioning decisions for choice of provider.
- Create collaborative links between nurse education and practice at strategic and operational levels to review the fit between ICT in the classroom and the clinical area
- Encourage student nurses to maintain a portfolio of their specific ICT and computer-related activities. In addition to supporting the NMC proficiency achievement this will also show the development of computing competence and confidence.

5.16 Dissemination of these findings

I plan to publish this research in peer reviewed national and international journals. I would also like to disseminate the findings through conference activity. I have already presented a paper on the methodological aspects of the study at the RCN International Research Conference (2012). I am part of a team working on global virtual mobility activities with other Universities in Europe and beyond. I have volunteered to take the operational lead for future virtual mobility projects

5.17 Links to future research

My research outcomes have generated a number of ideas for future study activities.

How do student nurses demonstrate an optimum level of computing competence and confidence?

Having set out an optimum level of computing competence and confidence, I would like to repeat the second think-aloud activity with student nurses studying towards the graduate exit programme. I would like to find out if there are any differences between a more recent and my original cohort. In addition, repeating this study with colleagues and students at another University would provide opportunity for collaborative work. This would give insight into the experiences of student nurses at other Universities.

How do practitioners assess student nurses' abilities as computer users? /What kinds of portfolio evidence do student nurses submit towards NMC proficiency achievement?

In the first study I asked the following question about practice. **"I would feel confident about working through a computer-based proficiency without any help."** I would like to find out about the portfolio evidence that student nurses submitted as proof of learning and achievement towards the NMC proficiency for ICT. The purpose of this type of study is to find out what constitutes as evidence and if there are any variations in the assessment and evaluation process.

How effective are the guidelines for working with students who fall into the different categories as computer users?

Having created different categories of guidelines to support each learner group, an evaluation of their effectiveness would give useful feedback and feed-forward to the School. This could be the number of times the guidelines were accessed and used, and students' opinions on the related support systems.

5.18 Conclusion

An interest in virtual environments to support practice learning sparked my initial thoughts about the importance of student nurses being competent and confident as computer users. A review of the literature showed some studies in this area. None had used this unique combination of variables or methods. The PCA confirmed the presence of a relationship between competence and confidence and detailed the nature of these phenomena in the first five components. The largest component reflected confidence as the dominant variable. The themes emerging from the five components showed student nurses saying they could work independently, they valued peer support and online and hard copy help, but found the taught provision unhelpful Some of these themes emerged again in the second study. Examination of the protocols showed that some small groups of students could work independently of taught provision, through peer interaction. Crucially the patterns in the visual analyses also suggested that confidence affected competence. This was seen where some students were not always confident as computer users, although they would have a go at working through an unfamiliar activity. Significantly the second study showed the value of interaction and learning through experimenting, watching, listening and talking. Together the components and the social, collaborative and dynamic dimensions seemed to indicate that student nurses had different levels of computing competence and confidence. The conditions for computing competence and confidence gave a clear indication about the recommendations for nurse education and practice. This section identified the value of collaborative links with clinical partners for student development.

This research design and structure could be applied to any artefact that requires human intervention for its operation. For this study concurrent think-aloud using The Observer XT gave unique outcomes not previously studied. This method showed that in undergraduate nurse education ICT there is a requirement for student nurses to develop triple parallels of careful and deliberate decision making, coping with the instant response from the touch of a keyboard, whilst working towards being a professional practitioner. The evidence showed that some student nurses find ICT a challenge. They do not seem to be able to handle the meeting or recognize the convergence of these parallels. Crucially the mixed methods approach clearly challenged assumptions that students will get it right because they have had previous formal study and experiences and are using other technologies such as mobile phones. This important observation confirmed the impressions in the opening chapter showing a fragile but crucial relationship between policy implementation, workforce and learner vulnerability. In nursing this relationship should reflect a safe and seamless transition from learner to registered practitioner. The gaps in this arrangement were that learners did not feel able to work competently and confidently with computers. These findings conveyed the requirement for appropriate social and educational models to support computing activity in health care practice.

In those students who demonstrated under-confidence in the second study, its appearance is suggestive of an all consuming insidious influence, pathological in nature. Given that the activity was selected from a repository of their usual e-learning activities, this was puzzling. Notwithstanding the recording of the proceedings, the environment was non-threatening and there was no summative requirement. The implications are that in real-time patient care if feeling under pressure, students in fear of ICT will display similar behaviours. This may be exacerbated where mentors under-confident. Background influences such as age, previous learning and experiences were significant in the findings. This supports the benefits of recognizing under-confidence and pre-empting its effects especially as when taken together the two studies offered glimpses of students' ways of knowing competence and confidence. The evidence in the second study implied that ways of knowing will influence ways of being. This suggests that in order to know competence and confidence it is important to know and understand their features at different levels and significantly recognize when the two domains appear to be competing for priority.

In addition to the distinctive methodology, a unique combination of viewpoints about competence and confidence emerged from the synthesis of the two sets of findings. These were: confident behaviour and the value of peer support, dwelling on emotions, the difference between being relieved and being pleased because of being correct, the use of language related to problem solving skills, the use of transferable skills and experiences, reactions to making mistakes, assumptions about year group, the right mix within student groups and using knowledge and skills from previous ICT study. All appear to influence the balance between being under and over competent and confident. Together these show that the social elements of learning are as important as the technical skills for ICT, computers and computing.

As a result of examining the evidence it is clear that the development of computing competence and confidence is unique in each student nurse. It is a given that growth and development will be uneven, supported or compounded by issues such as previous and current learning, qualifications and experiences. Irrespective of their previous learning and number of errors the confident students in the second study demonstrated a potential ability to influence the academic and professional development in others. They appeared to recognize the interface between ideas, communication, experimenting and action.

The studies have shown that some student nurses do not appear to develop their own knowledge frameworks but rely on interactions with others, in order to trigger computing skills for scholarship and practice. This may explain the behaviours of those students who were less confident but correct in their application during the task activity when working with their peers. A description of the behaviours related to the neutral characteristics, offered student nurses a signpost for the direction and management of their competence and confidence. Both studies have shown that some student nurses will develop their own ways of knowing. However others may require support to develop a structured way to think about competence and confidence. Although ICT has an established societal presence, both studies have shown that all student nurses have individual needs as computer users. This is irrespective of their experiences and circumstances. Importantly both studies have shown that computing experiences can be miserable or enjoyable, with consequences for academic and clinical outcomes, and professional practice.

Crucially the majority of student nurses are quite happy to chip away at computing challenges. However there is an equally intelligent smaller group who clearly have the ability, but do not approach ICT using an experimental approach and are therefore unable to cope with this environment. Whilst error is part of the human psyche for this minority, mistakes appear to have an insidious effect on their subsequent performance. With some caution it can be stated the combined results and findings from the two studies are applicable to the wider undergraduate population of nursing students.

The subject of computing competence and confidence is seemingly mundane and unremarkable compared to other more glamorous research topics. The reactions from some of my peers enquiring about the nature of my research area have been polite. However the rich detail emerging from the use of a mixed methods approach has shown that computing competence and confidence in student nurses cannot be disregarded and should be a major consideration in planning for teaching and learning. The compelling evidence from this work supports the need to raise the profile of this area of research.

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Appendix 1

Mrs Louise Sabir

Ethics Committee Secretary

Division Of Therapeutics and Molecular Medicine

D Floor, South Block

Queen's Medical Centre

Nottingham

NG7 2UH

2nd April 2008

Dear Mrs Sabir

Application for Approval by Ethics Committee

Please find enclosed documentation in respect of my potential doctoral studies. In accordance with the required protocol I have submitted thirteen copies of each document, plus supporting information for consideration by the Ethics Committee.

Ethics approval form
Information sheets – study one and study two
The research project proposal
Poster to be used for advertisement purposes
Letter and consent form to participants – study one
Proposed questionnaire – study one
Letter and consent form to participants – study two
Detailed description of activity for study two

If you require further information I can be contacted at the above address or by e-mail fern.todhunter@nottingham.ac.uk.

Yours Sincerely

Fern Todhunter

Lecturer

Doctoral Student

Appendix 2

Please quote ref no: SJ108
Direct line/email
0115 8230877
stacy.johnson@nottingham.ac.uk

Mrs Fern Todhunter

School of Nursing

Mansfield Centre

28th May 2008

Dear Fern

Re: SJ108 The relationship between and characteristics of computing competence and confidence in undergraduate students of nursing.

Your application for ethics approval has been considered by the School of Nursing Ethics Panel. The panel are happy to approve this study as set out in the protocol, subject to the following conditions:

- All approaches to students must be made at the end of lectures so that lecture time is not used.
- Please re-submit the Healthy Volunteer's Information Sheet information sheet using the standard Medical School Ethics Committee template including all the subheadings. In the section "Who has reviewed the study?" you should change "the University of Nottingham Medical School Ethics Committee" to "the School of Nursing Internal Ethics Panel".

Now that you have ethics approval from the Panel, you now have to approach the School of Nursing Business Executive to gain permission for access to the student participants. Please feel free to contact me if you have any questions or would like further guidance.

We wish you all the best with your study.

Yours sincerely

Stacy Johnson

cc: Professor Spiller Dr Timmons

Appendix 3

The University of Nottingham

Calling All First and Second Year Undergraduate Students of Nursing

I am a Lecturer in the School of Nursing and Part-Time Doctoral Student. This is a request to ask you to consider participating in my research. My work is about how students develop computing competence and confidence. I need 350 volunteers to complete a questionnaire. I can assure you that measures have been taken to make sure that your responses will treated in strict confidence and stored in a secure place by an Administrator here in the School of Nursing.

If you choose to become involved you will be provided with a Statement of Participation for your Portfolio.

If you are interested please would you kindly respond by e-mail contact, telephone or a written note to Fern Todhunter:

Email: Fern.todhunter@nottingham.ac.uk

Telephone: (01623) 465600

Write to: Fern Todhunter
Lecturer
The University of Nottingham School of Nursing
Mansfield Education Centre
Dukeries Centre
King's Mill Hospital
Mansfield Road
Sutton-In-Ashfield
Nottinghamshire
NG17 4JL

Many thanks for your consideration of my request

Appendix 4

Mansfield Education Centre

Dukeries Centre
King's Mill Hospital
Sutton-in-Ashfield
Notts
NG17 4JL

UNIVERSITY OF NOTTINGHAM MEDICAL SCHOOL ETHICS COMMITTEE

Information Sheet for Healthy Volunteers

The University of Nottingham, School of Nursing

Address of Unit

School of Nursing, The Kings Mill Hospital, Mansfield Road, Sutton-in-Ashfield, Notts

Title of Project

The relationship between and characteristics of computing competence and confidence in undergraduate students of nursing

Name of Investigator*:*

Fern Todhunter Lecturer and (P/T) Research Degree Student

I am a research degree student and interested in how students acquire competence and confidence as computer users. This is because health care areas now require registered nurses to use this type of technology in practice. The School Of Nursing is committed to supporting students in their acquisition of computing competence and confidence. I should be much obliged if you would consider participating in my research as a volunteer. This will involve the completion of a questionnaire about your competence and confidence as a student using a computer. The biographical information you submit such as your name and cohort will be stored in a secure area by an Administrator in the School of Nursing. You are not under any obligation to participate and your decision either way will not have any bearing on your own studies. If you would like to discuss this or receive more information I am available at fern.todhunter@nottingham.ac.uk/ or alternatively Telephone number 01623 – 465605. Thank you for reading this.

Background

The proliferation of the computer across organizations has influenced how contemporary learning and work experiences are structured within these areas. Professional groups such as Nurses can now expect significant computing contact time throughout their working day. This study is motivated by the recognized requirement for students of Nursing to develop competence and confidence as computer users for their current learning and beyond

Aim of the study

The aim of this research is to understand the relationship between competence and confidence and how these factors influence an individual's response towards working with a computer. This study may show how levels of competence and confidence in computer users affect quality of work in both education and practice settings. The study will be conducted over two years.

What does the study involve?

Each volunteer will be sent a questionnaire and return address envelope by the University's internal mail system. The questionnaire will use a summative rating format where weightings are assigned to statements. Respondents will be asked to underscore the weighting which reflects their opinion and then return the completed questionnaire in the provided envelope to the administrator.

The method for the second study is a video-recorded observation of individuals using a computer, their actual performance and spoken thoughts during this time. A data reduction technique in the first study will identify eligibility for the second study (Field 2002). Potential participants will be contacted by the administrator and provided with information about this study and two copies of a second consent form. Administrative arrangements from the first study will be applied. This study will be conducted in a designated recording area in the School of Nursing by the researcher with practical support provided by an audio-visual technician. Two video cameras will be set up to simultaneously record one student at a time working through the task and the events on the computer screen. No other persons will be present. Preliminary explanation, comfort and equipment adjustments will precede a small warm up exercise extracted from the actual task. Students will be asked not to reveal their code number. The completed recordings will be placed in an envelope with the student's details. Code numbers will be applied by the administrator only after analysis.

It is anticipated that the questionnaire will take 10 minutes to complete. The activity in the second study will take approximately 20 minutes to complete.

Research Methods

The first study is Principal Component Analysis. It sets out to examine the correlation between pairs of variables. In this research the variables are competence and confidence. The analysis of the questionnaire will be carried out using a social sciences software programme called SPSS available here in the School of Nursing and which you may be familiar with. The second study is known as either Protocol Analysis or Think-Aloud methodology (Ericsson and Simon, 1993). The idea behind this is to collect the spoken thoughts of individuals as they work or engage in a specific activity. This provides useful information related to people's thoughts and feelings about the task they are undertaking at that time. The analysis from the collected evidence will be carried out using a software package called The Observer XT. This has been approved of by The University of Nottingham.

Why have you been chosen?

The research requires the support of undergraduate first and second year students reading towards a Diploma /BSc in the School of Nursing to participate in the two studies. This is because as students you meet the criteria as potential computer users. For the first study 350 volunteers are required. For the second study the researcher is hoping to recruit 35 volunteers as a 10% sample of the original cohort. Cohorts of undergraduate students will be approached through prior arrangement with the head of School, the Course Director and their designated colleagues. Direct contact with students will be through the University's e-mail communication system and advertising poster containing the researcher's contact details. Posters will be placed across the School of Nursing in hallways and Students' Common Rooms. Having been provided with this information, interested students will be invited to make contact with the researcher.

Do you have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will be given a covering letter and code number to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. The only person who will have access to the combined names and codes will be a designated Administrator.

What do I have to do?

You will be asked to complete a questionnaire and return it to the Administrator

What are the possible disadvantages and risks of taking part?

Your inclusion will not influence the outcome of your studies. Likewise if you choose to withdraw at any time, this will not have a bearing on your status as a University student.

What if something goes wrong? / Who can I complain to?

If you are dissatisfied with any aspect of the study you can contact the researcher direct using the above e-mail or telephone number. Your complaint will be investigated in the first instance by the Researcher's Principal Supervisor. If this achieves no satisfactory outcome, you should then contact the Chair of the School of Nursing's Ethics Panel Stacy Johnson, B52, B Floor, Medical School, Medical Centre, Nottingham, NG7 2UH. Telephone 0115 8230877. E-mail stacy.johnson@nottingham.ac.uk

In the unlikely event that you suffer injury to yourself or damage to your property as a result in taking part in this research, the University does have an insurance policy to cover harm arising as a result of the defect in the design of the study. In addition, all medical practitioners taking part in the research have personal medical negligence cover.

Will my taking part in this study be kept confidential?

Anonymity In the first study the potential problems of anonymity will be addressed through the researcher not having access to the names of the respondents. The researcher will only be given the completed questionnaire with the code numbers. Matching names and contact information will be stored securely by a designated administrator using Microsoft Access. The cohort for the second study will be selected through their code numbers. The administrator will contact the appropriate participant. Students will be asked **not** to reveal their code number to the researcher at the video activity. The researcher will only know the code numbers after written analysis of the videos have been completed. The administrator will match the code number with the written comments. It is only then that this information will be returned to the researcher for a comparative analysis with the findings in the first study.

Confidentiality All data will be stored securely on the premises of The University of Nottingham School of Nursing and Midwifery. Information will be maintained and backed up on the School of Nursing and Midwifery's IT hard drive in a password protected site. The video recordings will be carried out at an approved designated area in the School of Nursing and Midwifery or at another approved University site. This material will be stored at a secure approved site. Any information about you which leaves the research unit will have your name and address removed so that you cannot be recognised from it.

What will happen to the results of the research study?

The findings from the research will be presented as the researcher's doctoral study. It is anticipated that the research will be published in a recognized academic journal. You will not be identified in any report/publication.

Who is organising and funding the research?

The research is being organized and funded by the University of Nottingham School of Nursing

Who has reviewed the study?

The School of Nursing Internal Ethics Panel.

Contact for Further Information

Dr. Stephen Timmons, Associate Professor, School of Nursing

stephen.timmons@nottingham.ac.uk

Thank you for your consideration of this study. It is really appreciated

Fern Todhunter

Lecturer 30th May 2008

Appendix 5

Dear Student

Research: The Relationship Between and the Characteristics of Computing Competence and Confidence in Undergraduate Students of Nursing

Thank you for your expression of interest in my research activity. As you are aware I am a research degree student who is interested in how students acquire competence and confidence as computer users. This is because health care areas now require registered nurses to use this type of technology in practice. The School of Nursing is committed to supporting students in their acquisition of computing competence and confidence.

Please would you kindly sign and print your name, Education Centre and cohort on the lines below this paragraph. Please would you also return the stapled copy of this letter signed, with the attached completed questionnaire in the enclosed labelled envelope provided? You will then be allocated a code number by my colleague. I can assure you that I will not have access to your combined details at any time during the study. An early response would be really appreciated.

Thank you very much for your participation in this activity. A statement about your involvement in this activity will be sent to you as evidence for your portfolio.

Name (Print):   **...**

Signature: **...**

Education Centre: ....

Cohort: ....

Yours sincerely

Fern Todhunter

Research Degree Student

Appendix 6

Research: The Relationship Between and the Characteristics of Computing Competence and Confidence in Undergraduate Students of Nursing

Information Sheet about the Questionnaire

Thank you for agreeing to participate in my research. This information sheet sets out the steps of the activity for you.

1. Please read the letter about the study. You are asked to sign and print your name on one copy.

2. A second copy of the letter is for your reference. A statement about your involvement will be sent to you. The letter and the statement can be used as evidence of participation in research for your portfolio.

3. Please complete the enclosed questionnaire. Ignore the blank space for the code number as this will be allocated by the Administrator.

4. Please return both the signed copy of the letter and the completed questionnaire in the enclosed labelled envelope.

Fern Todhunter

Research Degree Student

Appendix 7

The University of Nottingham

Questionnaire On Computing Competence And Confidence

Code Number…………………..

Demographic Data

Your answers will be respected. Confidentiality and anonymity will be maintained

When given a choice of answers, please underline the statement which applies to you.

When asked to provide information, please write in the space provided

1.Gender a) Male b) Female

2. Age……………

3. Please underline - current academic year of study a) 1st year b) 2nd year

4. Do you have access to a computer at home? a) Yes b) No

5. If you have answered no to question 4 please place a tick against c) **only. If you have answered yes to question 4 please place a tick against just one of the statements which best how you use your computer at home.**

a) Study ………………….

b) Leisure and home …………………

c) Not applicable as no computer at home……………….

6. **Prior to commencing your current studies, if your main previous activity involved using a computer please place a tick against just one of following statements between** a) and d). **If your main previous activity did not involve the use of a computer please place a tick against** e).

   a) Further education college…………………………..

   b) Sixth form at school…………………………………

   c) Paid work………………………………………………….

   d) Voluntary work………………………………………….

   e) Main previous activity did not involve the use of a

   computer………………………..

7. **Have you undertaken any formal study in computing knowledge and skills? E.g. European Computer Driving Licence, GCSE in Information Technology, GNVQ, RSA Word Processing)**

   a) Yes   b) No

   If you have answered Yes to question 7, please write the titles of all Courses on the lines below

   ……………………………………………………………………………………………………….

   ……………………………………………………………………………………………………….

8. **Do you use a computer in the IT Suite in the School of Nursing?**

   a) Yes b) No

The next section requires you to underline the appropriate response to the statement

9. I have learnt some computing skills by just experimenting

Strongly Disagree   Disagree   Agree   Strongly Agree

10. I have learnt some computing skills by watching other people

Strongly Disagree   Disagree   Agree   Strongly Agree

11. I have learnt some computing skills by listening to other people

Strongly Disagree   Disagree   Agree   Strongly Agree

12. I have learnt some computing skills by talking to and asking other people

Strongly Disagree   Disagree   Agree   Strongly Agree

13. I have found the 'Help' function on the computer useful

Strongly Disagree   Disagree   Agree   Strongly Agree

14. I have found computer manuals useful

Strongly Disagree   Disagree   Agree   Strongly Agree

15. The taught sessions in the University about using computers have been very useful in assisting my understanding of them

Strongly Disagree   Disagree   Agree   Strongly Agree

16. Some aspects of using a computer will always be the same irrespective of the activity (e.g. switching it on and off, using a mouse or scrolling down)

Strongly Disagree Disagree Agree Strongly Agree

17. I always use a computer to search for academic literature for my assignments

Strongly Disagree Disagree Agree Strongly Agree

18. I always use a computer to complete my assignments

Strongly Disagree Disagree Agree Strongly Agree

19. Using a computer in the University has assisted in the organisation / management of my studies

Strongly Disagree Disagree Agree Strongly Agree

20. My computing skills have improved since I commenced my current studies

Strongly Disagree Disagree Agree Strongly Agree

21. People will ask me for help if they have a computing problem

Strongly Disagree Disagree Agree Strongly Agree

22. I am a complete beginner when it comes to using a computer

Strongly Disagree Disagree Agree Strongly Agree

23. When I started to use a computer, my computing skills seemed to get worse before they improved, even though I practised

Strongly Disagree Disagree Agree Strongly Agree

24. I can quickly work through the computing activities that I am familiar with

Strongly Disagree Disagree Agree Strongly Agree

25. I sometimes guess or just use my intuition when working through a computing activity I am unsure about

Strongly Disagree Disagree Agree Strongly Agree

26. Sometimes I can complete certain computing activities without even having to think about them

Strongly Disagree Disagree Agree Strongly Agree

27. I can usually work through most computing activities I am faced with in the School of Nursing

Strongly Disagree Disagree Agree Strongly Agree

28. I have an excellent grasp of a range of computing activities linked to my studies

Strongly Disagree Disagree Agree Strongly Agree

29. I did not think about my level of confidence during my initial computing experiences

Strongly Disagree Disagree Agree Strongly Agree

30. I have some computing knowledge and skills and feel confident about learning new computing information and activities

Strongly Disagree Disagree Agree Strongly Agree

31. My confidence in my computing ability seemed to deteriorate after my initial contact with a computer

Strongly Disagree Disagree Agree Strongly Agree

32. I feel confident enough to have a go at working through an unfamiliar computing activity

Strongly Disagree Disagree Agree Strongly Agree

33. I dread the thought of having to learn any new computing activity

Strongly Disagree Disagree Agree Strongly Agree

34. I am confident about using a computer providing I have plenty of time to work through an activity, otherwise I become anxious

Strongly Disagree Disagree Agree Strongly Agree

35. I feel confident enough to work through a new computing activity using a hard copy Help manual

Strongly Disagree Disagree Agree Strongly Agree

36. I feel confident enough to work through a new computing activity using the online Help function

Strongly Disagree   Disagree   Agree   Strongly Agree

37. I feel confident enough to work through a new computing activity as long as there is someone available to help me

Strongly Disagree   Disagree   Agree   Strongly Agree

38. My confidence in using a computer appears to have increased with practise

Strongly Disagree   Disagree   Agree   Strongly Agree

39. I feel confident enough to work through a new computing activity alone without any help whatsoever

Strongly Disagree   Disagree   Agree   Strongly Agree

40. When using a computer my level of confidence is not an issue. I just get on with the task

Strongly Disagree   Disagree   Agree   Strongly Agree

41. The taught computing sessions in the University have increased my confidence in using a computer

Strongly Disagree   Disagree   Agree   Strongly Agree

42. During my studies when in the University, I am confident when asked to carry out an exercise using a computer

Strongly Disagree   Disagree   Agree   Strongly Agree

43. I have confidence in my ability to search for online literature

Strongly Disagree Disagree Agree Strongly Agree

44. I would feel confident about working through a computer-based proficiency in the clinical area without any help

Strongly Disagree Disagree Agree Strongly Agree

45. Even before my current studies I felt confident about using a computer

Strongly Disagree Disagree Agree Strongly Agree

46. I have confidence in my ability to help other students' with their computing problems

Strongly Disagree Disagree Agree Strongly Agree

47. I don't mind people watching me use a computer

Strongly Disagree Disagree Agree Strongly Agree

48. I am usually confident in using a computer away from the School of Nursing

Strongly Disagree Disagree Agree Strongly Agree

Thank you for completing the questionnaire. Your input is valued and much appreciated.

Appendix 8

SPSS Codes for Questionnaire

Full variable name	**SPSS Variable name**	**SPSS Variable label**	**Level of measurement**	**Coding Value**
1. Id	Id	Id	Nominal	Identification number
2. Gender	Sex	sex	Nominal	1 = males 2 = females
3. Age	Age	age	Nominal	In years 1 = 17 – 20 2 = 21 - 30 3 = 31 – 40 4 = 41 – 50 5 = 51 – 60
4. Current academic year of study	Curacyrst	current academic year of study	Nominal	1 = year 1 2 = year 2
5. Access to computer at home	Acomhom	access to a computer at home	Nominal	1 = yes 2 = no
6. Activity which best reflects home use of computer	Actrefhomuse	activity which best reflects home use of computer	Nominal	1 = study 2 = leisure 3 = not applicable as no computer at home
7. If your main previous activity involved using a computer	Practcom	If your main previous activity involved using a computer	Nominal	1 = post-16 study (FE college, 6th form, University)

				2 = paid work 3 = did not use a computer
8. Undertaken formal study in computing knowledge and skills	Frstudcomp	undertaken formal study in computing knowledge and skills	Nominal	1 = academic qualification (gcse, as, a level, module(s) as part of access course, module(s) at degree level study) 2 = vocational qualification (ecdl, rsa, gnvq, clait) 3 = no formal study
9. Using a computer in the School of Nursing	Usecompson	using a computer in the School of Nursing	Nominal	1 = yes 2 = no
10. I have learnt some computing skills by just experimenting	Lrnskilxp	learnt some computing skills by just experimenting	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
11. I have learnt some computing skills by watching other people	Lrnskilwach	learnt some computing skills by watching other people	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly

				Agree
12. I have learnt some computing skills by listening to other people	Lrnskilistn	learnt some computing skills by listening to other people	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
13. I have learnt some computing skills by talking to and asking other people	Lrnskilalkask	learnt some computing skills by talking to and asking other people	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
14. I have found the 'Help' function on the computer useful	Helfuncuse	found the 'Help' function on the computer useful	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
15. I have found Computer manuals useful	Compmanusfl	found Computer manuals useful	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
16. The taught sessions in the University about using computers have been very useful in assisting my understanding	Thtcompsess	taught sessions in University about using computers have been very useful in assisting my understanding of them	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree

of them				
17. Some aspects of using a computer will always be the same irrespective of the activity (e.g. switching it on and off, using a mouse or scrolling down)	samirespec	Some aspects of using a computer will always be the same irrespective of the activity	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
18. I always use a computer to search for academic literature for my assignments	Lisearasign	I always use a computer to search for academic literature for my assignments	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
19. I always use a computer to complete my assignments	Compleasign	I always use a computer to complete my assignments	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
20. Using a computer in the University has assisted in the organisation / management of my studies	Manofstud	Using a computer in the University has assisted in the organisation / management of my studies	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
21. My computing skills have improved since I	Skilimprov	My computing skills have improved since I commenced	Ordinal	1 = Strongly Disagree 2 = Disagree

commenced my current studies		my current studies		3 = Agree 4 = Strongly Agree
22. People will ask me for help if they have a computing problem	Peocomprob	People will ask me for help if they have a computing problem	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
23. I am a complete beginner when it comes to using a computer	Compbgin	complete beginner when it comes to using a computer	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
24. When I started to use a computer, my computing skills seemed to get worse before they improved, even though I practised	wrsbfrimprov	my computing skills seemed to get worse before they improved, even though I practised	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
25. I can quickly work through the computing activities that I am familiar with	Qkwokactfam	quickly work through the computing activities that I am familiar with	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
26. I sometimes guess or just use my intuition when working	Guesintuit	guess or just use my intuition when working through a computing	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree

through a computing activity I am unsure about		activity I am unsure about		4 = Strongly Agree
27. Sometimes I can complete certain computing activities without even having to think about them	Complwiouthnk	can complete certain computing activities without even having to think about them	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
28. I can usually work through most computing activities I am faced with in the School of Nursing	Wrkthrumosact	work through most computing activities I am faced with in the School of Nursing	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
29. I have an excellent grasp of a range of computing activities linked to my studies	Exclgrsp	excellent grasp of a range of computing activities linked to my studies	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
30. I did not think about my level of confidence during my initial computing experiences	dinthnkconf	did not think about my level of confidence during my initial computing experiences	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
31. I have some computing knowledge and skills and feel confident about learning	Somskilconfnw	some computing knowledge and skills and feel confident about learning new	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly

new computing information and activities		computing information and activities		Agree
32. My confidence in my computing ability seemed to deteriorate after my initial contact with a computer	Condtaftinicon	confidence in my computing ability seemed to deteriorate after my initial contact with a computer	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
33. I feel confident enough to have a go at working through an unfamiliar computing activity	Confhavgo	confident enough to have a go at working through an unfamiliar computing activity	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
34. I dread the thought of having to learn any new computing activity	Dredthtnw	dread the thought of having to learn any new computing activity	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
35. I am confident about using a computer providing I have plenty of time to work through an activity, otherwise I become anxious	Plntimean	confident about using a computer providing I have plenty of time to work through an activity, otherwise I become anxious	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
36. I feel confident	harcophlman	confident enough to	Ordinal	1 = Strongly

enough to work through a new computing activity using a hard copy Help manual		work through a new computing activity using a hard copy Help manual		Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
37. I feel confident enough to work through a new computing activity using the online Help function	Onlinhlpfun	confident enough to work through a new computing activity using the online Help function	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
38. I feel confident enough to work through a new computing activity as long as there is someone available to help me	Somhlpme	confident enough to work through a new computing activity as long as there is someone available to help me	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
39. My confidence in using a computer appears to have increased with Practise	Incrpract	confidence in using a computer appears to have increased with practise	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
40. I feel confident enough to work through a new computing activity alone without any help whatsoever	Cnwiouhlp	confident enough to work through a new computing activity alone without any help whatsoever	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree

41. When using a computer my level of confidence is not an issue. I just get on with the task	Gonwitask	using a computer my level of confidence is not an issue. I just get on with the task	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
42. The taught computing sessions in the University have increased my confidence in using a computer	tacomincon	taught computing sessions in the University have increased my confidence in using a computer	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
43. During my studies when in the University, I am confident when asked to carry out an exercise using a computer	Uniconx	when in the University, I am confident when asked to carry out an exercise using a computer	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
44. I have confidence in my ability to search for online literature	Conablit	have confidence in my ability to search for online literature	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
45. I would feel confident about working through a computer-based proficiency in the clinical area without any help	Combasprof	feel confident about working through a computer-based proficiency in the clinical area without any help	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree

46. Even before my current studies I felt confident about using a computer	Befcurcon	before my current studies I felt confident about using a computer	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
47. I have confidence in my ability to help other students' with their computing problems	Helothst	have confidence in my ability to help other students' with their computing problems	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
48. I don't mind people watching me use a computer	Donminoth	don't mind people watching me use a computer	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree
49. I am usually confident in using a computer away from the School of Nursing	uscomawa	usually confident in using a computer away from the School of Nursing	Ordinal	1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree

Appendix 9

Letter to Faculty of Health Sciences Medical School Ethics Committee

The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

School of Nursing, Midwifery & Physiotherapy
Division of Nursing
Mansfield Education Centre
Dukeries Centre
King's Mill Hospital
Sutton-in-Ashfield
Notts
NG17 4JL

Professor R. Spiller

Chair

Medical School Research Ethics Committee

Nottingham Digestive Diseases Centre

C Floor, South Block

Queen's Medical Centre

Nottingham

NG7 2UH

Dear Professor Spiller

Re: The relationship between and characteristics of computing competence and confidence in undergraduate students of nursing

In April 2008 I submitted documentation in respect of the above to the Medical School Research Ethics Committee for my research using student nurses as healthy volunteers. Permission to proceed was granted 5th June 2008. I have now completed the first study. For the second study the Medical School Research Ethics Committee agreed to the video recording of individual students carrying out a computing activity. I would like to make a minor change to the second study. My intention pending your approval, is to use exactly the same method but the small alteration is to video record groups of subjects (between 8

and 10 undergraduate student nurses) working together on a computing activity, instead of individual students. I would be much obliged if you would consider this minor change without further application documents.
I look forward to hearing from you.

Yours Sincerely

Fern Todhunter

Research Degree Student

Appendix 10

Information For Faculty of Health Sciences Medical School Ethics Committee

1. Recruitment of subjects

The group for the second study will be initially identified and contacted by the research administrator through e-mail. Participants who identify that they would like to participate in the study will then be followed up by the administrator. Each participant will then be contacted and provided with information about this study and two copies of a second consent form, including a stamped addressed envelope for return of one copy. Administrative arrangements from the first study regarding storage of information and maintenance of confidentiality will be applied. The students will then be contacted again and given details of the date, time and location within their Centre for the second study. All participants will be given a Statement of Participation for their academic portfolio.

2. Method

The method for Structured Observational Analysis is a video-recorded observation of a group of students using a computer, their actual performance and spoken thoughts during this time. This will be conducted in a designated recording area in the School of Nursing with practical support provided by an audio-visual technician. Two video cameras will be set up to simultaneously record the group working through the task and the events on the computer screen. No other persons will be present. As this is a concurrent protocol each group will be recorded individually. The observation will include how the students themselves decide on their part in the contribution. Preliminary explanation, comfort and equipment adjustments will precede a small warm-up exercise related to the task. The warm-up exercise will be an opportunity for familiarization and understanding of what is required. The completed recordings will be placed in an envelope and physically given to the administrator after analysis by the researcher. The students' names will be removed and the code numbers will be applied by the administrator only after the analysis. It is only then that this information will be returned to the researcher for a comparative analysis with the findings from the first study.

3. Ethical considerations related to the second study

The video recordings will be carried out at an approved designated area in the School of Nursing Midwifery & Physiotherapy or at another approved University site. All video-recordings will be stored securely on the premises of The University of Nottingham School of Nursing and Midwifery. Information about the study will be maintained and backed up on the School of Nursing and Midwifery's IT hard drive in a password protected site. Any information about the students which leaves the research unit will have their biographical details removed.

Fern Todhunter

Research Degree Student

Appendix 11

Response from the School of Nursing, Midwifery and Physiotherapy

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Please quote ref no: SJ108a

Direct line/email

0115 8230877

stacy.johnson@nottingham.ac.uk

Mrs Fern Todhunter

School of Nursing

Mansfield Centre

3rd August 2010

Dear Fern

Re: SJ108 The relationship between and characteristics of computing competence and confidence in undergraduate students of nursing.

I have reviewed the proposed amendment to the protocol for the above study and the associated information sheet and letter. I consider that this constitutes a minor amendment and have been able to take Chair's action. I am happy to approve this amendment, subject to the following condition:

- Participants need to be consented again due to the change to a group activity and the standard Medical School Ethics Committee consent form should be used.

Please feel free to contact me if you have any questions or would like further guidance.

I wish you all the best with your study.

Yours sincerely

Stacy Johnson

cc: Professor Spiller   Dr Timmons

Appendix 12

Letter sent to the students in first study cohort inviting participation in the second study

The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

School of Nursing, Midwifery & Physiotherapy
Division of Nursing
Mansfield Education Centre
Dukeries Centre
King's Mill Hospital
Sutton-in-Ashfield
Notts
NG17 4JL

Dear Student

Research: The Relationship Between and The Characteristics Of Computing Competence and Confidence In Undergraduate Students Of Nursing

Sometime ago you participated in my initial research activity on the above topic and I would take this opportunity to thank you again for your support. You will recall that I am interested in how students acquire competence and confidence as computer users, as health care areas now require registered nurses to use this type of technology in practice. I should be much obliged if you would consider participating in my second study. You will be working in a small group with other students to complete a computing task. This activity will be video recorded. The method is called Think-aloud. Participants will be asked to voice their thoughts as they work through the exercise. The activity will take 15 minutes to complete including a full explanation and short practise run-through of the process as a warm-up exercise. I would like to reassure you that you are not under any obligation to participate and your decision either way will not have any bearing on your own studies.

If you do decide to participate, please would you kindly write your name, cohort and Education Centre on the line below this paragraph. This will enable the Administrator to provide you with details of when and where this will take place. I can assure you that I will not have access to your combined details at any time during the study. The School of Nursing and Midwifery are fully aware and supportive of the students' role in this activity. Please would you return one signed copy of this letter in the enclosed labelled envelope. Thank you for your consideration.

**Name (Print): ....Signature: ....
.........**

Centre: ....

Cohort: ....

Yours sincerely

Fern Todhunter

PhD Student

Appendix 13

Letter to new students requesting volunteers to participate in second study

UNITED KINGDOM · CHINA · MALAYSIA

School of Nursing, Midwifery & Physiotherapy
Division of Nursing
Mansfield Education Centre
Dukeries Centre
King's Mill Hospital
Sutton-in-Ashfield
Notts
NG17 4JL

Dear Student

Research: The Relationship Between and The Characteristics Of Computing Competence and Confidence In Undergraduate Students Of Nursing

As you know I am interested in how students acquire competence and confidence as computer users, as health care areas now require registered nurses to use this type of technology in practice. The findings from the first part of my research appeared to be showing that students like to work in small informal groups when using a computer. I should be much obliged if you would consider participating in my second study. You will be working in a small group with other students to complete a computing task. This activity will be video recorded. The method is called Think-aloud. Participants will be asked to voice their thoughts as they work through the exercise. The activity will take 15 minutes to complete including a full explanation and short practise run-through of the process as a warm-up exercise. I would like to reassure you that you are not under any obligation to participate and your decision either way will not have any bearing on your own studies.

If you are satisfied with the conditions of the activity and decide to participate, please would you kindly write your name, cohort and Education Centre on the line below this paragraph. The School of Nursing and Midwifery are fully aware and supportive of the students' role in this activity.

Please would you return one signed copy of this letter in the enclosed labelled envelope.

Thank you for your consideration.

Name (Print): ....
Signature: ....

Centre: ....

Cohort: ....

Yours sincerely

Fern Todhunter

Research Degree Student

Appendix 14

Information Sheet for Normal Healthy Volunteers – New Cohort For Second Study

School of Nursing, Midwifery & Physiotherapy
Division of Nursing
Mansfield Education Centre
Dukeries Centre
King's Mill Hospital
Sutton-in-Ashfield
Notts
NG17 4JL

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Title of Project:

The relationship between and characteristics of computing competence and confidence in undergraduate students of nursing

Name of Investigator*:* Fern Todhunter Lecturer and Part-time Doctoral Student

Information Sheet For Normal Healthy Volunteers

You have been invited to take part in the second study related to my research. Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with your fellow students and others if you wish to. I would be happy to answer your queries if there is anything that is not clear, or if you would like more information. It is important that you really think about whether you wish to take part or not. You may keep this leaflet. Thank you for reading this.

Background

The proliferation of the computer across organizations has influenced how contemporary learning and work experiences are structured within these areas. Professional groups such as Nurses can now expect significant computing contact time throughout their working day. This study is motivated by the recognized requirement for students of nursing to develop competence and confidence as computer users for their current learning and beyond. The study is known as either Protocol Analysis or Think-Aloud methodology. The idea behind this is to collect the spoken thoughts of a small group of students as they work through a specific computing activity. This provides useful information related to people's thoughts and feelings about the task they are undertaking at that time. The analysis from the collected evidence will be carried out using a software package called The Observer XT. This has been approved of by The University of Nottingham.

What does the study involve?

Each volunteer will be invited to work with two other students to complete a computer based task. There will be one group only in the room. Your group will be invited to work through a small computing task which will be video recorded using two cameras. One camera will be facing the computer screen and the other camera will be recording the you and the other two students. The task is an extract from a Reusable learning Object (RLO). You may be familiar with the RLO website (www.nottingham.ac.uk/nursing/sonet/rlos/) as these are small online activities designed to help learners with a specific topic. You will be asked to work together on the Re-usable Learning Object. You will be asked to voice your thoughts and how you are all feeling about the activity whilst you are working through it. The video recording will show only your comments and facial expressions as you are working through the RLO and how you have supported each other during the process. On completion of the RLO activity you will be offered a comfort break and light refreshments before being asked about the experience of working with the other students on the task. Your comments will be written down, read aloud and also shown to you.

Before the three of you commence the activity, there will be time for introductions and a repeat explanation of what you have consented to be involved in. There will also be an opportunity for comfort and equipment adjustments and a small warm-up exercise from the task itself to help you. The activity will take a total of 20 minutes to complete. The persons present other than yourself and fellow students will be I as the researcher and an Audio-Visual Technician. You will be given a date, time and location to attend for this activity. The location will be your usual Education Centre. The activity will not interfere with your formal class studies or practice time.

Why have you been chosen?

You have been chosen because you will have had some experience on the Course of working with others in a small group situation.

Do you have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason.

What do I have to do?

You will be asked to confirm that you would be interested in attending. You will be supplied with a stamped addressed envelope and two copies of a consent form. You will be asked to return one signed copy using the stamped addressed envelope. The second copy is for your reference. This is a standard requirement by The University of Nottingham and has been designed to recognize your rights as a volunteer. You will then be contacted with specific details of when the activity will take place.

What if something goes wrong? / Who can I complain to?

If you are dissatisfied with any aspect of the study you can contact the researcher direct using the above e-mail or telephone number. Your complaint will be investigated in the first instance by the Researcher's Principal Supervisor. If this achieves no satisfactory outcome, you should then contact the Chair of the School of Nursing Ethics Panel, Stacy Johnson, Room B47, B Floor, Medical School, Queen's Medical Centre, Nottingham, NG7 2UH. Telephone 0115 8230877. E-mail stacy.johnson@nottingham.ac.uk/ In the unlikely event that you suffer injury to yourself or damage to your property as a result in taking part in this research, the University does have an insurance policy to cover harm arising as a result of the defect in the design of the study. In addition, all medical practitioners taking part in the research have personal medical negligence cover. If the above does occur then a report will be made to the University of Nottingham Medical School Ethics Committee. For your reference the contact details are Professor R.C. Spiller c/o "Ethics Committee Secretary, Mrs Louise Sabir, Division of Therapeutics and Molecular Medicine, D Floor, South Block, Queen's Medical Centre, Nottingham, NG7 2UH. Telephone 0115 8231063. E-mail louise.sabir@nottingham.ac.uk."

Will my taking part in this study be kept confidential?

Your participation in the study will be kept confidential. Two key areas have been considered to maintain confidentiality. These are as follows.

Anonymity In the first study the potential problems of anonymity will be addressed through the researcher not having access to the names of the respondents. The researcher will only have access to the code numbers allocated for the first study. Matching names and contact information have been stored securely by a designated administrator using Microsoft Excel. The cohort for the second study will be selected through their code numbers. The administrator will contact the appropriate participant. At no time will the researcher have access to the code numbers and the matching biographical data. The code numbers for students participating in the second study will only be released for a comparative analysis with the findings in the first study.

Confidentiality All data will be stored securely on the premises of The University of Nottingham School of Nursing and Midwifery. Information will be maintained and backed up on the School of Nursing and Midwifery's IT hard drive in a password protected site. The video recordings will be carried out at an approved designated area in the School of Nursing and Midwifery or at another approved University site. This material will be stored at a secure approved site. Any information about you which leaves the research unit will have your name and address removed so that you cannot be recognised from it.

What will happen to the results of the research study?

The findings from the research will be presented as the researcher's doctoral study. It is anticipated that the research will be published in a recognized academic journal. You will not be identified in any report/publication.

Who is organising and funding the research?

The research is being organized and funded by the University of Nottingham School of Nursing, Midwifery & Physiotherapy

Who has reviewed the study?

The study has been reviewed by University of Nottingham Medical School Ethics Committee and the School of Nursing, Midwifery & Physiotherapy's Internal Ethics Panel.

Contact for Further Information

Dr. Stephen Timmons, Associate Professor, School of Nursing.

stephen.timmons@nottingham.ac.uk

Thank you for reading this information and for your support of this study.

It is very much appreciated.

Fern Todhunter

Research Degree Student

Appendix 15

Letter and consent form to new group of students inviting completion of the questionnaire

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Our Ref: FT/LB

Tel: 01623 465605

E-mail: fern.todhunter@nottingham.ac.uk

Dear

Research: The Relationship Between and The Characteristics Of Computing Competence and Confidence In Undergraduate Students Of Nursing

You recently participated in a filming activity for my research and I would take this opportunity to thank you again for your support. The University of Nottingham has a strong research remit with an internationally recognized reputation, so your contribution towards this scholarly activity is really appreciated by the School of Nursing, Midwifery and Physiotherapy. You will recall that I am interested in how students acquire competence and confidence as computer users, as health care areas now require registered nurses to use this type of technology in practice. My PhD supervisors Dr Heather Wharrad (heather.wharrad@nottingham.ac.uk) and Dr. Stephen Timmons (stephen.timmons@nottingham.ac.uk) have identified the usefulness of obtaining your opinions as a computer user. I should be much obliged if you would consider completing the attached questionnaire. I would like to reassure you that you are not under any obligation to participate and your decision either way will not have any bearing on your own studies.

If you do decide to participate, please would you kindly write your name, cohort and Education Centre on the line below this paragraph and return this consent form and the completed questionnaire in the enclosed stamped addressed envelope? I have also included a copy of the consent form for you to keep. The School of Nursing, Midwifery and Physiotherapy are fully aware and supportive of the students' role in this activity. In the event that you require further information please do not hesitate to contact me or my Supervisors.

Thank you for your consideration.

Name (Print): .... **Signature:** ....

Centre: .... **Cohort:** ....

Yours sincerely

Fern Todhunter

Research Degree Student

Appendix 16

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	9.407	23.518	23.518	9.407	23.518	23.518	4.802
2	2.861	7.152	30.670	2.861	7.152	30.670	1.971
3	2.252	5.631	36.301	2.252	5.631	36.301	2.660
4	1.925	4.812	41.113	1.925	4.812	41.113	2.212
5	1.467	3.668	44.781	1.467	3.668	44.781	1.719
6	1.332	3.329	48.111	1.332	3.329	48.111	3.539
7	1.286	3.216	51.326	1.286	3.216	51.326	2.965
8	1.200	3.000	54.327	1.200	3.000	54.327	1.653
9	1.118	2.795	57.121	1.118	2.795	57.121	2.105
10	1.038	2.594	59.715	1.038	2.594	59.715	2.991
11	.963	2.408	62.123	.963	2.408	62.123	3.831
12	.944	2.359	64.482	.944	2.359	64.482	3.688
13	.909	2.272	66.754	.909	2.272	66.754	2.809
14	.855	2.138	68.892	.855	2.138	68.892	2.283
15	.841	2.102	70.994	.841	2.102	70.994	1.543
16	.803	2.008	73.003	.803	2.008	73.003	3.344

Appendix 17

Component Matrix Before Rotation

	Component															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
confident about computing before current studies	.770															
am confident when asked to do a computer exercise	.763															
confidence not an issue get on with task	.752															
confident in helping other students with their computing problems	.744															
excellent grasp of a range of computing activities for studies	.695															
am usually confident in using a computer away from the school	.689															
feel confident about learning new computing activities	.677															
dread thought of having to learn any new computing activity	-.676															
Can work through most son computing activities	.666															
feel confident to work alone without any help	.652					.304										
have a go at working through an unfamiliar computing activity	.651										.370					-.307
confident clinical area online proficiency without help	.604					.359										
complete beginner when using a computer	-.599											-.300				
quickly work through familar computing activities	.598															

Sometimes complete without thinking	.575									.444						
people ask me for help with their computing problems	.531				.298											
dont mind people watching me use a computer	.519						-.332									
have confidence in ability to search for online literature	.517									-.408			-.303			
confidence appears to have increased with practise	.500	.355														.337
am confident about using a computer if plenty of time	-.496															
confidence deteriorated after initial contact with computer	-.479			.309		.343										
skills got worse before they improved even with practise	-.405										.349					
learnt skills by talking to and asking others		.578														
taught sessions have increased my confidence		.568		-.510												
computing skills have improved since commencing studies		.565		-.379												
learnt skills by listening to others		.503			-.479											
learnt skills by watching others		.459			-.396											
computer has assisted in management of studies		.454		-.303												
have found the computer Help function useful			.553	.341			.319									
feel confident enough to work using online help function	.331		.541	.304			.303									

have found computer manual useful		.326	.521		.351											-.325
always use a computer to complete assignments			-.491		.354		.332									
feel confident enough to work with hardcopy help manual			.429	.299	.298											
University taught computing sessions useful		.477		-.547												
learning skills by experimenting			-.316	.449											.389	
always use computer to search for academic literature	.346						.431									
Sometimes guess or use intuition if unsure				.306				.602								
confident as long as there is someone available to help me		.302				-.377			.540				-.305			
did not think about my level of computing confidence initially	.422												.605			
some aspects same irrespective of activity			-.343									-.333		.450		

16 components extracted.

Appendix 18

Pattern Matrix

	Component															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
have a go at working through an unfamiliar computing activity	.810															
dread thought of having to learn any new computing activity	-.532								.298							
am confident when asked to do a computer exercise	.503															
Can work through most son computing activities	.416										-.340					
confidence not an issue get on with task	.299															
feel confident about learning new computing activities																
learnt skills by listening to others		.811														
learnt skills by watching others		.629													.437	
learnt skills by talking to and asking others		.576														
computer has assisted in management of studies		.386									-.309					
have found the computer Help function useful			.885													
feel confident enough to work using online help function			.842													
University taught computing sessions useful				-.895												
taught sessions have increased my confidence				-.879												

have found computer manual useful					.828											
feel confident enough to work with hardcopy help manual					.642											
skills got worse before they improved even with practise						.797										
confidence deteriorated after initial contact with computer						.770										
always use computer to search for academic literature							.838									
always use a computer to complete assignments							.816									
Sometimes guess or use intuition if unsure								.825								
confident as long as there is someone available to help me									.911							
feel confident to work alone without any help									-.381		-.379					
have confidence in ability to search for online literature										-.788						
am confident about using a computer if plenty of time						.347		-.335		.441						
confident clinical area online proficiency without help											-.647					
Sometimes complete without thinking					-.376						-.528					
excellent grasp of a range of computing activities for studies										-.345	-.478					
complete beginner when using a computer												-.635				
people ask me for help with their computing problems											-.381	.506				.329

computing skills have improved since commencing studies				-.332								-.481				
confident in helping other students with their computing problems											-.357	.473				
confident about computing before current studies												.379				
am usually confident in using a computer away from the school												.323				.316
did not think about my level of computing confidence initially													.918			
some aspects same irrespective of activity														.935		
learning skills by experimenting															.779	
dont mind people watching me use a computer																.692
confidence appears to have increased with practise															.308	.538
quickly work through familar computing activities																.384
Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Rotation converged in 22 iterations

Appendix 19

Structure Matrix

Key For Simple Structure = one high value in the row

= several high and many low values

	Component															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
have a go at working through an unfamiliar computing activity	.844											.316				
am confident when asked to do a computer exercise	.705					-.318				-.479	-.426	.333	.326			.324
dread thought of having to learn any new computing activity	-.673					.407			.386			-.304				-.424
Can work through most son computing activities	.610		.327			-.328	.322				-.521			.355		
confidence not an issue get on with task	.558					-.372				-.431	-.479	.343	.452			.372
feel confident about learning new computing activities	.526					-.402	.343				-.308	.379	.336	.415		.353
learnt skills by listening to others		.810														
learnt skills by watching others		.672													.517	
learnt skills by talking to and asking others		.641							.343							
computer has assisted in management of studies		.429		-.419		-.303	.332				-.398					
feel confident enough to work using online help function			.877													

have found the computer Help function useful			.860													
taught sessions have increased my confidence				-.873												
University taught computing sessions useful				-.856												
have found computer manual useful					.854											
feel confident enough to work with hardcopy help manual			.394		.683											
skills got worse before they improved even with practise						.800										
confidence deteriorated after initial contact with computer	-.392					.782										-.313
always use a computer to complete assignments							.818									
always use computer to search for academic literature							.806									
Sometimes guess or use intuition if unsure								.813								
confident as long as there is someone available to help me									.869							
have confidence in ability to search for online literature	.316									-.812						
am confident about using a computer if plenty of time						.497		-.405	.365	.549						
confident clinical area online proficiency without help	.343									-.330	-.719		.339			
excellent grasp of a range of computing activities for studies	.380					-.376	.348			-.500	-.636		.312			

Sometimes complete without thinking	.331				-.323	-.311		.312			-.616	.329				
feel confident to work alone without any help	.347							.330	-.516	-.449	-.538	.371				
complete beginner when using a computer	-.405					.410						-.724				
confident in helping other students with their computing problems	.407					-.302			-.305		-.561	.640				.467
confident about computing before current studies	.503					-.408			-.327	-.364		.607	.466			.429
people ask me for help with their computing problems											-.507	.568				.472
am usually confident in using a computer away from the school	.485						.388			-.333		.522	.353	.315		.490
computing skills have improved since commencing studies				-.481						.301		-.518	-.411			
did not think about my level of computing confidence initially													.889			
some aspects same irrespective of activity														.883		
learning skills by experimenting															.816	
dont mind people watching me use a computer													.334			.739
confidence appears to have increased with practise	.301						.377							.343	.398	.638
quickly work through familar computing activities	.316					-.365	.413					.435				.522

Rotation Method: Oblimin with Kaiser Normalization.