A Framework of Learning Experiences in Ultrasound Scanning

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Abstract

This thesis explores learning experiences in ultrasound scanning by examining the ways that sonographers, at various stages in their professional development, scan patients. The qualitative study developed a framework, the themed content of which emerged from the sonographers' own narratives of their learning experiences. The focus on, and the consequent analysis of the sonographers' narratives at different points in their learning led to the construction of a staged framework.

The study's sample was designed to cover a broad spectrum of experience and was divided into two groups, differentiated by their qualification status. Purposive sampling was used, recruiting ten participants who recounted their learning experiences to the researcher. The researcher took the role of participant observer. Data was generated via direct observation of sonographers in their working context and the use of semi-structured interviews facilitated the telling of narratives of the individual's learning experiences. These narratives were then formally analysed to seek a better understanding of why the subject performed in the way that they did.

The resulting framework was constructed from the analyses of the narratives; it comprises seven stages ranging from 'starting to scan' to 'excellence in scanning'. This Framework of Learning Experiences in Ultrasound Scanning is the first experiential framework of its kind which shows how progress in scanning develops over time. Its focus on process also adds empirical evidence to the sparse literature concerning scanning performance.

The framework is foundational in the sense that it has potential implications for curricula, training, and service delivery related to the Sonographers' profession and role. However, the intent of the framework is to understand better the experience of learning to scan and therefore it is a necessary precursor to any future work that seeks to apply that understanding to practice.
Chapter 1 Introduction

1.1 Introduction

This thesis explores the processes involved in learning ultrasound scanning using a qualitative approach. Participant observation and semi-structured interview are the methods used to generate data and narrative analysis provides the basis for evaluation of the learning experiences, where learning experiences are opportunities for learning and support during that learning. Presenting themes in a Framework of Learning Experiences in Ultrasound Scanning provides a way of showing progression in scanning, starting from pre-qualified learners at the beginning of their learning to sonographers showing excellence in scanning.

Chapter 1 discusses the rationale for the study and outlines the research question, aim and objectives, together with an overview of the contribution to knowledge. The structure of the thesis is outlined and the purpose of each chapter is briefly described.

1.2 Rationale for the study

Medical ultrasound scanning has influenced significantly the provision of health care in the UK since the 1980s. The innovations in technological developments have led to ultrasound being used in a variety of contexts. As the field of ultrasound has grown in importance, so too has the expansion of ultrasound services; in addition to hospital-based scanning, the miniaturisation of the equipment means that it is also offered increasingly within the community. As such, ultrasound is being used more and more by a wide range of health care professionals who need to be trained to a high level.

Traditionally, the Diploma in Medical Ultrasound of the College of Radiographers was the recognised qualification in ultrasound scanning, until the early 1990s, when education and training was devolved to higher education institutions. Now, a variety of modules reflecting the range and skills of ultrasound practice are offered at
postgraduate level by UK institutions. Professional Guidelines on extending ultrasound provision have served the community well and provided recommendations for supporting training needs (Bates, J., C. Deane, et al. 2003; ultrasound training recommendations for medical and surgical specialities, by Royal College of Radiologists, 2005; ultrasound training by radiology departments for other medical specialities by Royal College of Radiologists 2007).

Smith et al (1998) evaluated a surgeon led trauma ultrasound training programme, this American study focussed on evaluating the delivery of a specific training programme for surgeons. Whilst they found no significant differences in sensitivity, specificity or accuracy in surgeons who attended the course in comparison with those that had no formal introductory training, they concluded that focussed training improved learning scanning rather than relying only on numbers of cases scanned. In a more recent study to explore predictors of success in emergency medicine ultrasound, Costantino et al 2008 acknowledged a formal structured training programme was more likely to improve learner performance than increasing the number of hours spent on ultrasound scanning. Terkamp et al (1994) in a German study using ultrasound simulators concluded that simulators are well suited for providing structured ultrasound training. In a survey of surgeons and surgical trainees, Staren et al (2006) identified formal training courses in ultrasound improved the scan performance and confidence of those attending formal structured ultrasound training course.

The evidence shows that formalised training in ultrasound results in improved performance and can lead to a reduction in the number of scanning hours. The literature however, does not explain 'how' scanning is learnt and what assists and hinders the learning process. The monitoring of learners' experiences is not fully explored and there is little attempt made to gain a better understanding of how their
experiences of learning contribute to the improved outcomes. There is an emphasis on outcome, but little attention is given in the literature to how that outcome is achieved.

The research question is can the experience of scanning as told by qualified and pre-qualified sonographers inform how they learn to scan and can this experiential process be formalised? Can such a formalisation help to understand what assists and hinders the learning process?

The aim then is to explore how scanning is learnt and to consider whether education and training could be more effective and produce better outcomes, (whilst keeping pace with technological developments). Not only will this knowledge have the potential to show the individuals progression, it may also support the individuals on occasions when they fail to meet the assessment requirements.

There is little documentation concerning ‘how’ learning of scanning skills is achieved, a better understanding of learning experiences will go some way to address this.

Given the paucity of literature focussed on learning scanning and the representation of that learning, this emerging area of study will rely upon the work of scholars in other disciplines to provide a basis for a critique of outcome-based performance and provide more evidence to support learners.

1.3 Aim and objectives

The aim of this study is to develop a Framework of Learning Experiences in Ultrasound Scanning. The objectives are to;

- observe pre-qualified and qualified sonographers as they scan
- identify important themes on learning from analysis of narratives generated through semi-structured interviews
- summarise themes into characteristics of learning experiences
1.4 The contribution to knowledge

My contribution to knowledge will be the development of a unique Framework of Learning Experiences in Ultrasound Scanning. This framework provides a way of seeing progress from starting to scan to achieving excellence in scanning. It addresses the dearth of literature and provides a research tool for exploring learning ultrasound scanning.

1.5 Structure of this thesis

The thesis consists of nine chapters. Chapter 1 provides the context and background to the study, whilst Chapter 2 introduces ultrasound and learning in the context of ultrasound scanning. Chapter 3 introduces the research approach including the method. Chapter 4 introduces the themes and outlines the concept of a seven-stage framework of learning.

Chapter 5 and Chapter 6 discuss the findings of the study; pre-qualified sonographers are focused upon in chapter five and qualified sonographers in chapter six. The important themes that emerge from the analysis are summarised as characteristics of learning and presented in the framework in Chapter 7. The research process is evaluated in Chapter 8 and Chapter 9 outlines the conclusion and recommendation for further work.

1.6 Summary

This first chapter has set the context and background to this study. It is claimed that gaining a better understanding of how ultrasound scanning is learnt will assist in identifying what advice may be offered and how learners may be better supported during learning scanning.

As technological development continues to allow the expansion of ultrasound in health care provision, there is a demand for health care professionals to be trained to
high standards in scanning. The framework of learning experiences provides the potential to show progression in scanning and will also be useful for identifying what support may be required by learners at each stage of learning.
Chapter 2 Learning in the context of ultrasound scanning

2.1 Introduction

This chapter introduces ultrasound scanning and discusses the literature on skill acquisition. The first part of the chapter is designed to provide an overview of scanning, this provides the context for the second part of the chapter, which focuses on key influences in skilled learning.

As there is little published on skill acquisition related to learning scanning, I needed to know more about the major influences on skill acquisition in general and understand these in the context of ultrasound scanning.

The literature reviewed in this chapter aims to provide a context for exploring learning experiences in ultrasound scanning. Firstly an overview of the search strategy that led to the literature review is outlined. The literature review explores the role of reflection and then the role of observation in learning, feedback on performance, how different types of practising influence learning, the development of navigation skills and image interpretation, and how these are linked to decision-making skills. Finally, two well known approaches are critiqued, Fitts’s three-stage approach to skill acquisition and Benner’s Model of Nursing Practice are critically evaluated in the context of ultrasound scanning.

A search of Cinahl and Medline databases was the starting point for the literature search. Included in the scope of the search was ultrasound scanning; professional development; clinical education; clinical practice and learning; psychology; skill acquisition; skilled learning; frameworks of clinical practice. The search was designed to include International, European and UK literature and published in any language. The search also included peer reviewed professional journals and grey literature. Outside the scope of the search was curriculum development; clinical competency.
To extend the scope of the search, Psychology, sport science and educational databases were also explored, including: professional development; clinical education; clinical practice and learning; psychology; skill acquisition; skilled learning.

Terms such as 'ultrasound' can vary depending upon the source of literature. Therefore the scope of search terms was expanded to include variations of these, for example ultrasound was also represented by terms that included sonography, ultrasonography, sonographic.

To focus the search, search terms were combined using Boolean operators, examples of how these were combined are given below.

**Figure 1: Examples of search terms used in search strategy**

<table>
<thead>
<tr>
<th>Search Terms</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>ultrasound scanning and learning;</td>
<td>Ultrasound scanning and professional development</td>
</tr>
<tr>
<td>[ultrasound scanning] and [skill acquisition] or [skilled learning]</td>
<td>clinical education and learning</td>
</tr>
<tr>
<td>ultrasound scanning and clinical education</td>
<td>clinical education and professional development</td>
</tr>
<tr>
<td>[ultrasound scanning and clinical practice] and [learning] or [skilled learning]</td>
<td>clinical practice and learning</td>
</tr>
<tr>
<td>Ultrasound scanning and professional development</td>
<td>clinical practice and professional development</td>
</tr>
<tr>
<td>[clinical education] and [skill acquisition] or [skilled learning];</td>
<td>[clinical practice] and [skill acquisition] or [skilled learning];</td>
</tr>
<tr>
<td>clinical education and learning</td>
<td>clinical practice and skill acquisition;</td>
</tr>
<tr>
<td>clinical education and professional development</td>
<td>Frameworks and clinical practice</td>
</tr>
<tr>
<td>clinical practice and learning</td>
<td>Frameworks and skill acquisition</td>
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<tr>
<td>clinical practice and professional development</td>
<td>Frameworks and learning</td>
</tr>
</tbody>
</table>
When I reviewed the professional literature I found nothing on learning experiences in ultrasound scanning in the UK. The grey literature included professional guidelines for scanning. European, Australian and US based literature revealed some studies on ultrasound learning. I then moved onto psychology, sports science literature and then educational literature to explore skill acquisition, skilled learning, professional development and frameworks.

The search strategy was an iterative process. For example, as evidence of learning and skill acquisition was revealed in one area, evidence for its applications in the other disciplines within the scope of the search was sought. Through this process, the scope of the literature search progressed in stages, systematically. Search alerts were set up on a monthly basis and on line searching was repeated approx. every 3 months to keep abreast of new publications and developments.

The literature referred to Fitt's model in a range of applications looking at human movement performance, some of these examples are provided in the introduction to Fitt's model discussed later in this chapter. Benner's model was referred to predominantly in nursing practice and showed relevance to this study through exploration of the relationships between staged progression in clinical practice; acquiring clinical skills; experience and clinical knowledge. Benner's Model is explored more fully later in this chapter.

2.2 Context of ultrasound practice

Ultrasound practice has developed rapidly and driven by technological developments scanning skills have been modified and developed in line with the growing expectations of the referrers and the public alike. As a result of limited documented evidence to show this progress, little is understood about the complexities of the knowledge and skills underpinning scanning practice. There is, therefore, no
evidential standard on which to base opinion, or published evidence to draw upon, to make comparisons between levels of practice and what may constitute good practice.

**Ultrasound scanning**

Ultrasound scanning involves the practice of using ultrasound to investigate internal organs. Since the 1980s, the role of ultrasound scanning has diversified; whilst it’s predominant role is in obstetrics, ultrasound scanning is used in the diagnosis, monitoring and screening of patients in different disciplines of health care. It is now regarded as a key investigative technique for a widening set of clinical problems (e.g. gynaecological investigations, screening for and diagnosing fetal abnormality, investigations of the liver and biliary system, diagnosing and monitoring urological complications, musculoskeletal injuries, diagnosis and management of the acute abdomen and a role in the management of vascular complications such as in the diabetic foot).

Recent developments related to the miniaturisation and portability of ultrasound equipment permit it to be used more widely for instance at the bedside and outside the hospital setting. Thus, opportunities to acquire ultrasound skills outside localised ultrasound communities are afforded to a growing audience of health care professionals. Ultrasound scanning is being deployed in new contexts by a much more diverse set of practitioners than originally conceived, all of whom will need to learn to scan to a professionally competent level.

Formally, sonographers are health care professionals who have gone through a recognised programme\(^1\) of training and education in ultrasound scanning and hold a formal qualification in one or more fields of ultrasound scanning. The Consortium for the Accreditation of Sonographic Education (CASE), comprising representatives from

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\(^1\) Consortium for the Accreditation of Sonographic Education validated programme.
professional bodies and learned societies, is the validating body of ultrasound programmes in the UK. Obstetric scanning tends to be the first module studied in ultrasound education and it is within this area that learners acquire the basic ultrasound scanning skills; these scanning skills are transferable and are applied to other areas of scanning as learners progress. It is the learning of these basic skills that has been the focus of attention in the literature. Studies have shown that learning in ultrasound are less than ideal, particularly when ultrasound is used by a range of professions other than sonographers and to some extent Radiologists. A structured approach to ultrasound training has been shown to improve learning (Smith et al 1998; Terkamp et al 2005; Staren et al 2006). The literature however, does not go as far as explaining ‘how’ scanning is learnt and what may assist or hinders the learning process.

Ultrasound equipment

Ultrasound equipment varies in size and function; irrespective of size and portability, all machines comprise a central console containing control function buttons and a hand-held probe, encasing an array of transducers that emit and receive ultrasound, together with a monitor for viewing the image. The manipulation of the probe together with the setting of the image quality parameters are important actions carried out during a scan.

The role of the sonographer

The sonographer is responsible for managing the patient and performing the ultrasound scan. Sonographers’ responsibility is to evaluate the referral prior to the scan and afterwards to construct a report. Seated adjacent to the patient and facing the equipment, they bring the hand-held probe into contact with the patient. Crucially, the sonographer must integrate the probe movements with the manipulation of the
controls to produce high-quality real-time images. These dynamic images are concurrently interpreted by the sonographer during the examination. The findings of these images lead the sonographer to plan and instigate the next series of probe movements until the scan is complete. Constructing the report is the final stage of the process.

The main difficulty for learners of scanning is to produce identifiable and reproducible images of the internal organs and difficulties arise because these cannot be seen directly. Orientation to the image and knowing which way to move or angle the probe is one of the fundamental skills that must be acquired during the learning process. As previously mentioned, there is a lack of published research on how these skills are acquired. This research addresses this lack of explicit evidence and aims to explore the act of learning to scan.

**Obstetric ultrasound scanning**

Obstetric ultrasound scanning is the focus of this study on the basis that this is the first module studied by the sample of learners and they acquire scanning skills in this context which are transferable to other fields of ultrasound.

Ultrasound scanning was originally conceived in the 1980s in obstetrics for checking fetal number and fetal lie. As technology has advanced, ultrasound scanning has developed a significant role in antenatal screening and in the management of the obstetric patient. It has both a screening and diagnostic function. The majority of ultrasound scans in obstetrics are performed by sonographers participating in the antenatal screening programme. In this role, it is used to date a pregnancy, identify fetal number and the position of the placenta, identify fetal abnormality and monitor growth. It is often used in conjunction with other tests, to assist in the diagnosis of
abnormality and to monitor invasive procedures. Sonographers need to be able to scan to a professionally competent level in order to carry out these tasks successfully.

2.3 Learning in the context of ultrasound practice

Learning may be broadly defined as the acquisition of knowledge and skills that result in a permanent change in behaviour. Whilst this definition captures some elements of learning, it limits learning to an observable outcome and does not take into account how knowledge is understood by the individual.

To clinical practitioners, learning skills and knowledge in order to practice competently is the first milestone in their professional careers. Beyond this, excelling in skilled performance is regarded as the ultimate goal.

Professional learning blends together the ‘knowing that’ and ‘knowing how’, which are acknowledged by Benner (1984) as relevant to clinical performance. Despite the fact that skills may be acquired without the explicitness of ‘knowing that’, it is the ‘how’ of ultrasound scanning that is not evidentially understood. Exploring the ‘how’ may bring a better understanding to the learning process and contribute to broadening the knowledge of ultrasound practice.

How to represent learning in a way that demonstrates learning experiences is challenging. How that individual comes to an understanding as a result of learning whilst taking into account the impact of previous experience focuses attention on the individuality of learning. Moon (2004) recognises that, whilst learning is a unique experience, learning is staged and progressive. Whilst meaning attached to that learning for the individual takes into account prior experiences, reflection is part of the process of acquiring knowledge and putting learning into practice to create meaning.
The complexities of learning scanning and stages of skill acquisition have not been explored fully in the ultrasound community and thus learning of ultrasound scanning remains uncharted.

Whilst skilled learning occurs in stages (Fitts 1964), it is recognised that progress in all skills does not occur equally over time, nor does it necessarily follow a smooth rate of progression (Damos 1991). Learning curves mapping skill acquisition during multitasking performance show that there is a noticeable dip followed by rapid improvement in performance. Once the fundamental skills have been acquired, no significant improvement is observed and the learning curve tails off. It is during this period that skills are refined. Practising enables the discrete movements of the skill to become integrated, which results in an efficient and smooth performance.

Consistent performance defines the skilled or competent performer, where performance is largely determined by the accuracy and speed of execution (Wishart, et al. 2000). Currently, those learning ultrasound are expected to perform a scan efficiently or competently by the end of a twelve-month (part-time) period of training, and should be able to transfer skills to new situations.

Despite sonographers having a body of knowledge that has accrued over what is approaching three decades, there is very little published evidence on skilled performance. The next section explores reflection and experiential learning.

2.3.1 Learning and reflection

Reflection is related to experiential learning (Boud, Keogh et al. 1994; Moon 2004) and, accordingly, reflection on learning ultrasound scanning seeks to combine theoretical knowledge of the sonographic appearances of anatomy and pathology with the skills to perform a scan. As progress is made through each stage of learning, reflection brings meaning and fosters understanding of ultrasound practice.
Experiential learning enables the ‘organisation and construction of learning from observations that have been made in some practical situations, with the implication that the learning can lead to action’ (Moon 2004). One such method of organising learning in this way is the experiential learning cycle (Kolb 1984). The experiential learning cycle describes how the learner experiences an event; afterwards, reflection is used to bring meaning to that event. When the learner experiences a further event, reflection on that follows and so the cycle is repeated. Figure 1 shows the experiential learning cycle adapted from Kolb 1984. The cycle comprises four different stages of learning that follow in sequence. The learning cycle suggests that learning takes place through reflecting on the experience (reflective observation) to review the events, drawing conclusions from the experience (abstract conceptualisation) in order to learn. Applying what has been learnt to new situations (active experimentation) therefore learning is tested in new situations.

**Figure 2 Experiential learning cycle (adapted from Kolb 1984)**
Exploring learning through reflective processes like this implies a conscious effort on behalf of the learner to establish meaning (Moon 2004). Learners acquire knowledge more readily through involvement in an experience and their perceptions of that experience are how they develop meaning (Eisner 1991). Reflection implies more than simply recalling events but representing those events in a construct to make meaning of those activities; thus, reflection is a purposeful action to consider knowledge in a particular context to develop a greater meaning and understanding of that knowledge.

The individual learning experience and the ability of each learner to make meaning from newly acquired information is important during scanning. In these situations, learner achievements are highly dependent upon the application of knowledge to scanning practice and reflection is regarded as highly significant in the assimilation of new knowledge into a meaningful construct (Moon 2004). Accordingly, reflection on practice enables knowledge to be put into practice and enables understanding to develop. Later in learning, reflection may enable the application of existing knowledge to new situations.

### 2.3.2 The role of observation

Observation of practice is an important part of learning (Moon 2004 p116) and is particularly useful during the early stages of learning. Here, it provides the novice learner with the opportunity to observe practice before they perform the skill, and provides them with an overview of the skill.

Observation has also been found to be an effective learning aid for both simple tasks, such as repetitive movement tasks performed in a laboratory setting (Scully and Newall 1985), and complex tasks involving a range of movements. In a study
comparing two groups of participants learning how to ski, those who had combined observation of practice with practise outperformed those who had only practised the skills on a ski simulator (Whiting et al. 1987).

The advantages of observing movement patterns is that learners are able to identify related movement patterns (Gordon 2001), which may help to develop navigation skills, thus observation of ultrasound practice provides the opportunity to explore navigational movement patterns between the arm, hand and probe. A study of ballet dancers supports this notion: Ishikura and Inomata (1995) detailed learners’ observations of skilled practice. They showed that learners formed representations of sequential body movements from their observations of skilled performers. These findings concurred with an earlier study in which Carroll and Bandura (1990) demonstrated how participants successfully learnt sequences of paddle movements through observing the upper limb movements of a skilled performer during demonstrations.

2.3.3 Feedback on performance

Feedback on performance is part of the learning process. How feedback is given and the timing of when it is provided are important factors. In studies exploring motor skill acquisition, it has been acknowledged that repeated feedback during the performance of the task can inhibit the retention of knowledge in the long term because it leads to feedback becoming an integral part of the motor programme (McCullagh and Caird 1990; Weinstein and Schmidt 1990; Wulf, Schmidt et al. 1993). These studies tend to involve cursor movements on a screen and feedback on the accuracy of performance is provided almost immediately. Whilst there are some similarities between this and placing cursors over a region of interest in tracking performance in ultrasound scanning, what is more important in the learning process is
the encouragement of reflection by the learners themselves (Moon 2004 p179). After knowledge has been assimilated, learners should be encouraged to integrate that knowledge actively into practice and consider the consequences of this. Feedback on performance should enable the learner to assimilate knowledge and apply it to their future practice.

2.3.4 The role of practising in learning

Random practise and practising repeated movements or rote learning are two contrasting ways to practise learning a skill. Random practise involves practising under a range of different conditions and is advantageous when learning complex skills such as ultrasound scanning. It enables learners to adapt skills more easily to different situations and offers many advantages to the clinical practitioner.

The advantage of random practise is that it enables the learning of a whole task in situ and provides the learner with additional benefits, as learning in this way has shown that it leads to long-term knowledge retention (Gentile 1998) and skill transferability in the long term (Marley, Ezekial et al. 2000). This is likely due to random practise providing the learner with the opportunity for reflection and opportunities for assimilating newly acquired knowledge into future practice (Moon 2004), as learners who learn the skill in context integrate tasks better and tend to outperform in the long term those who alternate attention between discrete tasks (Gentile 1998).

2.3.5 Navigation skills in learning

Navigation skills executed concurrently give the appearance of a smooth performance (Marley, Ezekial et al. 2000), and it is smooth, efficient performance that is desired in ultrasound scanning. To achieve this, the directional movements, rotations and angulations of the probe need to be performed simultaneously. In addition to organising probe movements, the pressure of the ultrasound probe on the patient must
be controlled together with communicating with the patient and changing the equipment controls.

One approach to acquiring navigational skills directs learners to divide the task into subtasks and focus on each subtask separately; whilst this has been shown to produce a higher level of skilled performance, this is limited to the primary task and is to the detriment of performance in the other tasks (Marley et al. 2000). One of the other limitations of part task learning is poor development of timesharing skills (Lintern and Wickens 1991 p132); because learners focus attention on performing fewer tasks, they tend to switch attention between the different tasks (Marley et al. 2000) rather than process these concurrently. Subjects, on the other hand, who dual task train develop dual task skills (Lintern and Wickens 1991 p132) and are able to parallel process some subtasks, which results in a smooth, continuous performance as desired in ultrasound scanning.

2.3.6 Image interpretation

Analysing and interpreting the image is a fundamental part of ultrasound scanning. Interpreting the image efficiently provides a constant supply of information on which the sonographer can base decision making. Sonographers are expected to observe rapidly changing landscapes and make decisions based upon the information derived from the interpretation of the dynamic ultrasound images.

Evidence suggests that there are differences between novices and experts in the ability to acquire information from images. Expert pilots glean information more quickly because of their ability to identify relevant information efficiently (Kemper and Kite 1997 cited in Durso and Gronlund 1999 p292). Identifying information quickly and deciding what is relevant provides expert pilots with highly developed situation awareness skills: a strategy used by experts in skilled performance, such as pilots, to
judge outcomes efficiently based on experience and predict likely outcomes. It is this predictability that differentiates the expert from less experienced pilots. During the early parts of their training, pilots are expected to identify key landmarks. It is these basic elements which underpin the development of pattern recognition skills and these are built up gradually through visualising the same image patterns over time. This in turn contributes to the development of the decision-making skills which underpin the development of situation awareness skills.

Through practice, image patterns are built up over time and gradually image interpretation becomes automated. This frees cognitive resources to enable operators such as pilots to consider future actions. It is this ability to consider option plans that is the start of decision-making skill development (Jasper 2006 p114–115) and only happens once image interpretation is automated.

Option planning is an integral part of image interpretation and a fundamental part of decision making. During learning, pattern recognition develops from being able to detect basic unconnected patterns to being able to recognise structural features and make decisions on whether these represent normal features. Options are considered as part of this process. Experts, on the other hand, acquire information efficiently and are able to decide on its importance and relevance as part of the decision-making process more efficiently.

2.3.7 Decision making

Decision-making principles are based on the ability to make sound professional judgements based upon the available evidence (Jasper 2006 p115). Whilst the ability to evaluate information in a particular context of knowledge may be judged as decision making, a sound knowledge base is also required before clinical decision-
making skills can be sufficiently developed. It is only during the later stages of learning that the responsibilities for making clinical judgements are realised. During the early part of learning, much attention is focused on acquiring knowledge and skills and, whilst this involves some basic elements of decision making, it is limited to a simplistic form of problem solving. During learning, the beginner may be encouraged to ask themselves, ‘what is happening?’ and ‘why?’ Whilst this type of approach encourages reflection on practice (Moon 2004), it also forms part of the decision-making process. Questions such as ‘what?’, ‘why?’ and ‘who?’ encourage the learner to consider the options available at the time of scanning. Despite the fact that, in Jasper’s (2006) view, prompts such as these could be used as an awareness raising exercise by practitioners since experts use knowledge differently and take into account their wealth of experience, this mechanistic view could oversimplify the process for experienced sonographers.

In contrast, less experienced practitioners draw on limited know how and this must be recognised through support mechanisms to enable them to be accountable and responsible for their practice (Benner 1984). During the stages of learning leading to competence, learners’ lack of relevant experience means they are likely to begin to explore the options available as part of learning, which in time become part of the automised procedure (Jasper 2006 p114–115). In ultrasound scanning, pre-qualified sonographers may develop option planning as part of developing image interpretation skills and qualified sonographers who acquire routine information as part of this automised process will assimilate and analyse this with increasing effectiveness with more experience.

Decision making is more about the future than the ‘here and now’ situation. Durso and Gronlund (1999) argue that experts use information to make decisions about the
future. The principles around decisions about the future are part of the notion of situation awareness. This notion was developed in the aerospace industry, in which images and other types of information are assimilated and analysed efficiently by experts to provide an assessment of what action to take.

Exploring this concept in ultrasound scanning illustrates how the preparation period prior to scanning, when the background history of the patient is gathered, is important for setting the context to enable decision making during the scan performance.

It is suggested that experienced sonographers synthesise information acquired during the scan to make prospective clinical interpretations, and therefore rely on several sources of data, have an awareness of the nature and type of information required and assimilate this in order to come to an informed judgement.

2.3.8 The Fitts three-stage approach in the context of ultrasound scanning

During the post-war period, Fitts emerged as one of the leading authorities on the philosophy of systems and processes involved in skill acquisition. His work on the application of motor tasks involving precise aiming movements focused on the complexities of skill acquisition which subsequently led to the publication of a three-staged framework of skill acquisition (Fitts 1964).

The recognition that a skill has been acquired is when it is performed consistently well over several performances. To achieve this, the chief components of skill, performance, timing and anticipation must be combined effectively (Fitts 1964).

Broadly divided into two types, skills may be 'simple' or 'complex'. The performance of a simple skill is underpinned by behaviour/response elements and involves the creation of a motor response through following a procedural pathway rather than involving complex cognitive skills such as knowledge and understanding (Annett 1986). This may be referred to as a learnt skill in its fundamental sense and would
exist, for example, in repeatedly placing a set of paint cans from a conveyor belt into a packaging box for distribution.

Fitt's model has successfully been applied in a wide range of studies. Wastensson et al 1995 used Fitt's Model as a method for assessing neuromotor function in workers with current low exposure to mercury workers. The Model was specifically used to assess arm movements and rapid pointing movements. Fitt's Model was also used by McDougall et al (2006) to explore human performance, here Fitt's Model was used to predict potential success of surgical skill development in urology trainees. Decety and Jeannerod (1999) have used Fitt's Model successfully albeit in a small sample (15 participants) to measure human performance in a virtual reality experiment, where subjects simulated walking actions.

Pirolli (1999) has applied Fitt's Model in the development of IT skills. He was able to map the development of fine motor skill development during a mouse pointing exercise whilst the operator observed a corresponding moving cursor on a monitor (Pirolli 1999); in this study, Fitt's Model was used to demonstrate skill development that also included elements of hand-eye coordination. It is likely ultrasound scanning may follow a similar pattern of progression as reflected in Fitt's Model as ultrasound scanning requires controlled movement of a probe whilst observing the image on a monitor.

Performing a complex skill such as ultrasound scanning also requires cognitive processing as well as procedural performance. This application of knowledge helps to develop understanding (Gordon 2001) and this newly synthesised knowledge is assimilated into the cognitive structure through reflection (Fisk and Schneider 1984 cited in Lintern and Wickens 1991 p123; Moon 2000, p108). As a result of this process, learning is developed as new skills and knowledge are blended into memory.
constructs and, through such synthesis, new knowledge and understanding of the
scanning process is developed. As this knowledge is built up over time, the memory
construct becomes an ultrasound scanning motor programme enabling the practitioner
to plan and execute an ultrasound scan.

Motor programmes are cognitive frameworks of knowledge that enable the performer
to plan and execute skilled performance (Wishart, Lee et al. 2000). Such programmes
are organised into parallel systems that govern basic or routine functions with
cognitive processing (Fitts 1964). Once the fundamental units of a system have been
acquired, the basic skill movements may be performed automatically; subsequent
learning enables the refinement and modification of behaviour.

During ultrasound scanning, the probe movement and angulation together with the
equipment control need to be performed automatically in order for cognitive resources
to be released for decision making, which leads to improved efficiency in skilled
performance.

An important contribution of the motor programme is the control and temporal
sequencing of motor coordinates (Fitts 1964). Timing is seen as a crucial part in
movement control mechanisms (Rosenbaum 1986) and thus a coherent strategy exists
within a motor programme for carrying out subtasks in a particular sequential order.

Part of learning a skill is devoted to sequencing movements. The timing between
discrete tasks is reduced during efficient scanning; these conditions lead to a smooth,
continuous scan performance.

Learning, therefore, is the processing of received information, transferred to long-term
memory through reflective processes. As knowledge is acquired, an understanding
between the relationships of these concepts is developed into a knowledge framework
(Foltz and Wells 1999). As relationships between key concepts develop, so too does
the level of understanding (Ingvaldsen and Whiting 1997) until a level is reached that
leads to decision making taking place.

The principles of Fitts's (1964) three-stage approach to skill acquisition are based on
the thesis that skill learning is a continuous process with gradual shifts in the nature of
the processes as learning progresses. Fitts (1964) proposed that the learner moves
through three stages in the learning of a skill.

The three stages of skill acquisition (Fitts 1964; Anderson 1982) are:

I. cognitive stage

II. associative stage

III. autonomous stage

I. Cognitive stage

During the cognitive stage of learning, the learner attempts to understand the task
requirements through watching someone perform the skill and through verbal
instruction.

The initial stages of skill acquisition involve a significant amount of controlled
processing. The learner requires high levels of concentration in order to focus his or
her attention on the skill to be learnt. Because of these demands, this first stage is
known as the cognitive stage of learning.

During this initial stage, the learner needs to proceed under close instruction as
performance will be variable at this stage, as different strategies are tried out. Learners
rely on clear directives from verbal instructions, which may also be combined with
written instructions (Fitt 1964; Anderson 1982).

At the same time, verbal practise or rehearsal of instructions takes place. These high
levels of concentration impact on the cognitive demands and cause a reduced capacity
in verbal resources. As a result, the early stages of learning are an intensive part of the
learning process (Lintern and Wickens 1991 p124) and demand significant amounts of concentration.

II. Associative stage

During the second stage, or associative stage, coordination starts to develop. Movements are refined and become smoother as linking between discrete movements develops. Practise plays a large part in developing these links and Anderson (1982) proposed that it was this linking that underpins the development of coordinated performance.

III. Autonomous stage

The autonomous stage is achieved after extensive practise and is typified by the performance of a skill with minimal conscious effort. As the skill is performed automatically during the third stage, skill performance is more efficient compared with the cognitive and associative stages of skill acquisition.

It is proposed that there is an order of actions and each subtask follows the previous in a smooth and coordinated pattern; this provides the appearance of a continuous process. At a sublevel, however, there are discrete tasks being performed; the timing between the completion of one task and the commencement of the subsequent task are minimised in order to achieve this continuous process (Fitts 1964).

The autonomous stage is associated with the development of the motor programme. There is now a basic set of instructions and execution controls to govern performance. During scanning, discrete hand movements must be performed with minimal time delay between each movement if they are to appear continuous and smooth. Cognitive involvement is reduced during the automatisation of performance, thus freeing cognitive resources (Anderson 1995). This allows new ways of improving recall from memory and the development of decision-making skills, including
managing the application of information, to be acquired. Eventually, the learner becomes more accomplished in performing the skill. A smooth, coordinated scan performed in an effective manner should be a successful conclusion to the learning process.

Despite wide support for these three stages, critics suggest that the qualitative descriptions oversimplify the process. New ways of applying information must be acquired by the learner if he or she is to become a more accomplished performer and this happens when certain task components are carried out automatically (Rogers, Rousseau et al. 1999). Practising leads to aspects of performance becoming ‘routine’ or automised and, as the sequencing of procedures is ‘locked’ into long-term memory, there is a reduction in demand for cognitive resources and the performance becomes smoother and more efficient. Whilst these cognitive resources are employed in the development of decision-making skills, they may also be used to explore ways of applying skills to novel situations, an important feature of ultrasound scanning. This level of skill application is not accounted for in Fitts’s (1964) three-stage approach and so it is proposed that another stage beyond this would include the development of applied scanning skills to novel situations.

2.3.9 The Benner Model of Skill Acquisition in the context of ultrasound scanning

Patricia Benner applied the Dreyfus Model of Skill Acquisition to nursing in a well-publicised study in 1984. The Dreyfus Model, first published in 1980, was developed from a study of aviation pilots and chess players. Benner’s model suggests there are a number of stages on the journey to becoming a skilled practitioner. These are founded on three areas of performance: firstly, a move from ruled, governed behaviour to the lived experienced; secondly, a move from accepting situations as discrete entities to
seeing them as wholes; and finally, a move from 'detached observer to involved performer'. This model is important because it attempts to provide an insight into lived clinical experiences of nursing practice rather than focusing on outcome-based performance. This thesis aims to develop a staged framework of learning scanning, Benner's model offers a staged approach to the development of nursing practice. Her study focussed on; skill acquisition, development of experience and clinical knowledge. Although Benner's Model is firmly routed in Nursing practice it shares similar features with this study in the exploration of the relationships between staged progression in ultrasound practice that include scanning skill acquisition, experiential progression and clinical knowledge.

Benner's Model proposes that in learning and acquiring a skill there are five levels of proficiency: novice, advanced beginner, competent, proficient and expert. The first three of these five stages broadly share some features of skill acquisition reported by Fitts (1964). The cognitive stage shares general features of performance with the novice level of proficiency. The associative stage reflects the advanced beginner stage and the autonomous stage mirrors some aspects of the competent stage. Not accounted for in Fitts's three stages, however, is the recognition that, according to Benner, some form of decision-making process and the application of this to adapt technique takes place during the competent stage. Whilst Benner (1982, 1984) recognises the complex nature of clinical performance, the model doesn't take into account how these skills are acquired and at what stage these are developed. Benner's model, however, includes stages that demonstrate a pattern of progression in skilled performance from dependency on clear one-to-one instruction and 'rules'; making meaning and understanding how to perform a skill, and practising the skill; to becoming a skilled performer. Beyond these three stages, Benner's five-stage model includes proficient
and expert levels of proficiency which encompass the journey to developing an intuitive understanding of practice.

The five-stage model succeeds in demonstrating progression. Novices are expected to have acquired facts but not necessarily an understanding of the relationships between the underpinning concepts (Benner 1984). Experts, on the other hand, will have acquired extensive knowledge to develop a complex framework (Foltz and Wells 1999; Benner 1984).

Learning scanning skills is likely to follow a similarly progressive pattern. There are clear similarities between the novice and advanced beginner stages and Fitts’s cognitive and associative stages. Whilst there are similarities between Fitts’s autonomous stage and Benner’s competent stage, however, the complexities around competence make these links more tentative. Fitts’s model doesn’t take into account adaptability and the ability to cope with the contingencies, recognised (Benner 1984 p27) as an important feature of clinical practice. Similarly, sonographers are presented with a wide range of clinical situations on a daily basis and therefore must have navigational skills developed to a level at which these can be adapted.

Whilst learning skills is progressive and Benner’s model closely maps with Fitts’s model in these respects, the complexities of developing the ability to adapt the skills which are part of ultrasound scanning are not clearly accounted for.

The growing body of knowledge during the last forty years on skill acquisition is predominantly laboratory-based (Fitts 1964; Schmidt 1975; Fisk and Goodale 1985; Dreyfus, Dreyfus et al. 1986; Fleischer 1989; Winston and Schmidt 1990; Damos 1991; Lintern and Wickens 1991; Wickens 1991; Wulf, Schmidt et al. 1993; Schmidt and Wulf 1997; Shea, Wulf et al. 1999). Whilst controlling variables to produce ‘objective evidence’ has merit, it also has known limitations, not least because it
produces results out of context. Measuring the performance of tracking cursors on a screen, for instance, bears little resemblance to the complex performance of ultrasound scanning in the situational setting that includes a patient, equipment and a busy clinical department.

The advantage of exploring learning experiences in the clinical context is that learners will be practising under a variety of conditions which should be advantageous for enabling skill transferability (Marley, Ezekial et al. 2000) in the long term. To be able to multi-task successfully, performers need to sequence skills in order to complete these tasks and thus benefit from learning all the tasks together so that sequencing is part of the learning process (Lintern and Wickens 1991; Marley, Ezekial et al. 2000). This makes random practise and whole task learning appropriate for learning ultrasound scanning skills.

2.4 Summary

The literature reviewed in this chapter has provided a context for exploring learning experiences in ultrasound scanning. It has explored the role of reflection in learning, the role of observation in learning, feedback on performance, how different types of practising influence learning, the development of navigation skills and image interpretation and how these are linked to decision-making skills. Fitts’s three-stage approach to skill acquisition and Benner’s Model of Nursing Practice are critically evaluated in the context of ultrasound scanning.

Applying skills and knowledge to novel situations requires some level of decision making. Benner’s model closely maps with Fitts’s model in some respects; however, the complexities of developing the ability to adapt skills which are part of ultrasound scanning are not clearly accounted for in these models.
Each patient encounter in ultrasound is unique and, therefore, the transferability and adaptability of skills to new situations is paramount to the successful performance of an ultrasound scan. For these reasons, this study is conducted with participants in the clinical setting rather than adopting a laboratory approach and a framework is required that combines the best of these features but goes further.
Chapter 3 Methodology

3.1 Introduction

The aim of this study is to develop a framework of learning experiences in ultrasound scanning. During scanning, practitioners meet a wide range of clinical situations in which they must be able to transfer and adapt their scanning skills. Each patient encounter in ultrasound is unique and for these reasons this study is conducted with participants in the clinical setting.

This chapter begins by outlining the philosophical principles underlying the qualitative approach to this study; it then describes the sample, evaluates the methods of data generation, interview and participant observation and outlines the framework for analysing the narratives.

Temple (1998) argues that, unlike positivist research, a range of variations and standpoints exists from which to judge qualitative research and therefore the standpoint or paradigm must be made clear at the outset to judge the research fairly. Without such expectations, then limitations may be imposed for the purpose of judging the research process. Therefore, it is in the interests of the researcher to express at the outset his or her position.

3.2 Philosophical position

Constructionism provides the philosophical principles underpinning this thesis as I believe that the knowledge on learning experiences is subjective and relative to the context of the individual experience.

As individuals, we hold a set of beliefs about the world. These sets of beliefs constitute paradigms. Guba and Lincoln (1994 p105) describe the term ‘paradigm’ as:

A set of basic beliefs (or metaphysics) that deals with ultimates or first principles. It represents a world view that defines, for its holder, the nature
of the ‘world’, the individual’s place in it, and the range of possible relationships to that world and its parts.

Social constructionism is one of three paradigms that currently influence qualitative enquiry. Appendix I, adapted from Lincoln and Guba (2000), outlines the basic underpinning assumptions of social constructionism.

The relationship between ontological, epistemological and methodological issues around constructionism has influenced my approach in conducting this research.

Ontology describes how the world is viewed. Whilst some believe there is one reality that can be discovered (realism), constructivists would argue that reality is socially constructed (relativism) and that human actions such as scanning are understood in context to bring meaning and understanding to those activities.

Epistemology makes claims about knowledge representation: What represents truth. Any claim to know must be justified on the basis of how the claim was arrived at (Mason 2002). The epistemological perspective in constructionism claims that meanings and knowledge about human action are constructed, inasmuch as knowledge does not exist independently of context.

Methodology is the process of finding out about knowledge. Methodological issues centre on interpretation, and constructivists support the use of a wide range of methods for data generation, including participant observation and interview (Clandinin, D. J. and F. M. Connelly 1994).

Constructivists view knowledge as unstable and modified in perspectives of time and understood in context. Accordingly, it is not the method alone that generates knowledge; rather, it is a combination of method and interpretation (Denzin and Lincoln, 2003). It is the interpretation of data generated by participant observation and semi-structured interviews that reveals insight into learning experiences in this study.
Constructionism takes into account participants' and researchers' experiences in co-creating knowledge; what is known can only be understood judged against these values.

Modern ethnographic fieldwork has its roots in 19th and early 20th century anthropology. To gain a better understanding of social and cultural relationships, anthropologists immersed themselves within different social groups to carry out observation of day-to-day activities. Spending months or years within these groups, anthropologists would typically learn the language and participate in social events. Although ethnographic work may only involve small numbers of participants (Denzin and Lincoln 1994; Coffey 1999), it is the constant and regular contact with these groups that provides opportunities to acquire better understanding of day to day activities. Analysis often results in what is often described as a 'thick description' (Coffey 1999).

Ethnographic approaches to research have been applied in a variety of ways in the exploration of many disciplines. It is through observation that data is generated (Atkinson and Hammersley 1994). Silverman (2001) advocates participant observation as a method for gaining a better understanding of day to day activities, but also recognises the importance of generating and analysing data in context which includes listening as well as observing. Choosing to use observational methods has advantages for exploring complex situations. It may be combined as Mason suggests (2002) with other methods such as interviewing to provide a fuller account; for example, providing an insight into why processes happen in a particular way. Clandinin and Connelly (1988, 1994, 1995) have used this combination of methods successfully in the exploration of learning experiences in the classroom.
In contrast with the interview method, participant observation provides opportunity to generate data in a contextual setting. This experiential form of data generation is not without its challenges however. As Coffey (1999) recognises it is not just the methods of observation and recording fieldwork notes that require careful deliberation, but importantly, consideration to the ethical challenges and the role of the researcher in this process must also be attended to.

In defining the role of the researcher the participant-observer relationship needs to be explored. Comparisons of accounts recorded at different stages of the research relationship provide ways of illuminating changes in roles and relationships. How the researcher may see themselves; how the participant may view the researcher; how that relationship changes over time, and in different situations are examples, as Coffey and Atkinson (1996) suggest of reflexive ways for exploring the intricacies of participant observation. Glaze (2002) and Letherby (2002) provide examples of how they used research diaries to conceptualise their role in the research process and illustrate themselves as reflexive researchers.

The research approach adopted for this thesis has similarities with ethnography, but is also substantively different. Participant observation was used as one of the methods of data generation. Entering into the day to day activities of the ultrasound department provided opportunities to have the close contact with qualified and pre-qualified sonographers. Witnessing the actions is, as Hammersley (2002) claims, how we come to understand beliefs and behaviours more closely. Participatory observation was chosen so I could experience action and events in the scan department first hand. However whilst ethnographers typically enter social settings with limited experience of that particular group, for me it was different.
My professional capacity meant that I had experience of the scan setting. I had worked in ultrasound for a number of years and also my experience as a tutor in this field meant I had an insight into the complex relationships between supervisor-student-sonographer-patient-student. What would be different is that I was about to enter it in an observer capacity. I took time to consider how my role may be viewed in these relationships, but until I had experienced this first hand I was not sure what to expect.

Participant observation is associated with many challenges, including generation and recording of data. Ethical issues around access and engagement with participants require careful deliberation as do the issues associated with the role of the researcher, and how these impact on the research process.

Gaining access to participants was through a 'gatekeeper', the departmental manager. This presented a challenge as many wanted to know in some level of detail what I would be researching. I naturally wanted to be open and honest about the nature of the work and I was able to explain the aim and processes, but until the study had started I wasn’t in a position to provide any specific detail.

I was aware that my presence in the clinical setting and being part of that scan team would impact on the dynamics of that department, I was aware that I would be viewed differently by team members. At the same time I felt privileged at being allowed access into the world of the pre-qualified and qualified sonographers.

Ethnographers undertaking participant observation typically completely immerse themselves within the group under investigation. For my situation in this thesis it was slightly different. Participant observation as described for the purposes of this study relates to the fact that I was overtly present in the clinical setting and participated in activities within the clinical department and scan room, but I was limited to the range
of tasks I could undertake because I was not an employee of the NHS Trusts. I did not for example perform any scans.

Ethical issues around access to participants was given due consideration. Whilst I may have been recognised because of my professional role in ultrasound scanning; it was important that participants were given time and space to consider whether they wished to participate and would feel under no obligation to be involved in the study.

My professional role was to be a more challenging feature of the study with the pre-qualified sonographers. At the beginning of the study learners treated me warily, but as time elapsed and my relationship developed they became more comfortable with my presence in the department in general and in the scan room. Where silences in the scan room dominated the first session, conversation between us became more of the norm during later sessions. These silences in the early session were notable and critically reviewed as part of the evaluation of my role during stage 1.

Whilst observing from the back of the room gave me an excellent overview of the interaction and activities undertaken, it did at times during the very early stages of learning preclude me from some of the conversations. However as mentioned above once I was accepted, conversation became naturally occurring irrespective of where I was positioned in the room. I undertook day-to-day tasks such as room preparation, delivering paperwork and assisting patients in and out of the room.

My professional role was less of a challenge with the qualified sonographers. I was accepted more quickly into the departmental setting, there were no boundaries to conversation, and I was accepted from the very start as part of the team in the scan room. This led me to question my role and to question what the boundaries ought to be so that I could balance between ‘learning through observation and interaction’, and being part of the team.
In addition to ethical issues around access to participants, there were also ethical issues around data generation to contend with. Having started from a privileged position of having some knowledge about the field, I questioned whether this would give me a position to observe intricate events and more subtle interactions. I may not necessarily have observed this level of detail if I had come in to the field from a different background and therefore I explored the ethical approach to recording this level of detail. Mason (2002) notes that defining the level of detail to be recorded presents a challenge to the researcher who may observe or be party to information of a sensitive nature. Likewise I had to be open to the fact that participants may wish to reveal more about themselves; this ultimately would lie outside the scope of the research and therefore not count as data. Through the process of reflection and discussion with the participants I decided that the boundaries of what would be used as data, would be agreed through the processes of sharing the transcripts with participants.

Another branch of my participant role in the clinical setting extended to interactions with patients. Whilst my presence was always explained and consent for that obtained from each patient, how I was viewed by patients varied. Some ignored my presence completely whilst others asked me a range of questions based on either their scan examination and/or the research. Careful consideration was given to my responses to these questions, it was on one hand advantageous that I was participating as part of the team, but I also recognised the boundaries in which I needed to operate. Whilst in general I was accepted by the patient community, on occasions I felt as though I was intruding on what for most was a lifetime changing experience. Mason (2002) suggests that it is not always possible to anticipate what issues the researcher may encounter whilst engaging within the community. Indeed on occasions where pre-
qualified sonographers were scanning, not infrequently patients would ask me about the outcomes of the scan rather than asking the learner, this required careful explanation because I had not performed the scan it was outside the boundaries of my role.

Being involved in observation of ultrasound practice is not just about professional roles, as Coffey and Atkinson (1996) point out, the researcher brings a multitude of experiences to the research process; gender and age and social positioning in relation to those of the community with which I was engaged were important issues to reflect on. As a mature female sonographer, ultrasound tutor and novice researcher contributing to my role as observer and interviewer I endeavoured to develop and sustain awareness of these issues through my reflective diary.

The relationships with the departmental teams and participants were dynamic and during this study my research identity changed; for prequalified sonographers I was already known in the field in a tutor role, analysis of my reflections over time, revealed how my view on my role and others views on my role changed gradually. Clandinin and Connelly (1988) experienced similar issues around roles and turn taking in their classroom studies. During initial stages of their work novice teachers viewed them as the observers and those with the power, gradually however there was a change in the perceptions of the researcher’s role.

This is a short extract from my diary taken from a stage 2 visit. It shows one aspect of my awareness of the impact of my professional role on pre-qualified participants:

“As I sat in the staff room chatting with some of the sonographers who had arrived early I noticed one of my participants [pre-qualified] arrive. She avoided the staff room and I thought it strange that she didn’t socialise with the others. I thought she was avoiding me. I made her a coffee and left to go to the office; I met her on the corridor as I hoped I would and told her there was a coffee waiting for her. It was clear that she was avoiding me. We went into the staff room together
and from then on didn't stop chatting all morning. Today was a turning point”

This is a short extract from my diary taken from a stage 6 visit. It shows a different aspect of my professional role from that above and illustrates my relationship with one of the qualified participants;

“Arrived 7.55am, sat in the staff room chatting with some of the sonographers and office staff; ready for an 8am start. I noticed some sonographers acknowledged my presence, but left me alone after that. My participant [qualified] arrived. She immediately greeted me, was obviously pleased I was here early [ because there was an interesting case to scan], she asked me if I would set up the equipment for the procedure [which I was happy to do] and she came to join me in the scan room. She treated me like a colleague, ...the rest of day followed this pattern” I am accepted as part of the team.

Whilst qualified sonographer participants regarded me as a peer from the outset, other departmental staff related to me cautiously. Often guarded with their comments initially, their attitude towards me changed as I interacted within the department, calling patients through, escorting patients to clinic and handling paperwork meant I was regarded as part of the team albeit in a limited capacity.

Participant observation was used in this study to generate data. The data generated through observation of scanning practice was used to inform semi-structured interviews. Using participant observation in this way was advantageous in that it provided data generation ‘in context’.

The purpose of this study was to develop a framework of learning experiences in ultrasound scanning. In order to provide a systematic way to recording the data, broad areas for the purpose of observation were identified from analysis of the pilot study; persons present in the scan room, general layout of the room, interaction with the equipment, interaction with colleagues/supervisors. This was advantageous in capturing data that could have relevance to the development of the framework of
learning experiences. This process differed from some aspects of ethnographic approaches however, as it was not the intention to provide a thick description for the purposes of revealing cultural meaning, rather observational data was combined with semi-structured interview to generate data about what processes took place and why. This provided advantages as analysis of narratives revealed in semi-structured interview provided the in depth analysis of learning experiences which led to the subsequent emergence of themes associated with learning.

Access to participants and engagement with learners during different stages of their progress towards competence in scanning and those developing professionally provided many challenges. Each participant had unique learning experiences to share, one of the key challenges was to represent these experiences whilst recognising my involvement in the research process.

Whilst I participated in a range of activities within the clinical setting this did not include performing a scan because I was not employed to do so. The complex dynamics of the researcher-participant interface are important, and the constant exploration of these dynamic relationships underpinned the research process. Observation requires a complex range of skills and after each attempt at observation and interview, critical review of the processes helped me to reflect on my actions, interactions and evolving role in the research. This critical review enabled development and improvement in my skills during this research. It is the complexity and development of these dynamic roles and relationships and the underlying processes that I continued to work on throughout the development of this thesis. Learning experiences are not fixed; rather, the idea that knowledge is fluid, changing over time, and shaped by the natural influence of interaction and discourse (Mason...
2002; Silverman 2001) should be upheld. Thus, knowledge is constructed by associated meaning set against an individual's contextual framework.

Adopting a qualitative approach for exploring learning experiences in scanning provides the opportunity to explore the individual's perspective. Their interpretations of their learning will provide an insight into how they come to understand the meaning of their actions and experiences (Denzin and Lincoln 2000; Schwandt 2000; Holliday 2002; Mason 2002) in the context of professional learning.

Professional learning blends together the 'knowing that' and 'knowing how' which are acknowledged by Benner (1984) as relevant to clinical performance. Despite the fact that skills may be acquired without the explicitness of 'knowing that', it is the 'how' of ultrasound scanning that is not evidentially understood. Exploring the 'how' may therefore bring a better understanding to the learning process and contribute to broadening the knowledge of ultrasound practice.

The learner is a unique individual whose learning is influenced by prior and current experiences. These previously unexplored qualities become reality through the interpretation of stories and the observation of clinical practice (Benner 1984; Silverman 2001).

Whilst qualitative research conducted and analysed in a particular context holds particular meaning for those engaged with it, different meaning or understanding by others should not be limited or rejected. Rather, the intention is to provide a basis for criticism and evidence for the future exploration of learning ultrasound scanning. Naturally, not all activities associated with scanning can be captured through this type of approach; certainly, not all knowledge can be summarised in positivist theories. However, this approach goes some way to providing evidence to describe the different stages of skill acquisition in ultrasound scanning.
A criticism of postmodern views by those embedded in the positivist traditions of research is the apparent lack of structure and order in a way that postmodernists come to present knowledge. In an effort to address this criticism, this thesis, a seven-staged framework, provides a structured way of representing learning experiences in ultrasound scanning.

Qualitative research conducted and analysed in a particular context holds particular meaning for those engaged with it; how this meaning is expressed may be revealed in narrative form. Accordingly, Polkinghorne (1988) recognises that not all knowledge is context-free and much of the meanings and activities associated with knowing are embedded within existing clinical cultures. Telling stories provides a forum for the learner to 'tell it how it is for them'. Narratives convey meaning by drawing on the actions and events that are important to them at that particular time. Narratives are discussed later in this chapter in relation to data analysis (section 3.7).

The emphasis on the contextually situated nature of knowledge relies on a combination of method and interpretation to generate data (Denzin and Lincoln, 2003) and it is the interpretation of data generated by participant observation and semi-structured interview that reveals insight into learning experiences in this study. Themes that emerge from the data will underpin the development of a framework of learning.

3.3 Reflexivity

Reflexivity is synonymous with qualitative research (Silverman 2001 p39) and it may be revealed in different ways. Reflexivity has different roles according to the paradigm perspective of the researcher. In this study, the purpose of reflexivity would not be to demonstrate a 'true' answer but to facilitate a rigorous interpretative decision. Finlay (2003 p4) advocates a reflexive approach to qualitative research to
enable the researcher to explore his or her role in the research process. As the researcher, I am a co-participant in the construction of data in this research. Being reflexive is not to deny the existence of the researcher, nor is it to bring ‘objectivity’ by excluding ‘bias’ in the research process. It is, however, a way of expressing and acknowledging that the researcher is an inseparable part of the research process (Rice and Ezzy 2001 p.18).

According to Gergen (2001), having an awareness of the context of the interchange that generates meanings promotes reflexivity on the part of the co-constructors and participants. However, through the act of reflexivity, I endeavour to reveal the authenticity of this research (Gergen and Gergen 2000) and recognise that the data is generated through my interpretation of the setting and through the co-constructed narrative interviews.

To illustrate my point I have included examples of how I used my reflective notes to explore my role in the research process. Following this is a section containing brief extracts from my reflective diary; each extract provides an example of my reflective processes.

**Examples of reflective notes on my role in the research process**

During the preparation for the interviews, I considered how I could usefully employ strategies for interviewing, as suggested by Coffey (1999) and (Mason 2002).

To make questions meaningful to the interviewees and relate to their circumstances, I set out to spend time with each before the scanning session would commence. Coffey (1999) and Mason (2004) advocate being sensitive to the interviewees’ rights and I aimed to be aware of their needs.

Often arriving in the department up to an hour before scanning commenced provided opportunities to meet with staff and participants and get to know them better, this was
usually in the staff room. This helped me assess the ambience of the department; I noted whether the department was fully staffed. In the case of the pre-qualified sonographers, I wanted to establish the department's expectation of them. I didn't want them to feel compromised as learners or inhibited to ask questions. I chatted about my role and my research and hoped this would help build relationships and develop trust in having me in their department. The qualified sonographers seemed to be less anxious about having me in the department; they carried on their day-to-day business and seemed almost to forget my presence. This raised ethical challenges because they revealed information to me that was unexpected.

I noted too that I felt it would be easy to lose track of the purpose of the interviews and end up with a transcript that was a general chat about ultrasound rather than specifically related to the activities observed during the session. Coffey (1999) and Mason (2004) suggest practising interviewing skills to ensure that, whilst a relationship develops, there is an appropriate focus on the issues and topics relevant to the research.

I had practised my interviewing during the pilot study. As a novice interviewer this had presented challenges and the pilot helped me to develop my listening skills, pay attention to the silences and hesitancies. I endeavoured to remember key points of conversations as suggested by Coffey (1999) and Mason (2004); remembering what people had said provided a point to return to at a later stage in the interview or at our next meeting.

During the interviews in the early part of my study, I noted in my reflections on the process that I wasn't comfortable with how I was recording verbal and non-verbal cues. Making written notes as the participant was speaking affected their conversation, making it hesitant. Whilst I was looking down writing notes, I was also
not 'participating' by helping the flow of conversation. I changed my pattern of note
taking so that it was less intense.
Extracts from diary

1. Today was a good day: I am pleased about how much information I recorded. However, I have written rather intensely on the non-verbal clues and this made (pre-qualified sonographers) feel uneasy: at times they stopped talking. Next time, I need to pay more attention to the conversation and write brief notes more intermittently.

2. I was in the department for nearly five hours, it was very useful in helping to build relationships (with pre-qualified sonographers, qualified sonographers and departmental staff): the time before and after was just as valuable as the three-hour scanning session.

3. What has worked well: arriving early in the department; allowing pauses between questions to give the participant time to reflect; briefly noting non-verbal cues.

   I can help the (pre-qualified and qualified sonographers) participants by providing more regular feedback during the scanning session rather than at the end.

4. Preparation: highlight (significant aspect from the observational notes and interview) to link into the next meeting.
3.4 Sample

The sample included ten participants. The sample was divided into two groups:

- Pre-qualified sonographers
- Qualified sonographers

Pre-qualified sonographers in this study are defined as those participants registered on an ultrasound programme and attending the first module, obstetrics and gynaecology ultrasound scanning, and undertaking twelve months of study.

Qualified sonographers in this study are defined as those participants who have worked predominantly in obstetric and gynaecology scanning since qualifying.

All participants were based in the north-west of England at one of four hospitals and were registered on one of two courses.

The sample consisted of four pre-qualified sonographers and six qualified sonographers. The method of sampling employed was purposive sampling, it is a useful method for sampling in small participant groups (Bowling 1999) and all those selected to participate in this study have experiences of learning scanning. The purpose of sampling in this way is not to construct a sample for empirical representation, but to gain access to narratives of learning experiences in ultrasound scanning. Exploring small groups of participants in a situational context provides a way to explore meaning and develop a better understanding of experience (Denzin and Lincoln 2003).

Typically, those using stories to explore experiences, particularly around teaching and learning issues, involve small participant groups to generate data. The rich text produced from this approach has the advantage of providing knowledge in the situational context (Connelly and Clandinin 1986; Johnson and Golombek 2002).
Ethical approval

Congruous with the National Health Service research governance guidelines, ethical approval was sought prior to the commencement of this study. As this study was to take place within a number of hospitals in the north of England, approval was sought and given by the local ethics committee; following this, a local agreement with each hospital was also in place prior to the data generation. The Course Leader of those students who agreed to take part in the study was also contacted and university ethical approval was also sought and given by the relevant University Ethics Committee. Initial contact was made with the Departmental Manager of the Ultrasound Department and their permission was sought to contact the students and/or staff. Initial contact was made via a telephone call, and the aim and nature of the project was outlined. Each person was asked if they would agree to me observing their practice and to being interviewed about their learning experiences. A mutual appointment time and date was agreed between the participant, Departmental Manager and myself. This was followed up with an information leaflet. At the beginning of the first meeting, the project was explained to each participant, using the information leaflet, and it was also carefully explained that each participant could withdraw from the study at any point. This was provided in writing on a consent form. Each of the ultrasound educators was contacted initially by phone directly and their consent obtained similarly. Following this, four students, six qualified staff and six ultrasound educators agreed to participate in this study. Ultrasound is practised within a relatively narrow field in health care practice. Training in ultrasound is carried out at postgraduate level and approximately twenty university courses are offered nationally, which are accredited by the Consortium for the Accreditation of Sonographic Education (CASE). This body comprises representatives from several professional
bodies who use ultrasound within their daily practice. All students included in this study had to be registered on a CASE accredited programme. Typically, ten to twelve places are offered on such courses. In addition to this, clinical ultrasound departments tend to comprise small numbers of staff, typically four full-time equivalents. Thirdly, university imaging departments typically have one or two lecturers who specialise in ultrasound practice. This has two points of significance for this study: firstly, there is not a large population of students or staff on which to draw and, secondly, confidentiality and anonymity is crucial to protect the identities of the participants. Therefore, hospital and university identification has been removed from all paperwork, including that concerning local and university ethical agreements. Prior to commencing the data generation for this study, I held a position as Ultrasound Course Leader. I decided to step down from this and also withdraw from my role as an ultrasound tutor for this programme. I did not wish to provide a situation in which a conflict of roles could affect the academic rigour of the students’ training or my PhD. Exploring learning experiences in ultrasound has not been documented before and, in fields in which a paucity of research on experiences or learning exists, there are those (Clandinin and Connelly 1988; Clandinin and Connelly 1994; Silverman 2001; Denzin and Lincoln 2003) who advocate small sample sizes so that the outcomes can be used to improve understanding of the field and eventually influence practice.
Inclusion criteria for pre-qualified sonographers:

- All participants had to be registered on a CASE accredited ultrasound programme.
- All participants had to be attending the first module of an ultrasound programme.
- All participants had to have a successful outcome, i.e. successfully pass the module.

Exclusion criteria for pre-qualified sonographers:

- Participants were excluded from the study if they did not complete the 12 months of learning, i.e. if they left the course [as some did], their data was completely excluded from the study.

The qualified sonographers were based in one of four hospitals in the north-west of England, each sonographer was qualified in ultrasound scanning.

Inclusion criteria for qualified sonographers:

- All participants had to have previously worked full-time in ultrasound scanning since qualifying.
- All participants had to be currently working full-time in ultrasound scanning.
- All participants had to be currently working predominantly in obstetrics and gynaecology.

Exclusion criteria for qualified sonographers:

- Participants who had not worked full-time in ultrasound scanning since qualifying.
- Participants who had not worked predominantly in obstetric and gynaecology scanning.
The data generation method involved sixteen observations and twenty semi-structured interviews with four pre-qualified sonographers and six observations and semi-structured interviews with six qualified sonographers (Table 1). All the sample were female.

**Table 1 Overview of sample profile used in this study**

<table>
<thead>
<tr>
<th></th>
<th>No. of participants</th>
<th>Total no. of observations</th>
<th>Total no. of interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-qualified sonographers</td>
<td>4</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Qualified sonographers</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>22</td>
<td>26</td>
</tr>
</tbody>
</table>

It normally takes twelve months to complete the first clinical practice module in an ultrasound programme. Meetings to conduct observation and interview with pre-qualified sonographers were planned to be held in every three-month period (see Table 2).

**Table 2 Observation and interview plan for pre-qualified sonographers**

<table>
<thead>
<tr>
<th>Meeting</th>
<th>Period from starting the course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting 1</td>
<td>1/2/3 months</td>
</tr>
<tr>
<td>Meeting 2</td>
<td>4/5/6 months</td>
</tr>
<tr>
<td>Meeting 3</td>
<td>7/8/9 months</td>
</tr>
<tr>
<td>Meeting 4</td>
<td>10/11/12 months</td>
</tr>
</tbody>
</table>

Due to time constraints, it was not possible to meet with each participant at the same point in any 3 month period. Pre-qualified sonographers are qualified health care professionals in their own right and often would have commitments in their professional areas to attend to as well as time to attend university.
All observations and interviews took place on the same day. Meeting 4, observations and interviews, were held before each learner was summatively assessed. On successful completion of assessments, a further interview was held with each pre-qualified sonographer. The purpose of this was to return to the interview transcripts and discuss the emerging themes. This was part of the evaluation process described in detail in Chapter 7.

All interviews were recorded and transcribed verbatim. As part of the sampling process, an initial contact by telephone was made to potential participants to introduce the research project and this was followed up with information sheets (Appendix 4) on the study.

All the pre-qualified sonographers in the sample were successful and met the criteria for the award of being competent to scan in obstetrics and gynaecology after twelve months of study.

As in any piece of research, the data generation process did not always run smoothly. Three participants gave up their studies part-way through their course and hence had to be excluded from the sample. Two of these were radiographers, one female, one male; the third participant to leave was a female midwife. This caused difficulties in generating the data because recruitment to courses in ultrasound typically occur every twelve or eighteen months, and thus the period of data generation was extended to include a fourth learner. On reflection, recruiting more participants may have avoided the need to extend the data generation period. However, due to small numbers training in ultrasound in the region, these options were limited.

All the pre-qualified sonographers were enrolled on part-time courses. This meant that they divided their time between attending university, scanning and work commitments.
All pre-qualified sonographers scanned for a minimum of fourteen hours per week and observed on four occasions over a twelve-month period, with each visit lasting between three and five hours (see Table 3).

Table 3 Time spent with pre-qualified sonographers; observation and interview

<table>
<thead>
<tr>
<th>Learner ID</th>
<th>Meeting 1</th>
<th>Meeting 2</th>
<th>Meeting 3</th>
<th>Meeting 4</th>
<th>Meeting 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA</td>
<td>O: 3.00</td>
<td>O: 3.00</td>
<td>O: 2.50</td>
<td>O: 3.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I: 1.00</td>
<td>I: 1.00</td>
<td>I: 1.00</td>
<td>I: 0.75</td>
<td>I: 1.00</td>
</tr>
<tr>
<td>LB</td>
<td>O: 3.00</td>
<td>O: 3.00</td>
<td>O: 2.75</td>
<td>O: 2.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I: 1.00</td>
<td>I: 1.25</td>
<td>I: 1.00</td>
<td>I: 0.75</td>
<td>I: 1.00</td>
</tr>
<tr>
<td>LC</td>
<td>O: 3.00</td>
<td>O: 3.00</td>
<td>O: 3.00</td>
<td>O: 2.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I: 1.50</td>
<td>I: 1.25</td>
<td>I: 0.75</td>
<td>I: 0.75</td>
<td>I: 1.00</td>
</tr>
<tr>
<td>LD</td>
<td>O: 3.00</td>
<td>O: 3.00</td>
<td>O: 2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I: 1.25</td>
<td>I: 1.00</td>
<td>I: 1.00</td>
<td>I: 0.75</td>
<td>I: 1.00</td>
</tr>
</tbody>
</table>

Key Table 3:
Learner A-D: 4 Pre-qualified sonographers

[LA-LD]: Annotation used to represent each pre-qualified sonographer in presentation of narratives in chapter 5

Meetings 1-4: 3 month period for conducting observation and interview with pre-qualified sonographers

Meeting 5: Interview held with pre-qualified sonographers, after final assessments.
All units are in hours

O: Observation
I: Interview
Figure 2 shows a profile of the combined hours (observation and interview) spent with each learner during each stage of learning.

Note: The hours for visits I and II are broadly similar, and the hours for visits III and IV are broadly similar, but there is a slight reduction in the time spent with the learners in the two later visits compared with the two earlier meetings. This could be due to learners being more relaxed about being observed and interviewed which meant the interviews were conducted in slightly shorter times.

The 5th visit was to conduct an interview only.
Each sonographer was assigned to a category dependent upon their experience (see Table 4). Due to the timescales involved, a cross section of qualified sonographers for each stage of experience was invited to participate and two sonographers were selected for each category.

Table 4 Categories of scanning experience related to time since qualification

<table>
<thead>
<tr>
<th>Category descriptor</th>
<th>Years post-qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newly qualified</td>
<td>0–2.5 years</td>
</tr>
<tr>
<td>Intermediate</td>
<td>2.6–5 years</td>
</tr>
<tr>
<td>Experienced</td>
<td>&gt; 5.1 years</td>
</tr>
</tbody>
</table>

The inclusion and exclusion criteria, whilst providing a consistent timescale of experience, limited the sample size; it was important that all the participants had similar lengths of time in service for each category otherwise variable experience could not be accounted for in the data analysis.

Each of the six qualified sonographers was visited on one occasion for observation of practice and interview; each visit lasted between four and four-and-a-half hours (see Table 5). During the visit, observation notes were shared with participants. There was also an ongoing dialogue in between patients between the qualified sonographers and me, some of these conversations were recorded if they related directly to the field notes which we were discussing at the time.

Each interview was followed up and participants were given the opportunity to review the transcript. At the same time, broad agreement was sought on emerging themes.
Table 5 Profile of the qualified sonographer participants

<table>
<thead>
<tr>
<th>Learner ID</th>
<th>Meeting 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newly Qualified sonographer A [NQA]</td>
<td>O: 3.00</td>
</tr>
<tr>
<td></td>
<td>I: 0.75</td>
</tr>
<tr>
<td>Newly Qualified sonographer B [NQB]</td>
<td>O: 3.00</td>
</tr>
<tr>
<td></td>
<td>I: 1.00</td>
</tr>
<tr>
<td>Intermediate Qualified sonographer A [IQA]</td>
<td>O: 3.00</td>
</tr>
<tr>
<td></td>
<td>I: 1.50</td>
</tr>
<tr>
<td>Intermediate Qualified sonographer B [IQB]</td>
<td>O: 3.00</td>
</tr>
<tr>
<td></td>
<td>I: 1.25</td>
</tr>
<tr>
<td>Experienced Qualified sonographer A [EQA]</td>
<td>O: 3.00</td>
</tr>
<tr>
<td></td>
<td>I: 1.25</td>
</tr>
<tr>
<td>Experienced Qualified sonographer B [EQB]</td>
<td>O: 3.00</td>
</tr>
<tr>
<td></td>
<td>I: 1.50</td>
</tr>
</tbody>
</table>

Key Table 5:
Learner ID: 6 qualified sonographers

[NQA-IQB-EQB]: Annotation used to represent each qualified sonographer in presentation of narratives in chapter 6.

All units for meeting 1 are in hours

O: Observation
I: Interview

Ethical approval was acquired before data generation was commenced. An overview of the ethical approval process with consent pro formas and information sheets are to be found in Appendices 3, 4, 5, 6.

3.5 Pilot study

In qualitative research, it isn’t typical to pilot the research methodology. However, critics of qualitative approaches often question the credibility of data generation processes as being unsystematic. It was important, therefore, to pre-test (Silverman 2001) field note recording and interview processes before commencing the main study. I took the opportunity to conduct a pilot study on two pre-qualified sonographers progressing towards qualification.
The pilot study was conducted over four stages, each of three-monthly periods of learning. Differences in the actions for each stage of learning were observed, some of which were also reported in the narratives.

The outcomes of the pilot study revealed the difficulty in creating field notes. Hence, I developed the use of diagrams to assist the recording of data.

Two of the challenges during interviews were allowing participants to talk without me interrupting and convincing the learners that I wasn’t seeking a hidden truth.

Developing an active interchange between the participant and me would encourage conversation (Holstein and Gubrium 1998) and promote opportunities for respondents to ‘tell their own story’ (Riessman 1993; Frank 2003).

Developing my listening skills was also challenging and was necessary to allow participants to speak with minimal interruptions.

Each interview proceeded with a focus on the general themes of interest and then moved to the specific (Payne 1951 p34). I developed phrasing of questions to include the use of probes. These are useful in following up any statements which required more detail (Payne 1951 p43). Interviews are co-constructed between participants (Riessman, 1993) and the data generated is representative of the issues of importance at that point in time. Pauses and non-verbal communications contribute to the interview, and it is these variations across the interviews that are also valuable contributions during data analysis (Mishler 1986 p52).

Conducting a pilot study was a useful exercise in that it raised awareness of the challenges that recording field notes and conducting interviews hold for the researcher. It is the intention to explore further the issues that interviews present for the researcher. The data in the pilot study was not used in the main study.
3.6 Methods of data generation

This section provides an overview of the method and explains the two methods of data generation; firstly, participant observation will be outlined, followed by a discussion of semi-structured interviews.

3.6.1 Participant observation

Participant observation was used in this study to generate data from pre-qualified sonographers on sixteen occasions and six occasions with qualified sonographers. Embedded traditionally in ethnography (Bowling 1999), observational methods seek to enable direct observation of practice and enable the observer to be part of the cultural and social settings (Mason 2002 p55; Atkinson and Hammersley 1994). Whilst this has advantages for gaining access to clinical scanning to experience the behaviours and interactions that take place (Coffey 1999), it meant my physical presence would impact on the dynamics of the department. It was important to consider critically how my role would impact according to different situations involving practitioners and patient. Immersing myself in some of the daily activities enabled me to become part of the team. This developed in different ways depending on whether the participant was qualified or working towards qualification. Arriving early in the morning, sitting in the staff room engaging in discussions, preparing the scan rooms and escorting patients to different parts of the clinic were some of the activities that I felt on reflection helped me to be seen as ‘being part of the ultrasound team’.

Whilst sitting at the back of the scan room gave me a good view of the interaction between learner and probe, scanning actions and image on the monitor, it also served to minimise my presence during the scan with the pre-qualified learners. Despite this, however, it was reported that pre-qualified sonographers felt more nervous than usual.
and perceived conversation with patients to be limited 'for fear of saying the wrong thing' because I was observing them. As our relationship developed however, they took the opportunity of my presence to ask for feedback and I became more involved with the learner during the scan.

In contrast, the qualified sonographers appeared more comfortable with my presence and often would either invite me to stand or sit adjacent to them whilst they scanned. Field notes of observations that focused on the scanning process were recorded. It wasn’t the intention to record every finite detail (Riessman, 1993); rather, groups of activities, together with actions, and communications were recorded. The observations focused on activities associated with communication with the patient [seeking patient consent, asking questions about medical history, answering patient questions], and the scan performance, including navigation of the probe, arm movements, angulations of the probe, interaction with equipment controls and image interpretation. In addition observing pre-qualified learners receiving feedback from the sonographer was noted during stages I–IV. Documenting observations is recognised as challenging by those in the field and I developed a system as suggested by Wolcott (1999) that incorporated diagrams, symbols and abbreviations in an attempt to record as much detailed information as possible whilst simultaneously listening, observing and communicating with participants.

Whilst recording activities in a systemised way provides some insight into 'what' happens in scanning practice, it doesn’t provide the reasons 'why' they took a particular action.

Observation is often criticised as a method that provides interpretation; however, combined with other methods, it enriches the data generation since it is possible for a researcher to experience first hand the actions of the participant (Mason 2002 p85).
Field notes generated from observations were shared with each participant either at the end of each scan or at the end of the session. The intention was to seek agreement that the notes were a fair representation of the events that took place in the scan room. There were opportunities to amend information once agreed between researcher and participant; these notes then informed the interview process.

3.6.2 Semi-structured interviews

The purpose of the interview process was to generate narratives of learning experiences in order to seek a better understanding of why the actions were performed by the learner. Through their work of narratives and learning experiences in the classroom, Connelly and Clandinin (1986) have shown how participant observation has been successfully combined with narrative analysis to find out why certain activities have been performed. Furthermore, the co-constructed nature of the data generated in this way is appropriate for developing theory around practice, and brings a novel approach to understanding action (Connelly and Clandinin 1986). The role of narrative is to enlighten us to the world of the learner and in this way reveal a wholeness: a thick description (Mattingly and Lawlor 2000), rather than fragments that are selected purely to become the researcher's property.

A total of twenty-six semi-structured interviews were conducted during the study and involved one-to-one interaction. Twenty interviews were held with the pre-qualified sonographers and six interviews with the qualified sonographers. The interview strategy aimed to promote an active and constructive process (Holstein and Gubrium 1998). During the exchange, the intention was to promote a constant interplay of speaker and listener in order to jointly construct stories and to provide opportunities for narratives to emerge (Riessman 1993; Holstein and Gubrium 1998). Despite the intentional and unintentional turn-taking in 'conversation' (Mishler 1986),
there were often periods of silence and hesitancy within the interviews which didn't produce narrative. The silent periods are valuable contributions in which participants reflect on their experiences.

The tapes were professionally transcribed by qualified audio typists, and the transcript in itself represented a reconstruction of the interview (Mishler 1986). Whilst taped interviews provide a decontextualised reconstruction of the interview, reading the transcript in conjunction with listening to the tapes helps to identify the dominant issues. Brief notes were made about events that occurred during the interview, for example, if a learner became anxious or wished the recording to be stopped.

The interview data was generated by an interchange of verbal and non-verbal communication between both of us as part of the interview process (Mishler 1986). Topics identified from the observation of scanning activities were covered during the interview process. A semi-structured interview format was used to provide a flexible structure (Mason 2002 p62), whilst keeping closely to the aims of the study. The purpose of the design was to facilitate the telling of stories: to assist each participant to tell their story in their own way.

Narratives are constructed on reflections of personal experiences and the interview plan included questions intended to promote reflection on scanning practice (Risner 2002) (see appendix 7 for the interview guide). The questions in the interview guide are based on Moons (2004) suggestions for framing questions. These are intended to promote reflection on learning experiences. The interview questions were designed to be open and provide opportunity for participants to start telling their stories from any point in the scan process and any point in the session. Moon (2004) suggests framing questions in a way that lets the teller recount their stories in their own words, this has advantages as it provides a balance between giving the tellers some degree of freedom.
whilst following the boundaries of the study. To begin with participants were asked to recount what went well; what they had found challenging; thereafter questions were asked that built on these responses and included reference to notes and details recorded during observation. Observations of practice were included in the questioning to enable each participant to not only focus on detailed aspects of their practice but also talk more globally about their experiences. Concentrating on actions observed during the scanning sessions focused the interview on the individual. Through attending to these actions, the aim was to understand the experiences of scanning both at pre-qualification stages and post-qualification stages. Thus, participants were encouraged to ‘tell their own stories’ in their own way (Riessman 1993; Frank 2003).

Despite encouragement to tell their own stories, I was aware that learners saw me as a health care professional with domain knowledge. Particularly in the early stages of learning, I was aware of the potential imbalance which could lead to learners adopting the position that their knowledge in some way must match mine and my expectations: that they must provide me with the ‘right’ answer. Accordingly, Heritage (1998 p178) recognises that in such ‘asymmetry’ type relationships, for example the doctor/patient relationship, imbalances exists where the participant in the interview considers himself or herself not to be able to respond ‘correctly’ because of the knowledge difference. I therefore sought to prepare participants for the interview. Accordingly, Mishler (1986 p54) notes that, whilst interviewers often design themselves a set of guidelines, there is no clear ‘set of rules’ for the interviewee, which can lead to interviewer dominance. Whilst I wanted the interviewees to take responsibility for the meaning of their talk, I had to provide a focus to the interview which inevitably meant that I led the interview to some extent. The advantage of semi-structured interviews is
allowing informal discussion to take place whilst keeping to the focus of the study (Mason 2002 p62).

Used in combination, participant observation and semi-structured interviews are appropriate methods for gaining a better understanding of learning scanning. Teachers' learning experiences have been explored using these methods in combination (Connelly and Clandinin 1990) and Mason (2002) agrees that multidimensional data generated through observation, interview and narrative analysis are powerful methods to develop a better understanding of experiences.

3.7 Method of data analysis

This section discusses narrative in the context of professional learning and examines the role of narrative in analysing learning experiences in ultrasound scanning; this is followed by an overview of the narrative analysis process.

Qualitative research conducted and analysed in a particular context holds particular meaning for those engaged with it; how this meaning is expressed may be revealed in narrative form.

Accordingly, Polkinghorne (1988) recognises that not all knowledge is context-free and much of the meanings and activities associated with knowing are embedded within existing clinical cultures. Telling stories provides a forum for the learner to 'tell it how it is for them'. Narratives convey meaning by drawing on the actions and events that are important to them at that particular time.

Since reflection on learning increases self awareness (Moon 2004), it is conceivable that understanding learning through narrative may reveal elements of reflexive learning based on day-to-day learning accounts in ultrasound scanning. Accordingly, the evaluative clause within Labov's process of narrative analysis (Labov and
Waletzky (1967), as the reflective component of narrative, is particularly useful for capturing reflections of learning in the professional context.

3.7.1 Narrative and professional learning

Professional learning such as that in health care draws upon reflection on practice to further education and development (Moon 2004). Active involvement, such as that experienced through observation and interview with those learning and practising ultrasound, can provide opportunities to develop a better understanding of learning experiences. Thus, practice, as Connelly and Clandinin (1986) point out, is the starting point for enquiry.

To understand learning experiences better, emphasis is placed on the processes leading to the action (Connelly and Clandinin 1986). One of the advantages of narrative analysis is that it can take into account the professional nature of the event and the thinking processes that lead to why the action took place, which provides a contextual way of knowing (Connelly and Clandinin 1986).

Accordingly, Shern (1983 p7) cited in Johnson and Golombek (2002) has suggested that stories are all about 'knowing in action' and that stories foster the relationship between knowing and practice, thus the interview process has the potential to provide a forum for reflection on learning experiences in scanning.

Critical analysis followed by evaluation of the experience is part of making meaning of the event (Riessman 2003) and, since reflection on practice is as an integral part of experiential learning (Moon 2004), learners in ultrasound should be encouraged to account for a particular event in reflective ways. Narrative, according to Polkinghorne (1988), is about exploring interaction and, as ultrasound is interactive, narrative has the advantage of offering a way to explore the interactions associated with the probe and equipment controls and between the learner and sonographer.
Narratives are not just about the present situation, however, but also draw on past experience in order to evaluate the present context and consider future implications for practice (Clandinin and Connelly 1995). Clandinin and Connelly’s (1995) teachers’ professional knowledge landscape metaphor connects personal knowledge with professional knowledge. It proposes that professional knowledge has a sense of expansiveness and thus narratives of learning experiences in ultrasound offer in the same vein opportunities for the learner to explore their practice in context and plan his or her next set of actions.

According to Johnson and Golombek (2002), in their enquiries into experiences of teaching, learners reflect on their learning in order to narrate their experiences. Indeed, their narratives reveal and allow them to reflect on how they have come to understand their experiences and their perspectives on their own learning.

Since constructed knowledge cannot be separated from the knower (Connelly and Clandinin 1986), it can be argued that experiential learning and narrative have similar processes in their construct, as reflection has a role in the processing of information both in the learning process and in the construction of narrative.

One of the advantages of using oral narratives as representing experiences of learning scanning is to promote reflection on activities. According to Moon (2000 p147) and Eisner (1991), representing learning as a form of oral expression encourages reflection, thus offering learners the opportunity to tell their stories of learning through interview can encourage reflection on scanning practice and enhance the learning process (Shulman 1987).

During reflection, each learner organises and reorganises his or her knowledge of events to bring meaning and understanding to these activities. New experiences are blended with previous knowledge and new knowledge synthesised. Accordingly,
Reflection is an integral part of experiential learning and learners may be encouraged to account for a particular event by telling stories. Narratives are constructed through reflective processes and thus narratives of learning experiences can go some way to elucidating those learning experiences in ultrasound scanning.

3.7.2 Narrative analysis

It is not only the combined methods of participant observation and semi-structured interview but also the process of interpretation of narratives that is important in deriving meaning (Denzin and Lincoln, 2003). Learners' narratives have been explored to identify themes within narratives and those that extend across learners' narratives (Sweetland, Huber et al. 2004). Firstly, narrative clauses were identified using Labov and Waletzky's framework of narrative structure (1967). Rooksby and Kay (2003) used Labov in their analysis of reporting structures in Radiology work processes but not for learning. Secondly, narratives were analysed and themes identified (Agar and Hobbs 1982). Examining themes for coherence within and across narratives enabled dominant themes to be identified. It is these, combined with a summary of the actions, that provide the foundation for the development of the Framework of Learning Experiences in Ultrasound Scanning presented in Chapter 7.

Since Labov and Waletzky (1967) first published their framework of narrative clauses, there has been little published that provides such an explicit method for identifying and analysing narrative. Criticisms of their early work that tellers don't necessarily relate their stories in strict chronological ordering of events have been confirmed by Labov's later move away from such thinking. Despite these criticisms, Labov's outline of narrative clauses has been adopted as a method for analysing narrative, particularly by those exploring life experiences (Mishler 1986).
Accordingly, whilst the list of narrative clauses may be useful as a guide to identifying narrative, it isn’t necessary for all these elements to be present to constitute a narrative and, moreover, these elements may appear in any order (Mishler 1986 p80).

There are six main clauses identified that constitute narrative:

- Abstract
- Orientation
- Complicating Action
- Evaluation
- Resolution
- Coda

( Labov and Waletzky 1967 )

A summary of each clause follows. The abstract is normally at the beginning of the narrative and is a summary of the account. The people involved, together with spatial and temporal aspects, are identified within the orientation. The complicating action or plot, the ‘story’, contains the sequence of events. In a minimal narrative, this is all that may be present (Mishler 1986 p80). Evaluation is the ‘reflective’ element of the narrative. The resolution includes the result of the action. The coda is where there is a return to the present situation. If the point of the story has been evaluated, then some inference may be derived that refers back to the present context (Mishler 1986 p80).

Once each narrative had been identified, analysis for themes and their coherence followed. Drawing on Agar and Hobbs (1982), coherence in discourse is exploring the relational element of narratives and thus is valuable in a longitudinal study of learners’ experiences. Whilst exploring themes within each narrative provides some insight into the individual learning experience, exploring themal coherence across and
within narrative (Sweetland, Huber et al. 2004) enables dominant themes to be identified. This approach has two benefits: themes were evaluated in the context of existing literature and then compared with themes drawn from other narratives within the same stage of learning and across different stages of learning in this study. Examining coherence in this way preserves the wholeness of narrative (Mishler 1986 p91) and is beneficial in taking into account the context of the interview.

There have been attempts by some to describe types of narrative. Gergen and Gergen cited in Polkinghorne (1988) have described narratives in relation to progress towards a goal; ‘the stability narrative’ (progress remains unchanged), ‘progressive narrative’ (progress towards goal is made), regressive narrative’ (move away from the goal). Similarly, Frank (1997) offers 3 types of narrative told by those experiencing long term illness, that is, chaos, restitution and quest narratives. These narrative types show progression in the way that those suffering illness come to deal with it.

In the broader sense, quest narratives have been used to describe stories about life’s journeys. There are similarities here with the learning journey and narratives of experiences on a learning journey may be described as quest narratives. Quest narratives describe the whole journey. This holistic term however doesn’t reflect types of narrative at each stage of learning. As part of the narrative analysis process, types of narrative told at each stage of learning will be described.

Critically reviewing the data in the context of published research was also part of the analysis to enable what Mishler describes as ‘expansion of meaning’ (1986 p95). This has the advantage of embedding this new knowledge in existing theories in order to contextualise meaning. A summary of the narrative analysis process is outlined below in figure 3.
3.8 Method

Prior to each scan, patient consent was obtained for me to be present in the scan room during the scan. During each observation, I stood at the back of the room behind the participant. From this point, I could see the arm/hand position, the grip of the probe, probe movements and the monitor. I could also observe the equipment controls being used. Each participant was observed scanning. Notes were recorded of the observations. I remained silent during each scan and left the room on completion of the scan.

If there was time between patients, I would chat through the observations with each participant. Each observation session would last for either a morning or afternoon period.
At the end of each session, I interviewed each participant using the observations as a basis for the interview. Each interview was held in a room within the clinical setting but away from distractions. All interviews were recorded.

Interviews were transcribed professionally verbatim and the transcripts reviewed by each participant. Revised transcripts were agreed with the participant as a true record of the interview.

Analysis of each transcript included replaying of the tape to help understand the tone and emphasis of the conversation together with the silences. This helped to provide a context when reading the transcript. Field notes of the observations were also included at the same time in the analysis process.

Analysis of the transcripts, field notes and tapes was a continual process concurrent with the data generation in the qualitative research (Mason 2002).

The review of the transcripts to explore coherency with each participant helped to inform the process of developing themes (Agar and Hobbs 1982). Emerging themes were presented to the pre-qualified sonographers and formed the basis of a fifth interview held at the end of their formal training in ultrasound, before their final assessments. The purpose of this was to establish broad agreement on the themes. Emerging themes were also discussed at this point.

3.9 Summary

This chapter has explored the philosophical principles underlying the qualitative research approach for exploring learning experiences in the context of learning ultrasound scanning.
Observation and semi-structured interview as methods for data generation have been discussed and shown to be appropriate when used in combination for exploring experiences around teaching and learning (Connelly and Clandinin 1986).

Learning experiences in a professional context are linked with reflective processes that underpin learning (Moon 2004); reflection is part of active interviewing and can support the generation of narrative talk (Gubrium and Holstein 1998).

Typically, those using narrative to explore experiences, particularly around teaching and learning issues, involve small participant groups to generate data. The rich text produced from this approach has the advantage of providing knowledge in the situational context (Connelly and Clandinin 1986; Johnson and Golombek 2002; Silverman 2001).

Since participants and researchers co-create knowledge, what is known is understood and judged against these values (Denzin and Lincoln 2003). Riessman (1993), for example, recognises the co-constructed nature of narrative and the role of the researcher in the conducting of the interview. Reflexive approaches allow the researcher to develop an awareness of self in the research process and an exploration of his or her role in the research.

Validating knowledge is an integral part of the research process; revisiting interview transcripts with each learner provides opportunities to address clarity and agree content. Once content is agreed, ultimately it is the researcher’s interpretation and re-interpretation which leads to the construction of new knowledge. Constructing knowledge in this way draws on the contextually situated nature of clinical practice and the unique and shared experiences associated with learning scanning.

Narratives constructed through reflective processes can go some way to providing a better understanding of how ultrasound scanning is learnt. The analysis of narrative in
this study combines Labov and Waletzky's (1967) framework for identifying narrative structure with exploring each narrative for themes and themal coherence (Agar and Hobbs 1982; Mishler 1986), examples of two narratives with clauses identified are in appendix 8.

Narratives are co-constructed through reflection on practice and can go some way to providing a better understanding of learning experiences in ultrasound scanning.
Chapter 4 Staging characteristics of learning experiences

4.1 Introduction

This chapter presents an outline of the processes underpinning the development of the Framework of Learning Experiences in Ultrasound Scanning. It introduces the concept of using frameworks as representations of knowledge. It also illustrates how the data generated in this study has led to the development of a seven-staged framework. The stages within the framework, which is presented in full in Chapter 7, outline the characteristics of learning experiences.

Themes presented in the framework originated from the data. Observation of practice followed by semi structured interview were the starting points for the development of themes. The framework is based on the themed content which emerged from analyses of the pre-qualified and qualified sonographers' narratives of their learning experiences. This chapter introduces each of the seven stages of the framework and shows how the data collection informed each stage in the framework. It is the characteristics of learning experiences derived from these themes that are presented in the seven-staged framework of scanning.

The framework provides the scaffold for presentation of the data on pre-qualified sonographers' learning experiences as they progress towards qualification and presents characteristics of learning experiences for each of the stages (I-IV). It also provides a scaffold for the presentation of data on qualified sonographers' learning experiences as they progress towards excellence in scanning and presents characteristics of learning for each stage (V-VII).

In the literature that focuses on representing health practice, there is a wide range of terms used interchangeably to describe frameworks and models, with little attention paid to how each may be defined. As such, there is no consistent application of these
terms (Fawcett 1992; Dennis 1998; Elkan, Blair et al. 2000; Donovan, Egger et al. 2002). Moreover, in reviewing mental health frameworks for practice, Barry (2001) offers no attempt to define framework, but compares the content of different frameworks and explores how one such framework 'operates within a ... model'. Conversely, Whitehead (2003) describes how evaluation models of health promotion can be 'incorporated routinely into existing frameworks of practice'. Furthermore, in an article which focuses on models for population health, frameworks of knowledge are used alongside evaluation of models of practice (Evans and Stoddart 2003); in a similar vein, Hughes and Goldstone (1989) in their study of midwifery practice use models and frameworks interchangeably. Chen (2001) herself describes her model to assess perceptions of need for nursing homes as a 'conceptual framework', whilst Hampton (1994) highlights the need for conceptual frameworks in nursing to guide practice.

This lack of consensus demonstrates the importance of considering the role of frameworks to represent knowledge.

4.2 Frameworks as representations of learning

In its simplest description, a framework is 'a structure underlying a system' (Pearsall, Oxford English Dictionary 2001), where a system is a 'set of related parts of a complex whole'. These descriptions highlight the importance of the relational value of the structural aspects of a framework. From a postmodern perspective, a framework of learning is a way of representing learning opportunities. Learning events and supporting actions for that learning presented in an interconnecting network will provide a relational concept.

Components described as stages may operate to represent guiding principles to show progression in a learning journey. These guiding principles based on learning
experiences at a particular stage may be described as characteristics of learning experiences.

Using a framework to represent knowledge provides a way of charting knowledge related to the learning of ultrasound scanning. The presentation of ultrasound learning in an experiential framework is a new concept in medical imaging.

The framework represents learning experiences in ultrasound across stages of learning and therefore offers an opportunity for it to be a research tool to demonstrate progress along a learning journey. The framework has the potential to provide evidence of learning experiences at an appropriate stage in a practitioner’s quest towards achieving excellence in scanning.

4.3 The purpose of the framework

The purpose of this framework is to represent learning ultrasound scanning in a staged approach. It is a first attempt to research learning scanning and presents ultrasound learning experiences in an experiential framework which provides a way of charting progress. The framework is derived from themed content which emerged from participants’ narratives as they recounted their learning experiences at different points in their learning.

Accrediting and professional bodies involved in ultrasound education in the health care sector are responsible for monitoring and evaluating standards in ultrasound education provision. Despite the fact that standards leading to qualifications in ultrasound scanning are represented by higher education awards, how learners progress towards these standards of achievement is not currently documented in published literature. Furthermore, how sonographers progress towards achieving excellence in scanning is also uncharted.
The outline framework comprises seven stages of learning, four of which are pre-qualification and three are post-qualification. A staged framework provides the opportunity to demonstrate progression in scanning development and the stages are numbered I–VII. These stages are not impermeable and it is the intention to explore the dominant narratives of learning in and across these stages.

The stages will be mapped against descriptors of Fitts's (1964) three-stage approach to skill acquisition and Benner's (1984) Model of Skill Acquisition in Nursing Practice to show whether progression in learning scanning follows established modes of skill acquisition.

4.4 Stages

The first four stages (I–IV) represent developing scanning skills towards competence. This longitudinal aspect of the study charts four pre-qualified sonographers as they progress towards qualification. Each stage, I–IV, represents a timeframe of learning; each stage is over a three-month period. Thus, stages I–IV represent learning during a twelve-month period. Each stage permits the documentation of learners' narratives and scanning performance.

Each of the stages V–VII represents the progression of qualified sonographers towards excellence in scanning. This cross-sectional aspect of the study documents differences in narratives and scanning performance over periods of two-and-a-half years, where five years' experience or more is considered experienced (Benner 1984). Stages V–VII will only be compared with Benner's (1984) Model of Skill Acquisition, given that these are qualified staff.

Stage I

Stage I of the framework represents learners' experiences at the beginning of their training. It spans the first three months of learning.
In this study, evidence from learners’ narratives and observations of practice will be compared with descriptors of Fitts’s (1964) cognitive stage of skill acquisition and Benner’s (1984) novice stage of learning.

Stage II
Stage II of the framework represents learners’ experiences when they are three to six months into their learning. Evidence from learners’ narratives and observations of practice will be compared with descriptors of Fitts’s (1964) associative stage of learning and Benner’s (1984) advanced beginner.

Stage III
Stage III of the framework represents learners’ experiences when they are six to nine months into their learning. Evidence from learners’ narratives and observations of practice will be compared with descriptors of Fitts’s (1964) autonomous stage of learning and Benner’s (1984) competent practitioner.

Stage IV
Stage IV of the framework represents learners’ experiences as they reach a significant point in the learning journey at which learners emerge from stage IV as qualified sonographers. It is a transitionary stage which spans the nine-to-twelve-month period of learning and assessments are carried out during different stages of this time frame.

Whilst this stage does not have an apparent equivalent in Fitts’s three-stage approach to skill acquisition, it is necessary to explore narratives and practice during this end point of learning to see if any changes in skill performance take place that relate to adaptation to novel situations in readiness to scan competently. Evidence will be compared with Benner’s (1984) competent practitioner.
Stage V

Stage V of the framework represents learners' experiences during the early part of their careers as qualified sonographers. This stage spans the first two-and-a-half years of the post-qualification period. Stage V narratives and observation of practice will be compared with descriptors of Benner's competent stage (1984).

Stage VI

Stage VI of the framework represents learners' experiences during two-and-a-half to five years post-qualification. The narratives and observations of practice will be compared with descriptors of Benner's proficient practitioner (1984).

Stage VII

Stage VII of the framework represents learning experiences of sonographers who have been qualified in ultrasound scanning for five years or more. Stage VII narratives and observations of practice will be compared with the descriptors of Benner's expert proficiency stage (1984).

4.5 Characteristics of learning experiences

Themes based around learning experiences will be explored, where learning experiences are opportunities for learning and support during that learning. For the purpose of this study, dominant themes have been selected and summarised as characteristics of learning for inclusion in the framework. Whilst this has limitations, it does enable shared experiences to be documented and dominant themes identified from the analysis of observation and narrative that underpin this process. The themes are developed through an iterative process of data analysis and originate from the observational and narrative data. Where themes presented for each stage of learning have been identified from the analysis of the data, they are also based around evidence from the literature and there
are some differences between the pre-qualified and qualified themes. Actions noted from observations will be analysed alongside the narrative commentary for each stage of learning.

Dominant themes for each stage of learning will be presented as characteristics of learning for each stage in the framework.

Stages I–IV themes are:

1. Communication with the patient
2. Observation of the sonographer
3. Role of feedback on performance
4. Role of practising scanning skills
5. Navigation skills
6. Image interpretation

Stages V–VII themes are:

1. Communication with the patient
2. Navigation skills
3. Image interpretation
4. Decision making

Communication with the patient is an integral part of clinical practice and changes in communication skills will be explored and compared across seven stages of learning. Feedback from supervisors and observation of practice are important aspects of skill acquisition (Anderson 1982; Wickens 1991) and, whilst there is debate in the literature around the timing and frequency of feedback, observation of practice has been seen as important particularly in the early stages of learning. The role of feedback and observation will be analysed in each of the first four stages of learning scanning. Practising skills in context is paramount to retaining knowledge and
successful skill acquisition in the long term (Gentile 1998) and, according to Fitts (1964), leads to automisation of skilled performance. The effects of practising scanning skills will be explored across stages I–IV.

Navigation in the context of scanning involves the ability to control the direction and speed of the probe to locate the area of interest, control the pressure of the probe and manipulate the equipment controls to produce high-quality images. Fine-tuning the probe to ‘home in’ on the detail is the final phase of probe manipulation. The aim is to automise these navigational skills and once this is achieved cognitive resources can be focused on developing decision-making skills (Anderson 1982). Progress in navigation skills will be explored across seven stages of learning.

Image interpretation skills will be analysed and compared across the four stages of learning. Evidence (Durso and Gronlund 1999 p293) suggests that image interpretation is inextricably linked with decision-making skills, which are integral to situation awareness. The first part of image interpretation is pattern recognition, the ability to perceive information in a particular context that is meaningful. Image interpretation will be explored during the first four stages of learning scanning.

During stages V–VII, data analysis will centre around the theme of decision-making skills. In the context of scanning, situation awareness relates to how well the sonographer understands the context and implications of the information presented both before and during the scan and therefore impacts on the ability to predict likely outcomes (Durso and Gronlund 1999 p283). It is suggested that decision-making skills lead on from image interpretation and precede situation awareness. In complex situations, experts assess the circumstances using a variety of cues more efficiently than novices. It is likely that, through a process of decision making, sonographers progress to being able to analyse the situation efficiently concurrently with adapting
scanning in the clinical situation. Decision-making skills are an integral component of expert practice in complex skilled performance (Durso and Gronlund 1999 p300). Accordingly, Benner (1984) recognises decision making as an integral part of the competent practitioner’s role and therefore decision making is included as a theme during stages V–VII.

4.6 Summary

The framework presents a staged approach to learning ultrasound scanning. The first part of the framework comprises four stages and presents progress of learning towards becoming qualified. The second part of the framework comprises three stages and presents progress towards excellence in scanning.

Clinical knowledge is acquired over time (Benner 1984) and individuals learn at different rates. The construction of this staged framework is derived from analysis of learners’ narratives at different points in their learning. Observation of practice and semi-structured interview were the starting points for derivation of themes. Each stage within the framework contains characteristics derived from themed content which emerged from analyses of participants’ narrative accounts of their learning experiences. Presenting themed content over seven stages may provide a better understanding of the processes involved in learning to scan and explore how progress in scanning develops over time.
Chapter 5 Pre-qualified sonographers' learning experiences

5.1 Introduction

This chapter presents a discussion of pre-qualified sonographers' narratives together with observations of clinical practice during stages I–IV of learning scanning. Narratives extracted from interviews based on observation of practice have been identified using the Labovian Framework, part of the narrative analysis framework described in Chapter 3. Each stage of learning is reported in a separate section and the discussion is structured around themes on communication, feedback, practising, observation of the sonographer, navigation and image interpretation.

For the purpose of the discussion that follows and to maintain participant anonymity, the four learners have been coded as follows:

- Learner A is referred to as LA
- Learner B is referred to as LB
- Learner C is referred to as LC
- Learner D is referred to as LD

5.2 Stage I learning experiences

During stage I, pre-qualified sonographers as learners acquire basic theoretical knowledge, develop fundamental navigational scanning skills and basic image interpretation skills, including hand/eye coordination skills, orientation and directional probe manipulation and recognition of basic anatomical features in the image. There is a lack of understanding of how this knowledge and these skills impact on scanning practice. As Benner (1984) notes, novices are expected to have acquired facts but not necessarily an understanding of the relationships between the underpinning concepts. It is this level of understanding that is reflected in the style in which some of the narratives are told. Within some narratives, for example, the lack of evaluative commentary suggests that the events which are described have little meaning in terms
of the scanning process as a whole. Similarly, narratives of teachers in early stages of
their careers have been noted to be simple descriptions of events which lack
reflection; this is known to be associated with limited experience and is often seen in
those with a narrow range of professional knowledge landscape (Clandinin and
Connelly 1995). The professional knowledge landscape is useful in this context; as
Clandinin and Connelly suggest, it’s the combination of practice and theory that
enables reflection on practice and which underpins the development of the
professional knowledge landscape.

Further, pre-qualified sonographers experience pressure of time and experience
anxieties around working in busy ultrasound departments. They share experiences of
having an unstructured, chaotic approach to their work. As part of this, pre-qualified
sonographers have a perception of ‘being slow at scanning’ and this is a dominant
feature within narratives. Being aware of holding up the list of waiting patients, they
often only perform a partial scan.

Despite each learner being a qualified health care professional, they describe
themselves as students. This in part is because of a lack of confidence due to
experiencing new clinical situations and has been noted in nursing (Benner 1984) and
midwifery students (Begley 2001).

For example, LA:

\[
\text{... the patient comes first, if the patient is willing for me to do the scan,}
\text{then (that’s okay), obviously I’m a student and the patient wants}
\text{somebody who knows what they are looking at and someone who is}
\text{obviously qualified.}
\]

Although each pre-qualified sonographer has their own professional knowledge
landscape on which to build, they don’t feel confident at this stage to be left alone
with the patient and describe their role as ‘student’ when in communication with
patients and colleagues. However, this expectation may be manifested by
departmental culture, as seen in midwifery students (Begley 2001). During later stages of learning scanning, they describe themselves by their professional identity. This lack of confidence is reflected in the way narratives are told. Indeed, narratives share similar features with Frank's (1997) chaos narratives. Whilst learners describe the events, these are not always in chronological order. These unstructured types of narratives are challenging to analyse and, combined with the lack of situational context in which to evaluate these experiences, means they lack a reflective element too. Frank (1997 p97–98) describes chaos narratives as told by those living in an anxiety causing situation, whilst he uses examples based around those with long-term illness; nonetheless, he describes the teller as situated in the chaos and, as they have not acquired sufficient experience in the situation, they are not able to reflect on their circumstances.

Narrative type is ‘chaos narratives’. Chaos narratives are stories told in the absence of a contextual framework (Frank 1997), whereby the narrator recounts details but lacks sufficient contextual experience to evaluate the significance of these. This lack of situational experience means that pre-qualified sonographers have limited understanding of the scanning process and acquire unassociated facts at this stage.

5.2.1 Communication with the patient during stage I learning

There is brief communication with the patient at the beginning of the examination and during the scanning examination. Communication is limited due to the intensive nature and concentration required as part of the learning process (Wickens 1991). The patient’s details and history are checked, although this is carried out at a superficial level in comparison with later stages and usually under close instruction. A brief overview of the examination is described to the patient whilst they are prepared for the scan.
Accordingly, this initial stage of scanning or cognitive stage, as Fitts (1967) describes it, is intensive because of the considerable amount of controlled processing that requires high levels of concentration from the learner (Fitts 1964). Since high levels of concentration impact on cognitive demands, such as a reduced capacity to talk (Lintern and Wickens 1991 p124), pre-qualified sonographers tend to scan mostly in silence and tend not to communicate well with the patient during this stage.

5.2.2 Observation of the sonographer during stage I learning

The role of observing the sonographer perform a scan is an important feature of learning at this stage. Learners tend to observe the hand/probe of the sonographer performing the scan and relate this to the image on the monitor. This enables them to link pattern recognition with probe movement and angulation and is important for developing anatomical knowledge. It also provides the foundations of the motor programme development. Accordingly, Wishart, Lee et al. (2000) identified observations of qualified practitioners to be valuable methods of learning in skill acquisition. Observation of demonstrators is widely accepted as a useful method of learning for both the novice and experienced operator alike (Scully and Newell 1985).

Learning through ‘observing’ predominates learning scanning during stage I. LD comments:

... Erm, probably a bit of what I’d tend to do is watch the screen but also trying to watch and see what they’re doing with their [sonographer’s] hands. I don’t know whether you could see that I was doing that, sometimes just to see how they are making that image look better and where they’re angling with the probe to get the better image ...

You know it takes a bit more experience but I try and pick up on what they’re looking at and ... they usually do sort of stop in the plane and tell me exactly what they’re looking at.
Observation provides a learning opportunity to acquire an outline of the whole
scanning process and to link the actions of the scan performance to the image on the
monitor.

5.2.3 Role of feedback on performance during stage I learning

Feedback on performance from the same sonographer does have many benefits to the
learner during this stage. Feedback should augment performance since basic scanning
skills, such as holding the probe correctly within the hand and holding the probe the
correct way round, are acquired rapidly. However, unless feedback is clearly
structured and given immediately after the action has occurred, opportunities for
learning are reduced.

Since pre-qualified sonographers lack a framework in which to situate these ‘new’
experiences, performance is governed by the need for clear instruction. Judgements on
whether their performance is acceptable are limited and lack evaluation in terms of
goal setting; in addition to this there is high reliance on their supervisor for guidance.
The call for close instruction and high levels of concentration are key factors in the
cognitive stage of learning (Fitt 1964; Anderson 1982).

Whilst hand steering guidance happened rarely and only when the sonographer
perceived the learner to be experiencing difficulty with a particular aspect of
scanning, it has been shown to be a useful method of learning a skill (Wishart, Lee et
al. 2000), particularly during early stages of learning. On occasions where hand
steering was used by sonographers to assist the learner, it was viewed as a useful
method of learning. This is highlighted during LA’s narrative:

... I think probably to get to grips with it at the beginning was just
working with one person who made sure that you always had the probe
held properly, that you knew which way the probe was, you know they’d
have it the right way up if you like cause they’ve all got a mark on to
make sure that you have them in the right position. And just to tell me off
if I angled it in wrong, or. So I think it’s ... I suppose somebody at the
beginning that's quite firm with you and strict with you and made sure that you hold the probe right from the beginning.

During stage I, feedback to learners varied. Two pre-qualified sonographers in this study received clearly structured feedback on a regular basis and reported that their progress was enhanced by this type of feedback; in comparison, the other two, who didn’t have structured feedback, felt they did not acquire a systematic scanning action as quickly as expected. It is not possible, however, to contribute this lack of progress to the quality of feedback at this stage and it could reflect their lack of ability.

LC opens her discussion with me by talking about the need for feedback. Feedback is important in establishing achievement; in this case, LC has received insufficient feedback:

... achieving something and then say something difficult arose say baby was just in a difficult position or the mother’s habitus was affecting it and then I think, do I know anything? And then I think, am I just guessing or am I just subconsciously aware of things? And I don’t know where I am in my level of thinking ... I think, have I just got the BPD on those babies cause I’ve just happened to have got them in good positions and anyone can get them, or am I using my ability and then when something’s difficult can I not get it cause it’s difficult or just because I’m not putting theory into practice? So I do think that a bit. And that’s my only worry and when will I know I’m getting better really? Because my first day I got a lovely in-profile but I got it spot on, I’ll never get that again. But that was I just [because] I put the probe in the right place, so that’s a concern ...

The effects of knowledge of results on skill acquisition are seen as a critical factor in the acquisition of a motor skill during the early stages of learning (Schmidt 1975; Weinstein and Schmidt 1990; Wulf, Schmidt et al. 1993; Schmidt and Wulf 1997; Goodwin, Eckerson et al. 2001). To develop basic scanning skills during stage I, learners need clearly structured guidance, and feedback should be clearly structured and given at the time of the action or as soon as possible after the event.
5.2.4 Role of practising scanning skills during stage I learning

Practise enables the development of routine and repeatable patterns. Ultimately, these routine scanning patterns lead to the development of a motor programme of scanning (Carter and Shapiro 1984), which enables the sonographer to plan and perform the scanning tasks.

During the planning and execution of hand movements in stage I, the motor programme, which coordinates motor activities, is underdeveloped and thus learners lack the coordination to observe the image and distinguish anatomical features clearly and in a controlled manner. Whilst a motor programme acts as a framework to operationalise and control sequential movements of the arm/hand/probe, it also enables a consistent and efficient scan performance. Thus, practising skills contributes to the development of such a motor programme.

During the acquisition of these skills in stage I, it is necessary to focus pre-qualified sonographers’ attention on one aspect of the task. Performance of a task requires their complete attention and, as each part of the task is performed, feedback on performance as mentioned previously is imperative for learning.

Ultimately, each task needs to be performed in sequence and thus as multiple tasks are performed there is a need for concurrent processing (Wickens 1991). Receiving and processing information in this way leads to scanning actions becoming continuous and integrated, which produces an efficient scan performance. How well this is achieved during learning, however, is dependent upon the relationship between the individual task elements to be performed. If there are similarities between certain processing routines then concurrent processing may be performed efficiently; however, antagonistic task elements or task elements becoming jumbled between different routines means that there is competition for processing information which inhibits the
efficiency of concurrent processing (Wickens 1991 p4). For example, the need to focus attention on developing hand/eye coordination skills is necessary for the orientation of the image and inhibits the verbal resources in the individual. Once these movements become automised, however, it is easier to have a conversation (Wickens 1991).

Anxiety about the fetus being viable and the fear of discovering abnormalities feature widely in the narratives during this stage. A recurring theme across the narratives is a need for the patients to be chosen for ease of scanning. Often pre-qualified sonographers referred to the ideal patient as someone who is slim and easy to scan. Consequently, they may focus on constructing a systematic pattern of scanning which will be repeatable in the future. Since this pattern will form part of the motor programme of scanning, having easy patients to scan assists in the acquisition of navigational skills.

Repeated practise develops awareness of image pattern recognition and this in turn leads to the development of the use of the visual cues; fetal head, body and heart used as key visual landmarks during scanning performance. Using visual cues to improve spatial knowledge is also demonstrated during insect navigation (Tong, Marlin et al. 1995). The landmarks identified by the learner in the sonographic image determine the next movement of the probe; this may be a directional movement to a different position, or a rotational, angular movement about a fixed point. These fundamental movements, whilst discrete at this stage, do form the basis of scanning skills development.

Practising scanning to develop the basic skills is important at this stage and is linked with observation of the sonographer and the need for the sonographer to provide clear direction for practise to enable the learner to manoeuvre the probe confidently.
5.2.5 **Navigation skills relevant to stage I learning**

Acquiring navigational skills presents a significant challenge to the pre-qualified sonographer. Scanning movements are discontinuous and inelegant at this stage and learners are not able to orientate the probe sufficiently to achieve controlled movements of the probe. Similarly, Benner (1984) reports the faltering nature of novice nurses in carrying out basic nursing skills.

Scanning to find marked features of anatomy, such as the fetal head, body and heartbeat, is unstructured and lacks a methodical approach; rather than trying to complete a whole scan, learners concentrate their scanning on finding these key landmarks.

For scanning to become structured, learners need to develop a navigational strategy. Navigation is the ability to travel from a starting point to a destination along a pathway. To develop navigational scanning skills, learners need to decide on the direction and speed of probe movement and develop spatial awareness (Collett, 1996; Gillner and Mallot 1998). Spatial awareness in the context of scanning presents the biggest challenge because not only do learners need to know the extent of the boundaries for probe movement but also align these with the space occupied by the developing baby in the maternal abdomen.

Frequent observation of the hand/probe helps learners develop spatial awareness skills, since visual input is important for gauging relative limb position, visualisation is known to be a critical factor in the control of limb movements during skilled performance and, since visualisation of the hand enables an individual to perceive spatial orientation of limb movements, such as the arms during a reaching movement for example (Fleischer 1989; Mohrmann-Lendlia and Fleischer 1991), it follows that observation of the hand/probe is important in scanning as learners develop their
ability to control not only the directional movements of the probe but also the speed of execution of movements.

Efficient performance of scanning is dependent upon these separate movements and angulations of the probe being sequenced to appear smooth and continuous (Fleischer 1989). Since navigation of the probe takes place slowly during this stage, patterns of movement are easily observed and observing the probe during the scanning process therefore enables learners to identify the relative positions of the probe on the patient and the anatomical feature of interest. Qualified sonographers also observe hand/probe position during difficult scans; whilst this happens on a less frequent basis than with stage I pre-qualified sonographers, nonetheless it is a strategy used to help the qualified sonographer spatially orientate the limb/probe movement.

The lack of visible external landmarks on the maternal abdomen and the movement of the baby within present multiple challenges to the learner during stage I. It raises the question as to why learners are expected to acquire basic scanning skills on a dynamic target rather than learning to scan static structures.

Use of the equipment controls is limited or non-existent during this early stage of learning. LB used the depth control to change the position of the image on the screen during first trimester scans and used other controls haphazardly.

LD was uncertain of the equipment and did not attempt to use the controls. LD:

This morning ... it's been quite busy in the department, the sonographer that's been training me has sort of said 'you start and I'll join you part way through the scan', which I've not really been left on my own to do that before. So I felt as if I can do the big bits in that I could find out roughly where the baby was lying, check it's got a head, a body and a heart, but I couldn't do the finer things, I need a sonographer there just to sort of point me in the right direction and perhaps put their hand on the probe and move my hand.
Using the same piece of equipment and having assistance to operate the controls benefits learners in two ways: it allows learners to concentrate on acquiring orientation skills, and minimises the inconsistent use of equipment parameters which affect image quality.

Whilst recognising the importance of holding the probe correctly, learners have not developed sufficient awareness about controlling the pressure of the probe. LD focused upon some of her anxieties about applying pressure with the probe and controlling movements of it across a patient’s abdomen.

... Right, if I found something difficult, I’d probably say to whoever was supervising me ‘right how do I get this picture to look better? Is there anything I can do with the machine to make it look better?’ or ‘how do I need to move the probe to get a better image?’ It might be that they need to put their hand on the probe with me to show me. I think the other thing is I’m probably a bit too soft at the moment with the probe so the sonographers probably put more pressure on the woman and maybe dig in a bit more than I want to at the moment.

Despite pre-qualified sonographers knowing how to hold the probe correctly, the tendency to grasp it tightly restricted movement. There was a tendency to tense their arm, which also limited the scope of movement achieved by the sweep of the forearm. This, however, may be advantageous as it limited the distance over which they could sweep the probe and thus the probe remained relatively close to the starting point of the scan. This may inadvertently act as an aid in developing control of the probe movement because of the restriction over a small area. This, however, emphasises the point made earlier that it may be more beneficial to start scanning static structures rather than a mobile fetus, as shown in this example:

LA: I think it makes it a lot difficult. Again because you have to move the probe in different directions to keep up with the movements and to get the required images that you want. When the baby is still then obviously it would be a lot easier for you. But when the baby’s moving, you have to keep up with it and you have to kind of mentally picture the baby to see exactly what you’re looking at and where it is. I struggle with that.
There was some variance in the way pre-qualified sonographers had been told to commence a scan. Three of the learners had been told to start in the midline and obtain a longitudinal section through the uterus. In contrast to this approach, one of the learners had been shown two different ways to commence. Some confusion arose because of this; being shown different approaches instead of one set of instructions contradicts evidence that, during the early stages of learning, learners need to follow a simple set of rules (Fitts 1967; Anderson 1982; Benner 1984). Following rules and the need for simple, clear instructions provides the foundation blocks of knowledge on which to build practice (Benner 1984). The benefits to the learner in scanning means this would reduce the range of techniques and advice that would be otherwise offered by different professionals. LD explains:

... The other thing is the different sonographers' use the packages differently, so you've also got to be watching what they're doing and deciding what you think is useful and how they use it and what you're not going to use from what you've seen. I mean there's an awful lot of information being thrown at you at once really. ... the scanning is not easy but there's so many other things to learn, as well as the machines, it's different people's techniques and what you take from other people.

A recurring feature in the narratives is the emphasis on the learner trying to be systematic. LB has been shown two different methods of starting a scan and mimics the starting position of the probe:

... Errm, when I first get back into it after having the break, I try to start off pretty systematic, otherwise I really struggle if I just try to go back into it. I kind of don't know where the baby is, I am just waving the probe around to see what I can see. So if I get back to the systematic way of doing it and try to scan I seem to get more of a picture of how it relates to the screen ... I've got two ways of doing it. One person has taught me to start in a long section, to see the main points of interest I scan over to one side and then someone else has taught me to scan again in the long section and move across and then back to the centre and then move up a bit, I can't decide at the moment some patients I do one way and some patients I do another way. What I try and do is find where the head is and then try and work it out from there.
Repeatedly following the same pattern underpins the development of the motor programme. It is likely that working with the same supervisor during this stage would reduce the range of techniques shown to the learner and thus be of benefit to the learner during the development of these orientation skills. According to Fitts (1964), in the cognitive stage, the learner attempts to understand the task requirements partly from verbal instruction.

5.2.6 Image interpretation skills during stage I learning

Image interpretation skills during stage I focus on the main body parts of the baby. Thus, descriptions such as 'the head' or 'the heartbeat' are used to convey information to the patient.

Despite showing the fetal head, body and heartbeat to the patient at the beginning of the scan, little interaction occurs during the scan. Attention is focused on the large and significant landmarks and LC comments on her lack of ability to see fine detailed anatomy; like the other three learners, this seems to be a predominant feature at this stage of learning. LA reports on identifying gross anatomical features: the fetal head, body and limbs and the fetal heart.

LA, in response to my question of what she looks for first:

I'd say the head. Just a general overview to see whereabouts it is and the head. Then scan down the body and then have a look where the legs are, and kind of mental picture it and try to find out which way the baby is lying, which side up so when you scan what you're looking at first.

Pre-qualified sonographers do not confidently identify at this stage detailed anatomical features; instead, they focus on finding the fetal head and heartbeat, which helps with the orientation of the baby and forms the basis for developing hand/eye coordination skills. The ability to recognise important landmarks is part of developing navigational skills, as discussed earlier in section 5.2.5.
Learning to interpret the ultrasound image by starting with one or two significant landmarks shares similar features with the way that novice pilots learn to scan the horizon and the way that some insects use familiar landmarks to navigate between nest and foraging site (Collett 1996). This ability to recognise key features in the image as part of stage I learning needs to be achieved before learners progress their scanning skills to the next stage.

This lack of ability is likely to be linked to the difficulty experienced in achieving the fine hand movements required to manipulate the probe and to home in on the target. For example, LD:

I can do the presentation, probably the liquor volume, placenta site, check the fetal heart on my own and I feel quite confident about that, but actually getting down to do the measurements, the head circumference, the abdominal circumference, femur length, I still need a bit of guidance just to say really that you’re just in the right position of the baby. It’s the fine hand movements that I can’t quite get right, which is frustrating sometimes because you know what you want but you can’t always quite get it.

Pre-qualified sonographers predominantly tend to scan third trimester and first trimester pregnancies during stage I. Fetal presentation and the presence of a fetal heartbeat can be determined, but little else of the examination can be completed satisfactorily. Learners’ ability to identify the fetal head, body and fetal heartbeat meant they could in most cases recognise fetal viability. Beyond this, however, they have insufficient knowledge to comment on the interpretation of the findings and these are not discussed at this stage by any of the learners.

No dominant theme emerged as to whether there were benefits of scanning first trimester pregnancies over third trimester pregnancies. LA commented that first trimester scans are easier to perform because the whole fetus can be seen; on the contrary, other learners’ comments suggest that third trimester pregnancies were of
benefit in developing hand/eye coordination because of the reduced fetal movements, although not being able to see the whole of the baby was a limitation in this case.

Since those progressing towards competency do not always have an awareness of the 'bigger picture', it is not possible to expect them to have an appreciation of the necessary information that is required in order to make decisions on image interpretation during this stage.

5.2.7 Summary

During stage I, the narrative type is that of 'chaos narratives', as they share similar features with Franks (1997) description of chaos narratives. Pre-qualified sonographers attempt to understand the task requirements of ultrasound scanning through observation, feedback and verbal instruction, which are similar features to Fitts's (1964) descriptors of the cognitive stage of learning. Learners benefit from close instruction and prefer to work with the same supervisor; this method provides feedback on performance in a familiar and consistent way from which learners benefit. The need for close instruction and high levels of concentration are recognised features of the cognitive stages of learning (Fitts 1964; Anderson 1982). These high levels of concentration result in little communication between learner and patient. Scanning movements are poorly organised during this stage.

During stage I, pre-qualified sonographers are not able to orientate the probe sufficiently and focus on major landmarks to assist the development of navigational skills. They have insufficient hand/eye coordination to move freely around the maternal abdomen. Scanning skills are hesitant and, together with discrete probe movements, observations of the probe are used to relate the position of the probe to the image acquired on the screen, often pivoting the elbow to regulate sweeps of the probe. They are not yet able to complete a scan. Similarly, performance during the
cognitive stage, as Fitts (1964) suggests, is variable as the learner tries out difference performance strategies.

During this stage, pre-qualified sonographers acquire basic theoretical knowledge but lack understanding of how this impacts on scanning practice. As Benner (1984) notes, novices are expected to have acquired facts but not necessarily an understanding of the relationships between the underpinning concepts.

As a result, this early stage of learning is an intensive part of the learning process and the use of familiar equipment and surroundings helps learners to acquire the basic facts.

These are chaos narratives and reflect a lack of confidence experienced by learners in the new clinical situation and anxiety through fears of scanning slowly and holding up patients is experienced.

### 5.3 Stage II learning experiences

This section includes a discussion on the narratives and narrative themes on learning experiences in stage II and spans the three to six months of learning. Firstly, an overview of the type of narrative is discussed, followed by an analysis of the themes and actions of stage II learners.

During stage II the narrative type is that what might be called ‘getting it together’, that is, the control of fundamental movements has been achieved; to progress beyond this, however, practising of finer hand/probe movements such as angling and rotation is required.

The narratives illustrate a turning point in learning during this stage. It spans a three-to-six-month period of learning and what happens during this second stage broadly reflects Fitts’s (1964) description of the associative stage of learning and Benner’s advanced beginner.
During this stage, pre-qualified sonographers maintain a student identity; however, there is evidence that, as they develop confidence and begin to understand the scan process, they refer to themselves less often as a ‘student’. This may partly be due to developing an understanding of ultrasound scanning in the context of their professional practice.

5.3.1 Communication with the patient during stage II learning

At the beginning, each learner checks the patient's identity and previous medical history. A detailed description of the examination is explained to the patient. During preparation for the scan, the patient's abdomen is exposed and, noticeably, during stage II, additional information, such as checking patients have full bladders for example, is also checked.

During this stage, pre-qualified sonographers refer to the baby as a whole in comparison with the previous stage in which they described their sonographic observations of a baby by body parts.

Learners communicate on a basic but regular basis with patients. During the scan however pre-qualified sonographers still need to concentrate and focus attention on their scanning. They stop scanning when speaking with the patient. Communication is based upon basic, simple explanation, as learners have limited experience when dealing with more complex information.

LB: I know last we talked about how the family and the children got in the way and all the rest of it. But I don't – that doesn't really seem to bother me anymore ...

... And the fact that the baby was crying now I just find I can ignore it and it's just something that goes on behind me. But I'm conscious of the fact that they might ask me a question and I'll miss something, because my brain isn't really listening anymore. I can switch off to the noise and ignore it, but then kind of think if they ask me a question, I'm sure I'll ignore them ...
... 'Cause I'm not really listening to what's going on anymore. And I think that's the only way I can do it really. And I still think if she was saying "show me the head, show me this" then I still think I would have been interrupted. Because I would have to listen to her and not concentrate on the baby and I think at the moment I can either cut it all off, or listen to it all. I don't think I can pick out what I want to listen to and ignore the rest ...

... So it was good that she was quite quiet. I mean I'm sure I could answer just general questions about movements and stuff like that, but if they were trying to instruct the scanning, saying I want to see this and want to see that, then I don't think my brain could cope with all of that. But as a growth scan it was okay. I used to struggle with those 'cause when the baby got bigger you've got your image on the screen, you can't see the whole of the baby or most of the baby then I used to struggle, but that doesn't seem to bother me anymore.

During stage II, standard phrases become part of the scanning procedure; pre-qualified sonographers often stop scanning to communicate with the patient, they are able to communicate about the basic scan procedure with the patient.

5.3.2 Observation of the sonographer during stage II learning

Observation is an important feature of learning during this stage. Firstly, pre-qualified sonographers complete the scan and then observe sonographers scanning the women. Whilst learners relied upon observation to acquire image patterns during stage I, observation during stage II is chiefly used to ascertain feedback on probe movement and agree the measurements of the baby. This takes place during discussion as the sonographer performs the scan. The benefit of observing the sonographer is to reinforce knowledge, rather than to provide new knowledge.

LC: So, I would have liked more time with you and had more diverse things to scan. I feel better with certain things ... and also depending on the patient's habitus and the baby's position I feel better with these too ...

... watching them [sonographers] scan helps work out which way to move the probe ...

And actually I'm not worried about the scanning any more, even though I feel I might not have looked confident today, it's not that I don't feel confident, I just feel under pressure to prove myself to you; I don't know
why but I do ... but watching them [sonographers] and then agreeing with my measurements gives me confidence.

The benefits to learners come from both observation and discussion whilst the sonographer performs the scan. There is, however, an increased burden on the sonographer performing the scan to combine feedback to the patient and learner. Future work is warranted to explore further the role of feedback and the impact this has on the sonographer in the workplace.

5.3.3 Role of feedback on performance during stage II learning

Pre-qualified sonographers start to become aware of their limitations and, in tandem with increasing knowledge of the scan process, benefit from their own self awareness and feedback from different sonographers during stage II. This contrasts with the preference to work closely with the same sonographer during the previous stage. In spite of this, however, learners still prefer close instruction and benefit from concurrent feedback.

LD: ... I mean sometimes she’ll say just turn her onto her side and let us try that way. So sometimes ... I mean she’s not done it today, but still will put her hand on the probe as well to show me where you know, guide my hand to show me how to move it.

Learners seek to build on the basic elements of scanning acquired during stage I and have a conscious awareness of what they ‘don’t know’. Accordingly, Benner (1984 p24) explains that advanced beginner pre-service nurses require a lot of clinical support when she points out that;

“novices and advanced beginners can take in little of the situation: It is too new, too strange and besides, they have to concentrate on remembering the rules they have been taught”.

Having acquired basic information as a foundation on which to build new knowledge, pre-qualified sonographers start to reflect on their own practice.
Whilst reflection brings meaning to the learned information, it is that learned information which is known relative to other knowledge; in this way, understanding is developed. However, in the absence of enough contextualised knowledge, the information acquired is meaningless. Information acquired during stage I has served as a building block for the information learned in stage II.

Reflection has a role in this stage of learning by enabling the pre-qualified sonographer to begin making sense of scanning and to transfer the newly acquired knowledge to long-term memory (Moon 2004). In this way, learners bring meaning to their ultrasound scanning practice and are aware of what they need to do in terms of long- and short-term goals.

They have acquired the skills to hold the probe and steer the probe convincingly. Reflection is apparent as part of the learning in stage II as learners link theoretical knowledge with practice. LC, in response to my question on feedback:

... 'cause some people are really nice and don't want to say a bad thing, where some others will go 'come on [LC], you can do better' and then there's like [sonographer B] who challenges me. You know she says 'what would you call this if this happens, what would you call that'. And I feel that I have to show her what I mean ...

... The other day she asked me about pre-processing and I forgot the implications of it. The next day I came back to [sonographer B] and I've done this and she was like 'oh I wasn't checking up on you' and I thought, but it's like a personal thing, I feel oh I need to read up on that now and then I go to [sonographer B] I did this 'cause I want to show her that I am improving and learning it and then when I learn something I want to implement it so it sticks, otherwise you forget. That's why I forgot about the pre-processing because I never use them. So now I'm trying to change my applications and things a bit. Which one to change? Which one for which way?

I try to summarise what LC has told me: 'So what you're saying is you can go away and read up on something, but then you actually put that into practice and have a go?'

LC replies, 'Yes, if I don't, I forget'.

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Pre-qualified sonographers start to develop self awareness of improvement; this is demonstrated by LC in response to my question:

So once you've had a go at implementing something, do you then need feedback as well on that?

LC: Perhaps not, if I did something that was straightforward ... I think, oh it was a lot better.

GC: So you kind of know yourself?

LC: Yes and if it wasn't I'd probably say oh I'm not too sure on that you know am I doing it right. I'm not afraid to ask and they're not afraid to tell me.

During this stage, the role of self reflection and interaction between learner and sonographer forms part of the feedback mechanisms. Feedback on the development of scanning technique was predominant in LD's experiences, for example, suggestions on how to manoeuvre the probe to achieve more difficult tasks with the probe were given and this was combined with observation by LD of the sonographer scanning. It became clear that LD was preparing to move onto developing the finer hand movement skills required to 'home' in on the finer detail and develop precision skills in the next stage of learning. There is an intuitive understanding from her mentor that the basic skills had been achieved. This is evident, for example, in LD's response to my question on how useful was the verbal feedback that I had observed during the session.

LD: Very useful, I think now she [sonographer C] is sort of tending to say 'right we'll go right round the baby or you know right round, we'll try it from a different angle' or you know try, trying more things because I suppose she perhaps knows now that if I do, I will be able to do it whereas before I wouldn't have been able to do it.
On occasions, feedback from sonographers which questions the learners was not always positively received; only after reflection on their experiences and the nature of questioning did learners feel there were benefits to this approach.

LC: ... also because it's so busy and I've not got time to do the whole scan and sonographer F wears braces and belt you know she likes to double check everything, and she checks me more than other sonographers but I also learn more, she test me as she goes along ... what does this mean? ... what do you call that and what if I saw something coming out there what you would you see? How would you change that? ... and that makes me think in different planes...

And when I'm with sonographer F I always feel as if I've not achieved more than I usually do, but she's opened several gates ... where I thought I'd never even thought of that ... I've got to look at that, she gives me food for thought. ... But I find it a positive experience you know, not a negative experience ...

As they progress, pre-qualified sonographers acquire sufficient knowledge on which to base judgements about their own performance. The consensus view is that when learners start to reflect on their practice, reducing the frequency of feedback tends to improve motor skill learning in the long term, as participants can become too dependent upon constant feedback and in these situations the feedback becomes part of the 'learned' schema. When this is subsequently removed, it is comparable with placing the individual in a novel situation and poor performance tends to result (Winstein and Schmidt 1990; Wulf, Schmidt et al. 1993; Schmidt and Wulf 1997).

During stage II, I was still viewed by the pre-qualified sonographers as the tutor/researcher with the assumed knowledge and, therefore, power. I shared with the learners the transcribed interview and field notes from our previous meeting. Whilst this provided opportunities for them to add or amend the transcript, it also enabled me to reflect on my interviewing technique. I wanted participants to speak for longer periods and this meant I needed patience during 'the silences'. The interview with LC
commenced with us discussing the interview transcription from stage I. LC picked up on the issue of 'being slow': this clearly remains an issue of importance. However, there is a resolve to be more confident in obtaining detailed accurate images rather than rushing through a scan:

But now I just think it's more important I get a good section rather than rushing and if I got one patient, do that properly and then watch three rather than doing four patients hurriedly and I've not really done anything. So I don't really worry about my speed because they'll tell me 'go and get a coffee (name)', you know, so I'm not that bothered. Because it's a bit expected of a student ...

During stage VII, the role of feedback was discussed with one of the qualified sonographers; EQB reflected on her learning experiences leading to qualification. EQB recommends being with the learner during the early stages of learning (stage I, stage II). This provides an opportunity to assist in guiding the probe with the learner and EQB recognises the need for direct instruction, helping to set goals and being with the learner during the scan in order to provide feedback.

EQB: I think they have to, if you start off quite structured with them and tell them - 'right well we're going to start with booking scans, or growth scans'. Once you feel they've got a certain level of competency in that area or you're saying to them right I want you to go in that room, establish that the baby's alive and establish what position its in and then give me a shout. So you're giving them the confidence to go in there and do a little bit, they don't necessarily need to do it all and then you can go in and help them with the rest or you can do the rest of it. That has to be a gradual thing, I don't think you can go from being with them all the time and guiding them all the time to suddenly being nobody in the room, it's got to be a learning curve for them where they've got to go slowly through it so you've got to do it a little bit at a time ...

... Yes I'm just observing you to begin with and not putting my hand on the probe right through to the day that they're qualified when they're doing it all themselves and you can't just go from one extreme to another, you've got to gradually take them through that. So it might be right well go in there, do that booking scan, come and give me a shout and I'll come and look at your images and you can then show me what you've done. Or you can go gradually from you sit next to them and you give them guidance to right well you go in and I'm just going to stand at the back of the room and not say anything and only tell you if you're doing something
wrong. So that they get the feeling that yes you’re there to keep an eye on them but you’re not helping them in any way. But it has to be gradual.

In the following extract, in response to my question asking how the morning session had gone, LC demonstrates that, perhaps due to lack of structured feedback, she is relying on my comments on her performance.

... Well it’s not been ... you’ve not seen much and I would have liked a lovely slim lady to come in and I’d have done everything. I think I was nervous [that] you were there, I felt under pressure that I wanted to show you what I can do and not every patient is the ideal patient. I mean the other day, every patient I did had to be booked in for the Friday [list] after being in clinic which is patients that are too large you just can’t see things and that frustrates me because I have to learn what’s my lack of ability and what’s a difficult scan and if it’s very difficult then I can say well that’s just difficult because they came out and said you’re going to have to book another Friday afternoon ...

... But sometimes I do think I get angry when I’m struggling seeing something and then someone comes up and the picture’s better you know, their images are more clearer and I think how can I do that better, you know it’s more than resolution. So I’m aware I need to use the buttons (on the equipment) more ........

Continued ...

So, I would have liked more time with you and had diverse things I feel better with depending on the patient’s habitus and the baby’s position. And actually I’m not worried about the scanning any more, even though I feel I might not have looked confident today, it’s not that I don’t feel confident, I just feel under pressure to prove myself to you, I don’t know why but I do.

Discussing transcripts of our previous meeting also helped to focus the conversation around previous learning experiences and promoted active conversation.

5.3.4 Role of practising scanning skills during stage II learning

During stage II, pre-qualified sonographers lack confidence unless they practise regularly. In situations where they do suffer from a lack of confidence, they tend to practise on similar types of examinations on patients who are easy to scan, such as non-complicated cases and patients of average build and weight. For example, LA
comments on preferring slim patients due to a lack of confidence, having been away from scanning for two weeks, and she was determined to perform well as I observed her.

LA explained that the first scan had gone

... better than I expected because I thought I'd be a lot worse because that was my first scan in two weeks ... I think the patient, she was quite slim wasn't she, it was easier. The patient was quite co-operative as well so that helps.

Similarly, LD hadn't practiced scanning for a week and this affected her confidence.

She experienced anxieties about her scanning performance and perceived that the patients had all been challenging to scan. LD explains:

Umm ... I don't think it went as well today as it did last time. I don't know whether I was just more aware of you being there?

... I don't know whether, because I've not been here for a week, I'm putting emphasis on sort of getting back into it a little bit again. And I don't know whether the patients that we picked, I mean we didn't pick but the patients that we got, weren't probably the best patients, you know they weren't easy patients: I mean it wasn't a twenty weeks it was later, but that's just the way it is isn't it? Patients aren't always going to be easy.

LA: I think watching all the sonographers here and everybody has a different way of scanning and you pick bits up from different people and I'm kind of putting that together and then because I've been to university, I've learnt a bit more from there as well about the theory and learnt a bit about anatomy as well and things, so it makes it bit more easy for me and I've had a bit more practise as well having spent a week now. Before it was on and off, it was a week here, a day here, and a day there. I found that by the time I came back to the department I was back to square one again, but with increased practice, like I've been here for a week so that's helped a lot.

GC: Helped in what way?

LA: Because I'm continually scanning and there's no gaps in between, I think it just keeps your practice going doesn't it and its there and you know what you're doing and things. But when I had a day here and day there I'd forget. I'd forget how to use the equipment as well because I'd come after like two weeks, three weeks or whatever. And you forget the movements of the probe and things.
Practise is important for refining the major movements of the probe at this stage and shares similar features with Fitts’ (1964) associative stage, in which practise underpins the refinement of movement patterns.

5.3.5 Navigation skills relevant to stage II learning

During stage II, pre-qualified sonographers develop navigation patterns. Whilst there is still hesitancy in moving the probe around the patient, these movements are smoother and more refined than during stage I.

LA found experimenting with the probe movement was beneficial for learning at this stage.

LA: ... moving the probe. But I still struggle with the movements of the probe and I just kind of experiment to see which, if I’m probing in the same direction what kind of an image would it give me? ... Just like gentle movements and if I’m in a longitudinal position, just a slight twist, what it might give me, what image would I get? Because obviously I’m still learning at this stage. It’s very early for me to know exactly what to do so I kind of experiment and a lot sticks with me. And the same again if I’m in transverse, to see what slight movements of the probe will do …

… if I’m in a transverse position with the probe and I make just a slight movement to see what kind of image it gives me, I learn from that and it stays with me in my mind. At first I was struggling with moving the probe, but I’m kind of getting used to it.

Since learners perform each set of scanning actions using a step-by-step approach, discrete actions start to become linked as the time interval between each successive discrete movement is reduced (Anderson 1995) and movements become smoother and appear more continuous in comparison with the previous stage. Pre-qualified sonographers start to link theory with practice; anatomical features are recognised more easily and these are used to enable them to develop the skill to navigate the probe around the patient.

The main challenge presented during stage II is to navigate the probe around a moving baby. Movement presents an extra dimension of difficulty; since learners rely
less on external maternal features and landmarks, the movement of the probe is according to the features and position of the baby.

LA: I think it makes it a lot more difficult. Again because you have to move the probe in different directions to keep up with the movements and to get the required images that you want. When the baby is still, then obviously it would be a lot easier for you. But when the baby’s moving, you have to keep up with it and you have to kind of mentally picture the baby to see exactly what you are looking at and where it is. I struggle with that ...

[I seek clarification] ...

Of how the baby’s lying. According to where the organs are, and where they should be ... You quickly pick it up if you know what you’re looking at, or where it is, or whatever ... When you first start scanning it’s really hard to mentally picture where the baby is, or how the baby’s lying and you have to kind of scan around, and I have to scan to see if the head’s on the right side I have to kind of scan to have a look, and then look on the screen and relate to it, but I think that comes with experience.

LB’s narrative shows how the basic actions of scanning are becoming smoother, and she is able to communicate more easily with the patients:

I’m definitely getting better at it and from the midline I can work out and I always go to the head because I just like to see that it’s got one and more than anything. So I tend to start off in the midline and do my big sweep and then from there I just go to where the head is, and then scan through the head and then from there I go to where the heart is and when I’ve seen that then I think I relax at bit more.

... And then I can speak to the patient and say there’s the head and there’s the heart. I mean I might have worked out where the baby’s lying and be able to tell them from that but the heartbeat, it doesn’t take long to do it any more. I can put the probe on and then sagittal section and the midline, I’m much better at working out where everything is, more than having to see the spine to know where it is.

She continued later in the interview:

But I don’t really imagine it really at all. I know, I think if I was doing – if I’ve done say an abdominal section and I’ve taken the probe off and I’ve done my measurements, then I decided that I was going to look at the femur length, then I know where to start, you know, in the abdomen. I wouldn’t have to start by the bladder again in the midline and come up, I can go to whichever end or whichever side I know it should be, so it is
there, but I don’t scan with a little cartoon of a baby in my brain. It’s more what comes from the screen than anything.

Pre-qualified sonographers start to scan second trimester pregnancies during this stage and prefer patients who are easy to scan.

Whilst learners may have progressed their scanning skills and knowledge during stage II in comparison with stage I, they do revert to scanning in ways that reflect those observed in stage I when presented with novel situations. This demonstrates that whilst scanning skills may develop progressively, the application of these to new clinical situations is not easy at this stage.

During stage II, coordination starts to develop. There are similarities with Fitts’s associative stage. Movements of the probe are smoother than during stage I scanning because of linking between the discrete movements. During stage II, learners acquire the ‘know how’ and start to make links between theory and practice.

Having acquired orientation skills means learners are able to navigate around the key landmarks, and extended arm movements are used to sweep the probe across the maternal abdomen, which enables the identification of the main landmarks: head, body, heart and limbs.

Pre-qualified sonographers start to look for more detail in the image and along with this they need to develop skills to make fine adjustments with the probe.

Learners have an awareness of the ‘wider’ picture; they know what needs to be achieved in each area of scanning and this underpins their growing confidence.

Despite this, there is still a need to scan straightforward pregnancies, where a suitably sized patient will enable the production of good-quality images. Learners’ perceptions on several occasions were that patients weren’t easy to scan, even those that seemed
typically straightforward. I recognise that my presence, however, may have had some impact on this.

Learners start to be able to 'isolate' the baby from the mother, and this seemed to be an important goal in achieving orientation. Each of the learners reported in their own ways how they were starting to construct a mental image of the baby from the ultrasound images and the positioning of the probe. One unique experience, however, was described to me by LD. LD, as a midwife, uses a doll to teach midwives fetal orientation. She explained to me the role of this doll in her learning of ultrasound scanning.

LD: Right, well, I think the purpose of the doll for me is that, particularly for the twenty week scans in knowing the baby's left and right is that its almost like forgetting that you've got the mother, so she's gone and its almost like you've got to think of the baby, think of how the baby's lying and think of the baby's lefts and rights and the doll helps me to think of that. Almost like taking it out, looking at it and thinking right that's it's right, that's its left and once I know that I know I've got that sort of orientation, of it.

I then asked if she could apply that to the mum to be. LD continued:

Yeah once I've worked that out in the beginning I can ... once I know where it is [the baby] it doesn't matter then does it, what happens, where the baby goes, what it does or how you look at it ...

... so for me to look at her, to think, right well it's head is there, that's how it's lying therefore that is its left and that's where its heart is, that's what its stomach is and I know where it is and ...[I am] taking it out, looking at it and thinking about it and then ...

Learner D returns to this point later in our interview.

Because when I was watching people do twenty week scans I'd go home at night and I'd be thinking God how on earth? ... Because what I was trying to do I was thinking of the mother's left and right and the mother's head and feet and then, and then you've got to think of where the baby is, particularly at twenty weeks ... for you to know the organs are in the right place. And I was thinking how can I work it out and I remember I got this [doll] somewhere at home so I thought if I just forget the mother and just use the baby I can get my head round that.
In addition to using the doll, LD also used her professional skills, such as palpation skills, prior to scanning third trimester pregnancies; this combination enabled her to assess presentation and fetal size.

A qualified stage V learner, NQA, similarly used a doll to help her develop her orientation skills during the early stages of her learning in ultrasound:

Yes. I spent quite a lot of time, quite a number of weeks when I first started scanning with a little model of like a doll or something, or a teddy bear, anything and try and visualise if I put the probe on that thing, what I would see on the screen? And just try and get it round in my own head. Yes, I spent quite a lot of time, doing that you know. I could imagine 'that was a baby and the head's up there and the bottom is down there', and I had my probe like that. And 'right, I'll do a transverse section' and bottom would be there and I just spent ages trying to orientate myself and move it, and move it round like that. Now I put my probe there or, there and I know that to get a longitudinal section of the baby, I'd have to go up in transverse plane of the probe. And I just felt that that was critical really to get that in my head ... It's just a case of practise, practise, practise really ...

NQA continued:

Scanning as a whole ... I think after six months I thought yes I can do this. After about six months. It's a long time but I mean other people perhaps thought that I could do it before then ... But, it was like it was about six months. It was almost like a click.

Six months would approximately equate to the end of the stage II of learning in the framework developed in this study.

GC: What do you think happened at that time?

NQA: I knew you were going to ask me that. I think it's perhaps the integration of everything because as a student you try and kind of learn little bits and right I'll learn about this today, then learn about something else tomorrow and something else the day after and I think it's just the coming together of all those things. Control of the probe along with the recognition of pathology altogether probably just ... I don't know. Did it become a natural movement at that point? I don't know. Perhaps it just came to a point where I was scanning and realised that what I'm thinking about consciously about every single thing I did, just doing for a start. Perhaps it was that, that some of the things I'd learnt became automatic, I felt that it was part of me, I don't know.
In stage II, pre-qualified sonographers complete first and third trimester pregnancy scans. This compares well with stage I, when they were not able to complete a scan.

LB has achieved orientation skills and starts to combine these with the use of the equipment controls. Scanning patterns emerge as associations which are starting to be built. The timing between the discrete hand movements is reducing. These elements become less discrete and become more of a continuous movement.

LA responded negatively to my question on whether she thought she was getting faster at scanning:

Not immensely no, I don’t think. I tend to spend quite a lot of time scanning because I’m looking at the image and trying to pick up [recognise] like a structure, ... I need to see a lot of normals ... I keep that in my mind. And I do take a lot of time.

LA had not had as much time scanning and, although she shared similar stage II characteristics with the other learners, she hadn’t completely acquired the basic navigational skills; this could have been the reason for her slowness in scanning.

I think the most difficult part for me still is the orientation of the baby. Even if though I get there in the end, it doesn’t come straightaway and like I said if the baby is lying obliquely I wouldn’t have a clue now which is right and left, I mean I could say you know the baby’s clavicle and transverse and the bottom’s here and the head’s there but I wouldn’t be able to say right sides up or down or whatever, I still struggle with that.

Whilst the smoothness of probe movements is a noticeable feature during this stage, learners progress at different rates during this stage. There was variation in learners’ efficiency of scanning; observations on each learner were carried out at different times within stage II and may account for this difference.

Learners during stage II use the equipment controls on a more frequent basis in comparison with the previous stage, although they are often instructed to change parameters by the sonographer. In particular, learners focus on using the equipment parameters that affect image quality.
LC: So I’m trying to use the buttons a bit more. I do use the controls quite a bit to change the dynamic range on larger patients. That first patient, I said to [sonographer A] afterwards, if you’d seen the image you’d have thought she was a bigger woman. [I interrupt]: It was grainy wasn’t it, I agree with you.

LC continues: Yes and so I find I don’t like that, I want to get the next patient, but then you have to do it don’t you? I think it’s just because sometimes I think, is it my ability? And I know I won’t get it as much [means – in as much detail]. But I need to use say the post processing buttons a bit more and explore a bit. But because it’s so busy you’ve not got time to mess around as well.

Pre-qualified sonographers demonstrate an awareness of the need to use the equipment more often, but experience anxiety about completing the scan in a short period of time due to the busy department. It is due to pressure of time, however, that the equipment is seen as an additional extra to be learnt rather than a combined part of the examination. During stage II, they tend to hold the probe in a more relaxed manner than previously and, whilst extended sweeps of the probe are easily managed, the finer adjustments of the probe are practised. Pre-qualified sonographer, Learner B, explained that she was feeling more confident in handling the equipment controls and these were becoming more integrated with her scanning.

LB: I’m quite happy. And now I know whether it’s the machine and ... I’m starting to do that more naturally ... but I don’t seem to know where everything is on the obstetric scans. But I used to worry that if I started messing with that [equipment controls] then the section that I had would go. But that doesn’t really bother me anymore.

LA: ... I’m still struggling to pick up some [of the] things sonographers can see but I can’t, but I think that just comes with looking at the images more and scanning with experience. I’m a lot more familiar with the equipment now. That helps.

GC: When you say you’re more familiar with the equipment, what sort of things are you doing with the equipment?

LA continues: When using callipers to measure for example BPDs or head circumferences, [or] to magnify an image to a particular area. I’ve used gain control and I’ve used colour once or twice, I’ve not messed about with that too much, I don’t want to break the machine.
Pre-qualified sonographers lack confidence in using the equipment controls, and they often do not link well the contribution of the equipment controls to image quality, often referring to ‘messing’ with the equipment. There is a lack of coherence in their stories about using equipment and at times a reluctance to alter the controls and use of the equipment was observed.

Learners start to use the equipment controls with hesitancy during stage II and in some ways their stories mirror the chaos narratives of stage I. Consequently, they would benefit from structured guidance on using equipment controls.

There is a growing awareness amongst the learners that, as part of the refining technique, the pressure of the probe makes a difference to the quality of the image. However, they find it difficult to gauge how much pressure is required. LC:

Sometimes I find it hard on anomaly scans if they’re breech, if their head is into the mother’s belly button that can be hard. And really if the resolution is bad I find it difficult looking at the internal structures, you know, looking at the kidneys and I just can’t see them. So then again I think that’s my ability...

... And then sonographer B comes in and I go [means – sonographer B takes over the scanning] ... but I can see the kidneys much clearer ... and she’s not changed any of the buttons. And ... once I said your images are better than mine but you haven’t changed any of the controls and she said to the patient am I pressing hard? And she said no actually I pressed harder, so I don’t know if that’s again the wood for the trees, or just [that] I noticed that with [sonographer B].

LA also explained that it is difficult to provide an adequate amount of pressure with the probe to achieve a good image.

... I usually struggle with holding the probe and I don’t press – the sonographers tell me – as hard as the sonographers do. Because I’m learning I’m quite tense or whatever. She was slim so I found it quite easy and I didn’t have to press as hard. Sometimes I find when I press hard my hand tends to slip off the patient and the movements on her were easier than they would be on a larger patient.
LD too discussed how she was now starting to recognise that the pressure of the probe is important, and only now is she beginning to modify the probe pressure. She told me:

... I think the other thing is I was probably very soft on the patients before whereas now I’m getting firmer, you know I’m digging it in a bit more, being harder sometimes like [sonographer C] will say, ‘Was she softer than I was?’ You know, because if I’m doing it as hard as she’s doing it I’m probably getting better. Because I do think you tend to be a bit gentle and sometimes that worries me a bit with vaginal scanning, I’m probably too soft you know I don’t sort of angle it [the probe] up and down a lot ...

Despite advances in scanning skills, learners are not yet able to adjust the probe finely or gauge how much pressure to apply in order to achieve a consistently good-quality image.

5.3.6 Image interpretation during stage II learning

Pre-qualified sonographers have more confidence in image interpretation; they start to acquire pattern recognition skills and show an increasing awareness of normal typical findings, particularly involving scans of the first trimester and third trimester. Since learners start to scan second trimester patients, they are introduced during this stage to performing more complex and detailed scans. Second trimester pregnancy scans, also known as anomaly scans, are recognised as the most difficult scans to perform. As learning to scan patients in their second trimester takes precedence, standard easy-to-scan patients are desirable.

LC: With my anomaly scans, I do feel quite happy with my anomaly scans on the ideal patient, I feel that I can see everything apart from the outflow tracks and now I can get the lips and the palettes and there was something else I can do. The only concern I have with anomaly scans, is I’ve never really picked up a pathology ... and I think will I notice it?

... And I actually said that to [Sonographer B] and she said well actually you do see pathologies because some people are too interested in getting the perfect image, they’ve not looked at what’s there. And I was glad she said that because I thought, actually am I looking for pathologies?
During stage II, pre-qualified sonographers concentrate on acquiring the image rather than focusing attention on examining or interpreting the image.

5.3.7 Summary

Stage II narratives show progression from stage I narratives. Narrative type is that what might be called ‘getting it together’. It is derived from narratives and despite all pre-qualified sonographers experiencing challenges with their scanning practice, the stories are in general of developing confidence.

Learners have achieved the basics in scanning technique and recognise the need to develop finer and more controlled adjustments of the probe in order to modify their technique and, in this stage, progress towards more challenging scanning; second trimester pregnancies.

Since they have gained knowledge about probe angulation, movement and equipment controls that affect the quality of the scan image, pre-qualified sonographers are able to navigate the probe to observe important landmarks. Once each landmark or target has been observed, fine hand adjustments are required to ‘home in’ on the finer detail.

Whilst learners have started to acquire mental constructs of images, they concentrate on acquiring the image rather than interpreting the image.

Learners recognise the need to develop communication skills, in particular to deal with adverse outcomes. They have more of a patient focus than during stage I learning; they use their knowledge to consider what patient factors may affect image quality, rather than assuming it is their limited scanning technique.

5.4 Stage III learning experiences

This section includes a discussion on the narratives and narrative themes on learning experiences in stage III and spans six to nine months of learning. Firstly, an overview
of the type of narrative is discussed, followed by an analysis of the themes and actions of stage III pre-qualified sonographers.

The narrative type is what I call 'becoming confident'. What happens during this third stage broadly reflects Fitts's (1964) description of the autonomous stage of learning and some features of Benner's competent practitioner.

During this stage, learners are able to plan the scan and are confident in their ability to perform and complete 'routine' scans. They exhibit more confidence in knowing 'how' to organise and perform scans; this is due to sufficient experience having been gained by this stage to be able to understand the situational context of the 'routine' work.

During scanning, for example, pre-qualified sonographers confidently deal with the findings and also start to develop skills and acquire knowledge to generate expectations about the scan. Learners know their limitations and, in general, commence most scans unassisted.

The autonomous stage is associated with having developed a motor programme (Fitts 1964) that controls scan performance. Since learners have acquired a basic set of instructions and execution controls, automised movements free up resources to allow some decision-making processes, albeit limited, to take place (Anderson 1995).

Speed of movement, however, remains a limiting factor in the overall speed and efficiency of scanning. During scanning, time delays between each discrete hand/probe movement affect the overall appearance of the scan performance. Whilst the scan performance is smooth and continuous, delays between each of these movements need to be minimised further for an efficient, continuous and smooth scanning action to be achieved.
There are advantages to scanning unassisted at this stage, as pre-qualified sonographers take the opportunity to practise enhancing their finer scanning skills. This ultimately leads to a noticeable difference in this aspect of the scan performance between stage III and stage IV.

Despite scanning unassisted, rehearsing scanning skills in this way enables learners to progress from 'rules' governed practice to autonomous practice.

In stage III of the framework the narrative type of what I call 'becoming confident' is reflected in pre-qualified sonographers knowing their limitations and, whilst they are secure enough in their knowledge to undertake most obstetric scans alone, they are also confident to deal with the findings whilst encompassing expectations of how to deal with abnormal findings.

LB's confidence is demonstrated in this example taken from the beginning of our interview:

... but it was alright, I didn't really feel like I had any problems you know, like I had to go and get someone, 'cause I couldn't handle the situation. I remember the first time I started, she said [sonographer] it was OK for me to have a go at scanning ...

The difference between stage III and stage IV scanning performance is therefore probably a result of refining these fine, discrete probe movements.

During stage III, learners commence scans alone and this provides an opportunity to practice communication, planning and executing the scan. Research suggests that learners who learn skills in context develop the ability to assimilate better a range of tasks into skilled performance and tend to outperform in the long term those participants who alternate attention between discrete tasks (Gentile 1998). Therefore, it is likely that practice in a range of clinical situations during stage III provides the opportunity to refine the finer movements of the probe. Practising scan performance is important in developing efficient scanning skills (Wishart, Lee et al. 2000) and,
importantly, enables the refinement of motor skills and the development of a scanning strategy.

Ultimately, practise during stage III leads to pre-qualified sonographers developing efficient ways of applying knowledge during each scan.

5.4.1 Communication with the patient during stage III learning

The demonstrable difference in communication with the patient between stage III and previous stages is demonstrated during the initial contact with the patient, when the conversation focuses around detailed information about medical history and preparation for the scan. This ability to acquire information through verbal communication may also continue during the scan but this depends upon each situation. It is an indication of how learners are developing the ability to recognise the importance of detailed information in the planning of the scan and during the scan performance. There is a tentative link with Benner’s competent nurse (1984 p27), who exhibits ‘deliberate planning ... to help achieve efficiency and organisation’.

As part of automised scanning, learners are able to hold conversations with the patient whilst continuing to scan, which is due to the ‘freeing’ of cognitive resources during the automisation (Fitts 1964). LB recalls:

I used to have to concentrate so much on my scanning that if somebody spoke to me, then I either didn’t hear them at all and I used to have to stop and ask them what they’d said ’cause I wasn’t listening, or I’d heard them but then either I couldn’t answer the question ’cause I wasn’t thinking about it or, then it just completely ruined my scanning and I had to kind of start again and work out where the baby was, and start from the head and scan through again. So it used to interrupt me whereas now I don’t feel like it interrupts me so much anymore.

During stage III, pre-qualified sonographers communicate on a regular basis with patients, but this is variable dependent upon the situation.
Learners have difficulty dealing with more complex information, which suggests that their ability to problem solve during the scan is limited.

5.4.2 Observation of the sonographer during stage III learning

Pre-qualified sonographers focus their observations of practice during stage III on controlling the finer probe movements. They focus their attention on linking the image on the screen with the positioning of the probe and information is readily assimilated from different sonographers. LA, for example, commented:

Yes. I find observing somebody scanning, watching their hand movements helps me and watching them scan, watching how they’re actually moving the probe and then having a look at the screen helps me see how they get their images, how they get different sections. Just looking at the screen doesn’t help me but watching the hand and then looking at the screen helps me a lot.

She continued: ... different people have different ways of scanning, different movements, different technique and the way they move the probe and they can get different images on the screen. That helps me too – how I can manipulate the probe to get a certain image. But I mean just looking at the screen itself on its own doesn’t help ... “

I can look at pathology if I want and I can see different anatomy and stuff like that but I don’t really know how they’ve actually got that image on the screen so it doesn’t really help me. But looking at the hand and then looking at the screen to see, you know that helps me.

... But ... I’ve just learnt from other people just little tweaking movements can make a major difference. And rocking the probe can make a major difference to your image and get a proper section. So yes definitely I think observation is a big thing.

Observation of practice is a valuable learning aid. The focus of attention, however, varies during each stage. During stage III, learners benefit from observing techniques with different sonographers; this contrasts with observation during stage I, for example, when staying with the same sonographer was beneficial, but is similar to stage II.

LA: Yes definitely. I think for me the best thing I mean you learn different things from like I say you learn different things from different people. Different people do different things, I mean you pick things up from
different people and then just put all that together and then you have your own way of scanning. And it's whatever works for you isn't it?

Observation of practice in stage III may provide the mechanism for pre-qualified sonographers to focus their attention on variations in technique in preparation for adaptation of practice.

5.4.3 Role of feedback on performance during stage III learning

Feedback on pre-qualified sonographers' scanning takes the part of reassurance during stage III. Tending to scan alone; they take more ownership of their learning and supervision is in the form of the learner providing verbal feedback to the sonographer.

LB: ... in my stage now I'm happy to say I've seen this, this and this, I can't see this or I've seen this and I'm not happy with it.

... And I'm confident in what I'm saying whereas I used to say the baby's in this position and I kind of think well I hope it doesn't move now so it makes it look like I'm lying or I don't know what I'm doing.

... Whereas now, that's a confidence thing as well, now that I'm happy that I say that the baby's in this position and it might have moved and that doesn't matter, it's just moved. But I think that's the confidence in myself to know that I do know what I'm doing. I think that's quite a new thing really. I was getting there before.

During stage III, pre-qualified sonographers provide an overview of the scan as feedback on performance progresses to a two-way conversation between learner and sonographer. Learners are able to reflect on their actions and evaluate their own practice. Through feedback to the sonographer, they start to take responsibility for the scan and feeding back in this way helps to develop their problem-solving skills.

5.4.4 Role of practising scanning skills during stage III learning

During stage III, the finer scanning or 'homing' techniques are refined through practising. Pre-qualified sonographers have developed situation awareness through
experiencing a wide range of patients. It is known that improvement in performance occurs due to repeated performances in variable practice conditions (Gentile 1998) and refining scanning skills through practise during stage III results in a smooth, continuous, automised scanning performance. Whilst maintaining a methodical approach to scanning, learners don’t necessarily recommence scanning at the beginning point. Rather, they can pick up scanning at the point at which they left off when part-way through a scan.

LB: I feel like I just need to refine everything really. I think the basics are there. I know I need a bit more confidence with looking at hearts and scanning bigger babies as well 'cause the AC measurements can be very difficult to get and fetal breathing and that you can have poor contact because of the shape of the maternal abdomen, but yet they’re very important, you know, the growth scans. So I feel I need a bit more confidence with that, but I think it’s just refining everything really ...

... I’m still glad I’ve got till next February, but that’s good that I don’t have to take the responsibility yet. And I’m still glad about that, that I’ve got the time to refine everything and increase my confidence, because I don’t want to be at the stage in February when I’m still thinking you know I want someone to check me. I want to be happy that, I’m happy with it and its fine.

Discrete tasks such as arm movement, wrist movement, probe angulation and rotation are now performed continuously rather than at discrete intervals. Despite these signs of progress, there are limitations to the automised scanning process. Regardless of their autonomous scanning ability, scans are not performed with the same degree of efficiency as those in stage IV. The appearance of continuity is due to minimising the timing between the completion of one task and the commencement of the next (Fitts 1964). Thus, during scanning, each discrete probe movement must be performed with minimal time delay between each movement if they are to appear continuous and smooth and scan performance is limited by these factors (Anderson 1995). This can
only happen when certain task components are carried out automatically (Rogers, Rousseau et al. 1999) and practise is part of this refining process.

Practising scan performance is important in order to scan efficiently (Wishart, Lee et al. 2000) and develop a strategic approach to coordinate cognitive processes, receive information, interpret information, evaluate options and take action. Practising scanning in a range of clinical situations challenges the learner to develop and improve ways of recalling relevant and appropriate knowledge from memory. Practising scan performance repeatedly is important so that efficient ways of applying that knowledge are acquired.

It is likely that pre-qualified sonographers are able to process cognitively subunits of information together, a process known as chunking. Chunking was first discussed by Miller in 1956 (cited in Anderson 1995 p211); as a result of practise, information is stored within long-term memory in subunits (Damos 1991 p446). These chunks link units of common types of knowledge or behaviours; this means that less time is required to process the groups of information. Mackay (1982), cited in Annett (1986 p202), suggests there is a hierarchical structure to processing information, in which the higher levels of consciousness, such as problem solving and spatial awareness, are employed to assimilate information in blocks or chunks and process it holistically, thus reducing the cognitive processing time.

The importance of experiencing a range of clinical situations accords with contextual interference or random practise as an important aspect of performance improvement. Whilst the adage 'practice makes perfect' is a well-known anecdote, merely repeating a performance time after time without reflection brings little benefit. This is demonstrated in a study involving a letter enumeration task; whilst this is not as complex as ultrasound scanning, experience-dependent performance enables a
relatively stable performance to become established fairly rapidly, partly through reflective processes (Hauptmann and Kami 2002).

5.4.5 Navigation skills relevant to stage III learning

During stage III, scanning actions become automised. Movements of the probe are continuous and smooth and this gives the appearance that pre-qualified sonographers are able to scan more efficiently than during stage I and II. However, there are notable differences between autonomous stage III pre-qualified sonographers as learners and stage V qualified sonographers. In spite of stage III learners recognising the importance of prescan planning, they do not use the information to adapt their plans. On the contrary, qualified sonographers during stage V not only recognise the importance of prescan preparation and planning, but are able to use this to start adapting their plans, albeit in a step by step approach, in challenging situations.

Automisation allows the freeing of cognitive resources (Anderson 1995), which enables learners to focus on refining their technique and introduce the basic elements of problem solving into the scan performance. LB explained:

I think the only time I would [stop and think about scanning] is if—especially with the bigger lady I did today that 31 week twins – when I get a loss of contact and I think that’s maybe the only time where I try and work out where this shadow is coming from? ...

... from this loss of contact? ... Or whether it is the jelly? ... Or it’s the shape of her abdomen? Or whether it is the position of the probe on the abdomen? ...

... So I think that’s the only reason I would check it now. And I don’t notice really that I’m disjointed ... it just all seems to happen a lot easier now. I don’t have to push anything. And I don’t seem to like ... struggle in my own mind in working out where things were ...

I think I used to ...

I used to have to stop, if I was doing something, if I was doing the [fetal] head or whatever and I used to stop and think you know, why can’t I get it what is wrong? Is it the angle? Or am I too far up the abdomen? Or too low? Or is it the baby’s position? ...
... Whereas now I don't feel like I actually have to sit and think about it and keep the probe still. I used to sit and think and keep the probe still just for a second or so, but I don't feel like I have to do that anymore, I can just kind of work out what's gone wrong, which angle's wrong, or which way I need to turn. I don't know if you noticed?

Despite demonstrating automated motor control, learners resort to stage I actions when presented with challenging clinical situations. In the following example, the learner was not able to obtain a desired cross-sectional image of the fetal head due to the position of the baby and observed the probe on several occasions.

LC: Do you know, I looked at my probe as well? It was because at first when I scanned it I got a coronal view, where you can't see if it's [the baby] flexed. Because at first I got 33 mm and I wanted to get a sagittal view ...... I got it eventually but you can't see that, so I was also looking at my probe to see which way... spine up or down... which way should I turn it? How much space have I got to move it 90 degrees?

Do you know what I mean? Because I needed to move it to a 90 degree plane and I was already angled a little bit so I thought well I can't really get it that way and tried and still didn’t look and I went over there and I was leaving the long length and so that’s when I came over there [articulates hands to show how the probe was moved] I was just trying to move to get the longest sagittal plane. That's why I looked at my hand ...

... 'cause if they've got a bigger bump you can move round better can't you? It’s when you're skinny and your bones are sticking out and then I can’t get it.

Navigation during stage III is performed continuously and smoothly. Pre-qualified sonographers find themselves presented with more challenging clinical situations. In the previous stages, they would stop scanning or experienced sonographers would take over the scan.

During stage III, pre-qualified sonographers acquire the skills to manoeuvre the probe and manipulate the equipment concurrently to obtain normal images.

For example, LC comments:
... You know it's flowing better, where I kept forgetting to do things or concentrating on doing one thing and I'd forget to do the other ... I'm remembering now to look at my movements, everything is beginning to come into place a bit better.

During stage III, pre-qualified sonographers become aware of needing to adapt their scanning technique. As mentioned earlier in this section, observation of different techniques enables learners to acquire ideas that can be applied to practice.

More advanced techniques, such as transvaginal scanning, are now being undertaken by all the learners. LC demonstrates how learning the different technique of transvaginal scanning is likened to learning scanning, and the basic skills of orientation and probe manoeuvrability have to be acquired.

Because I think also my orientation was mixed up with the TV probe you know I couldn’t have told you at that point whether the uterus was retroverted or anteverted. So I think I was disorientated as I was trying to use a new technique ...

Despite the difficulties encountered during the transvaginal (TV) scan, there is a confidence shown in knowing what needs to be acquired to become competent in (TV) scanning.

In contrast to evidence in stages I and II, learners in stage III have progressed from wanting patients to be normal or perfect. They have acquired the confidence to ‘scan anything’ (LB). Underpinning this confidence is the development of some decision-making skills during stage III. The pre-qualified sonographers have an awareness of the options available; they can decide to interrupt the scan if, due to positioning or an incompletely filled bladder, a poor image is obtained.

LB: No ... I mean that’s one thing that I have noticed recently is that I’m quite happy to scan anything. I used to think oh you know like a 6 or 7 week viability, I didn’t used to like scanning them. Because even if it was alright sometimes you couldn’t show them ... there was never a definite outline ... you couldn’t tell them one way or the other and then what happens if it wasn’t viable and you know, but I’ve kind of got over that now and I’m happy enough to tell them either that I can’t see ’cause it’s
too early and they need to do a TV scan or that I can't see but I'm still training so I need to get a second opinion and you know .... ....

... I'm quite happy with that now. I scanned a lady with a previous miscarriage yesterday and I was quite happy to go in and have a look.

LC has an established motor programme; she can plan the scan and has the knowledge to implement her skills to perform the scan.

We returned to this element of planning later in the conversation:

I've got a little box in my head, there's a filing cabinet and I'm filing everything away and I know now 'oh what should I do, oh I've got a first trimester scan what do need to look for?' and I'm opening this draw and I'm going oh I've got to look at this intrauterine pregnancy. You know is it viable, how many, what's the length, is there any adnexal cysts or anything, and it's flowing ... where before I didn't have that and I don't think I didn't like not knowing things. Because I prided myself as a radiographer. I don't mind being a student but because it was a very practical situation, and I didn't mind the theory, but I didn't know things. I remember getting frustrated between the four things that you've got.

The execution rate of the scan performance is noticeably more rapid as a reduction in the time taken to perform a scan is achieved. This is largely due to the reduced time lapse between the different skill components: arm movement, deceleration, homing in on detail, probe angulation and fine adjustments. The skilled performance has become smoother because the sequencing and timing of the components have become integrated within the motor programme.

Pre-qualified sonographers start to use prior knowledge to plan expectations before the scan. Prior knowledge is also likely used to enable navigation from one view to the next to be performed efficiently and smoothly in routine scans; patterns from previously executed pathways can be repeated. However, a mobile fetus, or a fetus lying in an oblique, transverse or breech position will be scanned at a slower rate as scanning technique has to be adapted. Having an understanding of the planning stage prior to commencing the scan is an important feature of stage III scanning.
5.4.6 Image interpretation during stage III learning

Pre-qualified sonographers have acquired anatomy, physiological and physics knowledge, which they apply confidently during scanning. This underpinning knowledge is partly responsible for their confidence shown in clinical practice. Whilst their focus is on obtaining the image and recognition of features, there is some attempt at interpretation, most of the normal sonographic features can be located and readily identified. Whilst sections of finite detailed anatomical features such as in the heart are not always obtained, learners can recognise these on the image. Pre-qualified sonographers acquire information from the image more efficiently than during previous stages and start to interpret images in the context of their prior experiences. This change in emphasis from image acquisition to image interpretation is an important one and is part of the developing decision-making skills. They tell how they start to lack confidence in their scanning ability if they think about being qualified. The main issue associated with this is taking responsibility for the scan as currently they are supervised.

LC demonstrates anxiety associated with taking responsibility for the scanning:

Yes I understand [how to scan]. That's because, I'm glad you've actually seen me do an anomaly [scan]. Not I don't mean, I can see everything; but I lack confidence in anomaly scanning say 100% ...

I think it's being aware that soon I'll be doing anomalies on my own and I need to be 100% sure. And I said to [Sonographer E and Sonographer F] 'cause I was talking to them before ... I did really well in IVF and I said I know I can do anomalies ...

... I just need to get that confidence because I'm looking at it now at a different level rather than 'oh yes I saw this spine', I saw the spine and I'm 100% sure to put my name on that form that nothing's wrong with it ...

... So I feel that I've gone back a bit because I'm looking for more, I'm expecting more out of what I'm doing.
The basic elements of problem solving involve option evaluation, as described by Durso and Gronlund (1999 p300). During stage III, learners assimilate knowledge on the orientation of the baby noticeably more easily than during previous stages, which means they are able to navigate around the baby effectively. They 'see' the baby in isolation from the mother and navigate the probe based on interpretation of the image. This means that they can return to a chosen point on the baby at any point during the scan, rather than recommencing the scan in the maternal midline as demonstrated during stages I and II.

In response to my question regarding being more confident in decision making, LC responded positively with the following example:

Yes I do. And because I remember doing the other day an intrauterine contraceptive, you know a coil and usually I'd be struggling to get it and then I'd send her out, 'cause she needs to fill up and especially when I want the bladder really full where straightaway I said, oh you need to fill your bladder. So it's learning what it means: is it the patients habitus? is it the equipment? what the guidelines are ...

... 'cause also the sonographers, some will fill them up some won't.
That's why I didn't say they had to go to a TV scan. Some would say fill her up and some would say no, do a TV scan. Some will just go oh it's not full but we can get away with it. And it's just learning what all those are and what I feel comfortable with as well.

Despite pre-qualified sonographers' confidence in their ability to perform a scan during stage III, they also share anxieties about becoming qualified and having to take responsibility for the scan. Part of taking responsibility is linked with decision making (Durso and Gronlund 1999) and finding new ways of applying information; evidence suggests that more time is required to enable learners to adapt their ways of working better.
5.4.7 Summary

Practising during stage III of learning produces automised skilled performance which ultimately leads to improved efficiency in carrying out the scan. During this stage, new ways of improving recall from memory and managing the application of information are learnt. Eventually, the pre-qualified sonographer becomes more accomplished in performing the skill, which leads to a smooth, coordinated scan performance with minimal mental effort. The sequence of procedures is now part of a motor programme framework of ultrasound scanning. New ways of applying information must be acquired by the pre-qualified sonographer if he or she is to become a more accomplished performer.

Narrative type is that of what I call ‘becoming confident’; learners tell stories demonstrating their confidence in scanning, but anxieties about becoming qualified sonographers.

Their narratives in comparison with earlier stages of learning are more evaluative in stage III and encompass an element of reflection, the evaluative clause. Pre-qualified sonographers in stage III have acquired the skills to plan and perform an ultrasound scan. There is a dominant strand of confidence across their narratives and scanning is performed more efficiently.

Reflection is evident within stage III narratives. During this stage, there is a reduction in the level of resources employed in carrying out the task and more time is allocated to reflect on practice.

5.5 Stage IV learning experiences

This section includes a discussion on the narratives and narrative themes on learning experiences in stage IV and spans nine to twelve months of learning. Stage IV of the framework represents pre-qualified sonographers’ experiences as they reach a
significant point in the learning journey: becoming qualified. Firstly, an overview of
the type of narrative is discussed, followed by an analysis of the themes and actions of
stage IV learners.

Narrative type is that of what I call 'becoming qualified'. Learners emerge as
qualified sonographers with the new responsibilities associated with this. At the end
of stage IV, they have acquired sufficient skills to conduct an obstetric scan
efficiently.

During stage IV, pre-qualified sonographers are confident to take patients in turn
rather than selecting only certain types of examination, even in cases where there are
indications that the scan may present difficulties. They learn to adapt their knowledge
and skills to novel situations; for example, LB commented:

I do feel a lot more confident recently. There are occasional things that
I'm not sure about, things that I just haven't done so much of. And I think
the early viabilities, I'm still a bit unsure of. But generally I'm just you
know, happy to take any card and just see what happens really. And just
being prepared to face whatever.

... I'm quite happy with my obstetrics as a whole really. ... I'm quite
happy to have a go at everything now and twins are difficult but twins will
always be difficult. And I go off and do my measurements and again, if
I'm struggling and I know that I'm struggling, there's no point in getting
hung up about it. You've just got to carry on really. But no I'm quite
happy with my obstetric scanning on the whole.

Detail is seen and interpreted more quickly than in previous stages as pre-qualified
sonographers have developed a greater understanding of the scan process. As a
consequence of this, their situation awareness is better developed and as scanning is
automised, cognitive resources are focused on adapting practice. They begin to
individualise their practice and seek new ways to improve memory recall and apply
information to practice.
In preparation for becoming competent during stage IV, learners construct their own reports, apart from on occasions where abnormal findings are being reported or the case is not typical, when assistance is often required.

LB: ... I'm getting better with my report writing, the proforma that we’ve got with the obstetric growths and things, that's fine, no problem with that. It's more the pelvic ones ... And if it's a miscarriage then I'm happy with those and if it's there and it's alive then I'm happy with that ... it is when you get something you know ... like if you get a cyst adjacent to the ovary or, it's things that it's just a little bit out of the ordinary that I'm not too sure about. But I'm still happy to go off and write the report and the sonographer goes and does another scan and when they come back they read what I've put. So I've still got to have a go at it but there are things that still get checked.

Having a better understanding of the scan process in comparison with earlier stages of scanning and improved performance are important differences between stage III and IV.

5.5.1 Communication with the patient during stage IV learning

During stage IV, more attention is paid to the planning stage, recognising its importance as part of the scan preparation, and there is continuous communication with the patient during routine cases. Feedback to the patient is part of this.

LB also explained how her confidence in communication had developed:

Communication with the patient has changed. I used to have to ignore them and then finish what I was doing and then talk to them and you know answer their questions or whatever. But I feel like I can just talk about what I'm doing now really. And I think that's partly a confidence in that I do know what I'm doing and that I can tell them ... and I know that what I'm telling them is correct.

... But I still think if I'd seen an abnormality today I think I would have got hung up ... And that's inexperience as well, if you're not in that situation very often you start to wonder what you're saying and have I got this right? and have I just got the wrong angle? and all things like that come through your brain again ...
Automisation of the scanning procedure releases cognitive resources (Lintern and Wickens 1991), so that pre-qualified sonographers communicate more easily with patients during this stage in comparison with earlier stages of learning. Acquiring sufficient information before and during the scan enables pre-qualified sonographers to provide some feedback to the patient on the progress of the scan procedure.

Communication is now an integral and regular feature of the scanning process.

5.5.2 Observation of the sonographer during stage IV learning

Observation of the sonographer is used during this stage as a means of comparing the outcomes of the scan, in particular, the measurements. More often, however, the sonographer observes the pre-qualified sonographer whilst he or she scans and confirms measurements.

Observation of the pre-qualified sonographer during this stage is very much dependent upon the sonographer and learner relationship and is a less important feature of learning in this stage than during previous stages. It is mainly used as confirmation of the scan outcomes and measurements.

5.5.3 Role of feedback on performance during stage IV learning

During stage IV, pre-qualified sonographers were noticeably more relaxed. They talked more openly and discussion was exchanged more freely between us. They have acquired a wide range of experience on which to reflect and reflections on their previous learning experiences from stage I were frequently recounted and used as part of developing their own self awareness in scanning. At this stage, learners rely much less on feedback from sonographers. Instead, they have the skills to monitor their own performance.

GC: You have found feedback from your colleagues helpful too.
LC: But with that you [they] don’t actually break it down, the scan’s not actually broken down whereas you go through everything. The way I scan, and what have I actually said, why I’ve done this, why I’ve got the image or whatever. But if I talk to a sonographer, it’s just general ... open you know ... how I found scanning, did you get everything? But this is a lot more detailed.

LB shared the same views in response to my probe on feedback when she identified feedback related to the measurements as being useful.

GC: At this stage do you think you need feedback or are you happy to have a go yourself?

LB: I think there’s some feedback involved. If you show somebody your images and they say oh that’s very bright or, I think you can get feedback that makes you think next time well maybe I should change that. But I still think you’ve got to do it yourself. And that everybody has such different views on what’s a right image that you have to make your own mind up of what you like to see and how you want to see the image.

Pre-qualified sonographers’ self awareness and reflection on their practice underpins their ability to analyse their own practice. Feedback by sonographers on their performance is generalised and focuses on confirming learners’ outcomes.

5.5.4 Role of practising scanning skills during stage IV learning

In previous stages of learning, pre-qualified sonographers have shared their anxieties with me and experienced lack of confidence when they have not been scanning on a regular basis. Similarly, lack of opportunity for regular practising occurred as a theme across two of the stage IV narratives. Despite having nearly twelve months of scanning experience, time away from the department leads to learners experiencing a drop in confidence. LA, for example:

Well from experience I should think I’ve improved a lot since your last visit, discussed things, gone through your notes and things.

Like I said, I’ve been away for a week and I didn’t think I could follow through and scan as well as I did today. Having spent a whole week at uni, I just thought God I can’t scan anymore.
But I think like I've had a lot of experience, I'm here full time now, I'm more confident at scanning so that's actually improved my scanning.

... Generally I think I'm OK. I'm a lot more confident than I was last time and I can communicate with patients a lot better and that's 'cause I've been scanning a lot more and getting used to it.

LC also recalled a similar episode:

... Yes, I've just taken a month off, I've just been to XXX and when I came back I had to have a look where the probe was. And when I had put it on the patient I just needed to go up and down and I double checked everything. So, sometimes after a break I find the scanning difficult.

'Cause when I came back and then had my exams, I had not really scanned for about six weeks, I thought oh I'll be rubbish, but I was impressed that I could still get BPDs and things like that. What I had forgotten was I wasn't systematic. I had to make sure I had my orientation before I started anything else ...

Despite learners approaching qualification, regular practising is important to maintain confidence levels; whether this has an impact on performance can not be ascertained from this study.

5.5.5 Navigation skills relevant to stage IV learning

In stage IV, pre-qualified sonographers are preparing to be assessed as competent to scan. They start to think about how they can adapt their knowledge and skills in new situations. Certainly, orientation is an automated and integral part of the scan process. Learners have a greater understanding about the scan process. They follow a plan of scanning and use a step by step approach to adapt technique. LA recalls, for example:

“... Yes, I'm a lot more confident now than what I used to [be]. I had a few sessions with the sonographers here and they've worked really hard to kind of explain to me how to work out fetal lie ... Yes, I think I'm more confident now I try to ... well use large sweeps like you say, to work out the fetal lie and look at the head and the spine and then work out how the baby's lying and then I adjust the movements and get a reasonable picture to show the patient.

... It's really difficult to work out what I do, but I think my scanning has improved because I know how the baby's lying now. Before it was like searching for something, but now I know exactly where it is, I can just put
the probe and then manipulate the probe accordingly and get the lie of the baby if the baby’s not lying towards me.

In discussion with LB, I noted that she had observed the probe briefly when scanning to assess the liquor volume on a third trimester pregnancy. LB had to perform very precise movements of the probe to locate small areas of liquor; she observed the probe to check for the positioning of the probe so that she did not inadvertently measure the same pocket of liquor twice.

LB: ... And then I went on to do my [liquor volume assessment] and I haven’t done many of them and I know that you have to be very quick in case the baby moves and I wasn’t too sure exactly where the controls were and all the time I was thinking you’ve got to hurry up because the baby’s going to move here and you’ve got to get all your four quadrants accurately ... I was checking back to the abdomen on this one. And that was because I know that you’ve got to keep the probe straight and you’ve got to keep within the quadrants and I didn’t want to drift out of the small parameter that you’ve got. So I think that’s just a bit of inexperience with those really.

LB performed smooth, continuous scanning movements, constantly observing the monitor on all other occasions. LB continued:

Maybe that’s just a confidence thing that when I’m looking at the placenta then I’m happy that I do know where my arm is. Whereas when I’m doing my [liquor volume assessment] there’s other things going through my mind ... that I’m frightened, oh maybe I’m drifting off a bit or ... I’m sure that’s what it is just a bit of inexperience really about that certain thing. ... I don’t feel like I struggled like I used to. I feel like you know ... if there’s something I want to go and look at then I just go and look at it. Without having to think about where everything is and if I move over here I’ll get this image and that I just can get what I want.

GC: How do you think you know that?

LB: I really don’t know. It can only be just from doing it and seeing more fetal positions and having to adapt and getting used to adapting really. It’s just going for it, I’m sure it is.

GC: Do you think having scanned a lady now you would be able to show me on her abdomen the position of the baby?

LB: Yes, I think I could now. Especially with the bigger ones. The bigger ones I always found those easier to set in a position. But yes, I’m pretty happy now where they are and so that if I want to go and find a femur I
know where it is rather than having to follow the abdomen and just finding my angle.

The equipment is an integral part of the performance and a more efficient scan performance results in shorter scanning times being achieved.

GC: I noticed today that when you altered the equipment controls you could do that concurrently as you were scanning. Could you tell me how you feel that has developed?

LD: Erm, I think it is probably mainly one of the last things that develop. I think that when you first start, I mean, you get your presets ready and you might just sort of alter your depth or alter your focal point but it is sort of becoming more natural now to try and think of the other things that you can do.

... I suppose you have always done your gain and your TGC and things ... but it's probably a little more natural now to think right can I make it look better that it does and you know mess about with the controls a little bit more.

I mean sometimes even if you put it on a preset and it does not look right, having confidence to completely start, you know, go change the preset totally, to see if it makes any difference and it amazes me how different people's eye's are.

You know how people come in sometimes and you are scanning quite happily, just happened with a couple of grainy scans this morning. And somebody else comes in and says 'oh no, do this and do that' ... and I think ... well I can see that fine, before and I can't see it at all now.

So as a student I find that quite irritating sometimes, because I have got it how I can visualise it and somebody comes in and does it to their eye. I think that is probably more with gyne. scans, than actual obstetric scans. So ... yes I have got to grips with how I work the controls and that it happens as soon as you get more confident with your scanning and it just happens naturally really.

Learners also adopt their own image settings at this stage and are confident about producing images whilst recognising variations in image quality.

5.5.6 Image interpretation during stage IV learning

Pre-qualified sonographers focus on analysing and interpreting the image rather than just on acquiring the image.
As part of them developing problem-solving abilities, learners blend knowledge acquired prior to the start of the scan with information acquired during the scan to form patterns of decision making.

One aspect that is more refined than in stage III, however, is the ability to acquire information about the general well-being of the baby and its position within the uterus more efficiently. Despite pre-qualified sonographers’ awareness of potential problems, adaptation and the ability to plan accordingly is limited at times due to lack of confidence about their ability in finding and recognising abnormalities.

LB: I’m happy that I’ve got you know, a bit longer. I wouldn’t, I don’t think I would be happy to qualify now. Because it’s just not there yet that I can put my name on it and say yes that baby has got two arms. It’s just not, that little bit, that bit of confidence that I need to say well this is what I’m saying, this is what I’m putting on this report and no-one else is going to have a look. I’ve not got that yet. I’m still happy that someone else is going to have a look. You know no matter what happens, someone else is going to have a look. And I still need that at the moment. Not quite there yet ... 

When I’ve found an abnormality I often say I’ve found this but I don’t know what it is ... and that’s usually just with a couple of abnormalities that I’ve found with hearts. Other things that are a bit more definite, then I’m happy to say oh yes this is this and the thing that’s changed recently say in the last month is that I used to be wrong. And I used to be happy that I’d come out and say oh I’m not sure about this ... And recently I’ve not been wrong. And that frightened me a little bit. But before it was just I had the wrong angle, you know, the sonographer would come and sort it out and say this baby hasn’t got an abnormality.

This ability to acquire and interpret information concurrently is part of the reason why stage IV learners scan more efficiently than in previous stages. This aspect of image interpretation is important for the pre-qualified sonographer to arrive at a decision on the outcome of the scan.

5.5.7 Summary

In stage IV, pre-qualified sonographers can perform a scan. Narrative type is that of what I call ‘becoming qualified’. They tell stories that overall demonstrate confidence
in scanning, but lack confidence to some degree about identifying abnormal situations.

They are able to manage the scan, communicate comfortably with the patient, use the equipment controls concurrently and recognise normal obstetric images. The ability to recognise abnormal findings is a source of anxiety, as many learners have limited experience of scanning abnormal pregnancies.

Pre-qualified sonographers construct their own reports which are checked before being sent to the referrer. Whilst confident to carry out routine tasks, pre-qualified sonographers are, however, apprehensive about approaching the end of the module and feel anxious about being responsible for the entire scan and report once qualified. In new situations, they may start to consider ways to adapt their knowledge and technique; however, they may revert to stage I type scanning, such as observation of the probe, to assist their orientation. This reflects Benner’s (1984) observations of qualified nurses who, when presented with novel situations, would exhibit novice behaviours.

For qualified sonographers emerging from stage IV, new ways of working and applying information must be acquired if they are to become more accomplished performers (Rogers, Rousseau et al. 1999); thus, beyond this stage, day-to-day practice becomes part of this refining process. Cognitive involvement is reduced during the automation of the scanning procedure; this in turn means that more cognitive resources become available (Anderson 1995). These cognitive resources will be ultimately used by the newly qualified sonographer to adapt their practice and develop decision-making skills.
5.6 Summary

The pre-qualified sonographers' experiences have shown that learners benefit from working closely with one sonographer during stage I, and rely on easy patients to scan. Communication skills develop from almost scanning in silence during stage I to frequent communication before, during and after the scan. During stage I, the narrative type is that of 'chaos'. The role of observation changes with progress as pre-qualified sonographers become aware of their own practice; so too does feedback as learners move from reliance on regular feedback from the sonographer to learners' feedback back on their own performance during later stages of learning. Stage II narrative type is that of 'getting it together'. Once the basic navigational skills have been acquired, practise refines these during stages II and III. Stage III narrative type is that of 'becoming confident'. The role of practise changes again during stage IV as pre-qualified sonographers start to adapt their scanning skills to novel situations. They focus on acquiring the image during early stages of learning and, whilst there is still a tendency to focus on image acquisition rather than analysis during stage IV, interpretation is viewed as observing normal features. Stage IV narrative type is that of 'becoming qualified'. Table 6 summarises the stages of learning and defines narrative type.

Table 6 Summary of stages I-IV of learning and narrative type

<table>
<thead>
<tr>
<th>Stage of Learning</th>
<th>Narrative type</th>
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<tbody>
<tr>
<td>Stage I</td>
<td>Chaos</td>
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<tr>
<td>Stage II</td>
<td>Getting it together</td>
</tr>
<tr>
<td>Stage III</td>
<td>Becoming confident</td>
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<tr>
<td>Stage IV</td>
<td>Becoming qualified</td>
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Chapter 6 Qualified sonographers’ learning experiences

6.1 Introduction

This chapter presents a discussion of qualified sonographers’ narratives together with observations of clinical practice during stages V–VII of learning scanning. Narratives extracted from interviews based on observation of practice have been identified using the Labovian Framework, part of the narrative analysis framework in this study which is described in Chapter 2. Each stage of learning is reported in a separate section and the discussion is structured around themes.

Stages V–VII concern qualified sonographers’ experiences and their learning towards excellence in scanning.

For the purpose of the discussion that follows and to maintain participant anonymity, the six sonographers have been coded as follows:

Newly Qualified Learner A is referred to as NQA
Newly Qualified Learner B is referred to as NQB
Intermediate Qualified Learner A is referred to as IQA
Intermediate Qualified Learner B is referred to as IQB
Experienced Qualified Learner A is referred to as EQA
Experienced Qualified Learner B is referred to as EQB

The sonographers are categorised according to scanning experience related to time since qualification as shown in table 4. Table 4 was first presented in Chapter 3 Method.

Table 4 Categories of scanning experience related to time since qualification

<table>
<thead>
<tr>
<th>Category descriptor</th>
<th>Years post-qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newly qualified</td>
<td>0–2.5 years</td>
</tr>
<tr>
<td>Intermediate</td>
<td>2.6–5 years</td>
</tr>
<tr>
<td>Experienced</td>
<td>&gt; 5.1 years</td>
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Narratives and themes have been mapped against Benner’s (1984) competent practitioner, proficient practitioner and expert practitioner stages to see whether similarities exist between learning experiences towards excellence in scanning and the published literature.

The themes are based on communication, navigation, image interpretation and decision making. Feedback from peers and peer observation of practice are not carried out as routine practice and therefore are not included as themes in stages V–VII. Whilst decision making was previously discussed as part of image interpretation, decision-making skills are an integral component of expert practice in complex skilled performance (Durso and Gronlund 1999 p300) and so are included as a separate theme to image interpretation during stages V–VII.

6.2. Stage V learning experiences

This section includes a discussion on narrative type followed by the narratives and narrative themes on learning experiences in stage V and spans the first two-and-a-half years post-qualification period.

Narrative type is what I call ‘being’ (inexperienced), stage V narratives reflect an organised approach to scanning. Newly qualified sonographers place an emphasis on planning and preparation for the scan and these features closely map to Benner’s (1984) competent nurse.

Sonographers quickly assess request cards and seek out further documentation, such as previous scan reports or other test results, before calling the patient through to the scan room. Here, they check the patient’s identity and ask about previous medical history, enquiring further if more detailed background information is needed.
The patient’s comfort and needs are attended to, as are those of family or friends with the patient. A thorough description of the examination is explained to the patient prior to commencing the scan.

The sonographer has the ability to manage a wide range of situations and planning and preparation are part of contingency planning. Predictions of scan outcomes form the basis for decision-making processes, before and during the scan performance. As Benner (1984) points out, planning enables assessment of the current situation and prediction of the future situation.

6.2.1 Communication with the patient during stage V learning

Stage V sonographers confidently communicate with patients, particularly during the planning and preparation of the scan. Despite this, however, there are brief periods of silence, during which attention is focused on acquiring information.

Stage V sonographers are aware of their responsibilities and medico-legal requirements. Whilst they communicate easily with patients, their awareness of medico-legal issues impacts on their confidence at times; this meant their responses to patients’ questions were often guarded. On a few occasions during interview, I was asked questions related to legal awareness in practice.

NQB: I was just wondering if you’d noticed in newly qualified if you like or those qualified recently, whether we’re more conscious of medico-legal cases? ...

... I just wondered because of the increase of medico-legal cases in obstetrics. It’s where all medico-legal cases are ... and they are increasing [in obstetrics] more than in any other part of medicine, and I’d just wondered if you’d seen that kind of side of things, more than in the older qualified sonographers?

Communicating confidently during the planning of the scan contrasts with their diminished confidence to communicate freely during the scan performance; this is likely due to awareness of the new responsibilities that come with being qualified.
6.2.2 Navigation skills relevant to stage V learning

During stage V, the automated scanning actions are such an integral part of the performance that sonographers find it difficult to explain how they make fine adjustments of the probe. For example, NQA reports her experiences:

... Just looking at the screen really and what I see on the screen. I feel I hold the probe on the baby automatically and I don’t really have to think about that at all ...

... But I think I’m actually guided by what I see on the screen. I obviously have a bit of a routine, where I start in the midline. Just get the fetal heart, then I come back and do a sweep of the adnexa and then I start on the baby. I’m obviously just ... I don’t know. I must have a checklist in my head of things I need to see. There’s the baby. Has it got a heartbeat? Yes. Show the mother. Come back to the uterus ... look round the adnexa and can I see anything abnormal? No. Then I can come back to the baby. Where’s the placenta? I’ve got a list of questions in my head. The image of the placenta is obviously important and then [I] start on the baby. I tend to start off at the head but not always because if the head’s in a difficult position then I’ll leave it till the end and come back to it and get what I can. And I just think, oh I need to check the head, I need to check it’s the right shape, there’s no gaps and no – the right anatomy for the head. I need to measure it, and just working like that really and just working through the checklist in my head of all the things that I need to do.

... Right before I get the part of the stomach, I’ll decide in my head, this baby’s left side now, so I need to be seeing the stomach and the heart. So I’ll decide that while I’m going down, but then I’ll come back up again ... And I’ll do a transverse spine then I go back. I must go up and down the baby hundreds of times because then I’ll do like an abdominal scan, then I’ll look at the bladder and if it’s in the region of the spine then I’ll do the spine and like a saggital spine. I think I probably target things, but then if something’s there staring in my face, I’ll probably divert from my plan. Especially if its something like the heart or the face, which can be difficult to get in further scans. Or I’ll divert from there and maybe go back to it ...
Despite this, however, there is a tendency to observe the probe in novel situations and during these periods there is an increase in concentration, which means limited communication with the patient. There are similarities between stage V narratives and descriptors of Benner’s competent stage (1984 p27). Benner suggests that at this stage there is a feeling of knowing ‘mastery’ and the ability to cope with day-to-day situations. However, they experience difficulties when meeting new circumstances and need more practice in dealing with complex situations. In novel situations, they share similar features with stage I pre-qualified sonographers.

6.2.3 Image interpretation during stage V learning

During stage V, sonographers focus on analysing and interpreting the image rather than obtaining the image, as NQB reports, for example:

Yes I suppose what I’m trying to say is, I think, that when you’re qualified, I want a lot more detail, I wanted to see the spine in a lot more detail than perhaps I did when I was training ...

... Just for the whole abnormality of this baby really. I think to a point where you’re training you’re always, not blasé, but you always think well if I don’t get that four chamber it doesn’t matter ’cause somebody will be coming in to check my scan anyway so ... so you want to be sure that what you see is normal.

Sonographers focus on the detail in the image and this is used to inform the decision-making process.

6.2.4 Decision making during stage V learning

During stage V, whilst sonographers take responsibility for the examination, they lack confidence in making decisions that the examination is ‘normal’. Often repeatedly scanning over the same region of interest to be certain of not ‘missing’ an abnormal feature is part of lacking the confidence to make decisions. They work through the options systematically and methodically. Having less experience to rely upon during
this stage than later stage sonographers, they use a step-by-step approach to exploring options as part of developing their decision-making ability (Durso and Gronlund 1999 p300) during scanning; this could be the reason for the apparent slowness in scanning.

NQB: I think I just ... I think when I actually qualified I became a lot slower at scanning, I think at first you're a lot slower because you're constantly almost double-checking yourself and getting into that system. Which I suppose in hindsight it would be better to do, before you're actually qualified. But it's something that you don't fully appreciate until you're qualified ... in getting into that routine system ... a list if you like. So I think once you are qualified you're slower and methodical ...

... Working through. Yes ... Constantly checking yourself really. Yes ... is this normal? Yes ... It is right ... let's go onto the next part. I think you look in a lot more detail as well.

Stage V sonographers tend to follow a plan but can adapt this depending upon fetal position. NQA comments about learning to be confident in adapting technique:

Why do I do that? I think it's good to have a plan in your head because you don't forget to check that everything’s right.

GC: What makes you divert from your plan?

NQA: Just if something’s off tune really. Like it can be difficult to get the heartbeat. If it's lying in a nice position when I first start scanning and it's lying face up, I'll get the heart 'cause I know that in a few minutes I'll just turn over and then I'll struggle then at the end of the scan. I'll have to get the lady on, go for a walk, come back, scan and just go for it, so.

NQB: I think that initially, I think that's observing the sonographers when you're training. So when they're checking you, you're watching what they're doing to see if, to see the views that they're getting. So you're looking and saying well that's the kind of view I need to get. That's what I'm trying to achieve. Which is fine when you're training. When you're qualified I think it changes because it's your name on that report and you've got to be happy with what you are seeing so yes the view that you're getting at that point is the view for you to say yes that's fine.

Stage V sonographers need support to develop decision-making skills; one of the ways of achieving this is to identify a clear purpose for scanning. One of the reasons why pilots and air traffic controllers, for example, take time to make decisions is the
inability to perceive information in context. Durso and Gronlund (1991) illustrate this point with an example of expert pilots, who have well-developed situation awareness skills, and are able to scan the environment, searching for cues that would mean a change in plan and they use information to predict a possible outcome. Whilst stage V sonographers have awareness of what constitutes normal findings in an ultrasound scan, applying that efficiently in each clinical situation does not yet happen.

6.2.5 Summary

Narrative type is what I call ‘being’ (inexperienced), stage V narratives reflect an organised approach to scanning. Emphasis is placed on planning and preparation for the scan.

Newly qualified sonographers are accountable for the ultrasound scan examination. In response to coping with their new responsibilities, they slow down their scanning actions. During this stage, sonographers frequently scan and rescan an area in order to become confident to make a decision. They focus on image interpretation rather than obtaining the image and whilst scanning to a plan is evident, developing adaptation of the scanning plan is also observed during practice.

Stage V learning experiences map closely with Benner’s (1984) competent practitioner.

6.3 Stage VI learning experiences

Stage VI sonographers have been scanning for a minimum of two-and-a-half years, and, confident in their knowledge of what to do, they have the ability to make decisions.

In preparation for the scan, sonographers quickly assess the request card and seek further documentation, such as previous scan reports or other test reports, before calling the patient through to the scan room. They also review previous medical
history and would ask further questions if necessary both before and during the scan to elicit more detailed background information. A thorough description of the examination is explained to the patient, and often the context of the scan is explained to the patient. The patient's comfort and needs are attended to, as are those of family and friends accompanying the patient. There was no observable difference between stages V and VI about these aspects of the scan. The prescan preparation is an important part of the decision-making process; as Durso and Gronlund (1999) suggest, more experienced operators spend time evaluating the situation in order to plan their expectations.

Narrative type is what I call 'being' (experienced), stage VI sonographers' narratives demonstrate confidence in scanning in most situations. However, in some more unusual situations or where an abnormality is encountered, sonographers revert back to a controlled plan of scanning. Communication with the patient is an integral part of the scan; however, where an abnormality is encountered, communication stops whilst the learner concentrates on the scan.

Information is acquired before starting the scan in order to establish cues during image interpretation and to inform the decision-making process. These cues enable learners to analyse situations as an ongoing part of performance. They are able to select the important cues and use these as a basis for decision making. As Benner (1984) notes, the proficient performer perceives situations as wholes. They note which aspects stand out as being important.
6.3.1 Communication with the patient during stage VI learning

Scan preparation is identified as important in supporting communication with the patient. It is recognised that information often asked by the patient is also standardised and so patterns of information may be recalled in response to patients' questions automatically. During novel situations which demand high levels of concentration, sonographers limit communication with the patient, whilst they concentrate on identifying important aspects of the scan in order to come to a decision. However, what is different from previous stages is an awareness of what information needs to be acquired before communicating information to the patient. There is a suggestion of having a clear goal; learners actively search for key information in order to come to a decision.

IQB: ... (I need) to be sure, 'yes this is what I'm looking at, yes I know this is definitely what I'm going to put in the report, so I tell them. And it's knowing when to tell them as well.

... Like I said before, you can't always speak to them too soon because if it's bad news or it's not what they're expecting you can't get through the rest of the scan. I've even ignored people sometimes when I've picked up an abnormality and they've said is everything OK and I've already searched once but I'll just have a look through and we'll talk at the end. And I keep going on and I just have to switch off. I've got to get that information down quickly ...

I can and I do switch off as well. I can do scans when they scream at each other in the room, it doesn't bother me. I just shut down and concentrate on what I'm doing. I think a lot of the dialogue, it sounds a bit cruel but it's the same with most scans, same with most patients so unless they ask you something out of the ordinary, it's an answer that's already up there for that scan anyway ...

I've got like a box of answers for anomaly scans, a box for Dopplers and one for growths. Not consciously but it's up there. You can just feel a question coming on sometimes. They're very similar in what they ask ...

... Which is natural, I mean there's not an awful lot you can ask about your baby.
Whilst Benner (1984 p31) comments that proficient performance may regress in novel or challenging situations, this narrative illustrates that the learner has a command of the situation and is developing the ability to seek for and select information that is important.

6.3.2 Navigation skills relevant to stage VI learning

Stage VI sonographers rely on experiences and don’t follow a rigid plan. They scan freely and are able to assimilate significant cues to enable them to navigate the probe efficiently. They respond quickly to situations where obtaining the desired image is limited, by changing their scanning plan.

GC: But if you can’t, you are quite happy to sort of do it in a haphazard way?

IQB: Yes, yes, if that is the way it is going, ‘cause sometimes they are all over the spine and you can’t get to the heart straightaway, or they are lying deep cephalic and you can’t get to the head straightaway, so you just move on. You are under so much pressure time wise to get them in and out and obviously do a good job as well that you can’t if something is not there you can’t wait, hanging around, waiting for it to move, you go and look at other things and then hope that it would have moved and then go back to it ...

This narrative reflects the importance of past experiences to underpin practice during stage VI. In novel situations, Durso and Gronlund (1999) recognise that experienced operators use cues more efficiently than less experienced operators to make decisions. Focusing on relevant information in order to inform the patient relies on the sonographer needing not only to consider the current context of the clinical situation but also the implication for the patient’s future.

6.3.3 Image interpretation during stage VI learning

Sonographers use a mental construct of images to recall and compare with newly acquired information. The information acquired during prescan preparation enables them to have expectations about the scan. These expectations focus the sonographer to particular cues in the image.
GC: OK. What do you picture in your head at that time? Do you know?

IQA: No, not really, no, I mean in my head ... what things should look like ... and I suppose if I have not seen what I think it should look like, then it is just abnormal pattern recognition isn't it? Like looking at X-rays really.

GC: What do you mean by that?

Well you know, you see so many normal and you know from all your training and looking at text books what normal looks like that you would hope when faced with abnormal that it would hit you like a ton of bricks really. Although some things are more subtle, like cardiac things sometimes and some of the things to do with the brain are a little more subtle, I suppose, but most things I would hope would like really jump out at me, because it is abnormal pattern recognition really.

According to Benner (1984), because of this experience-based ability, the proficient performer identifies the abnormal situation efficiently. Thus, image interpretation is part of the decision-making process which enables learners to be able to recognise an abnormal or normal image in the context of the scanning situation.

6.3.4 Decision making during stage VI learning

Stage VI sonographers use their experience to interpret situations and predict future problems; whilst this is part of decision making (Durso and Gronlund 1999 p300), learners don't always select the relevant information and, despite being experienced, there are still limitations in the decision-making process if what is being experienced is considerably different to previous encounters. For example, one sonographer had previously worked in a department where patients were scanned lying the opposite way to the normal orientation. Whilst there are some aspects of skill transferability, scanning orientation was limited and this slowed the decision-making process. The sonographers' narrative suggests that the motor programme for performing the scan is not able to take into account this different way of scanning. It suggests that the qualified sonographer returns to aspects of scanning performance similar to that of a
stage II pre-qualified sonographer when the scanning action has to be thought about rather than being automised.

IQA: And it slows you down because when I worked at another place where we scanned the opposite way round, for a time, for about a week or so, I was having to thinking 'cause everything is opposite to what you normally do 'cause the patient is lying the other way round that your mind is then half on what your arm is doing. I do not really know what it really is because it goes on between your brain and your arm and half on what you are looking at as well, which I find quite frustrating really because it slows me down and also I am aware that I am having to put more brain power into thinking what my arm is doing and I would rather put 100% of my brain power into what I am looking at.

Despite this, however, sonographers seem to have a clearer idea about what information is relevant to inform decision making than during the previous stages of learning. Accordingly, stage VI sonographers use prior experiences as part of the decision-making processes but, as commented upon previously, Benner notes that proficient performers may regress in new situations. Despite this, there is appreciation of implications and predictions for future practice.

6.3.5 Summary

Narrative type is what I call ‘being’ (experienced), sonographers in this stage of learning are confident and able to scan quickly and efficiently. They adapt their technique as part of their schema. However, in some novel situations for example where an abnormality is encountered, sonographers revert back to a controlled plan of scanning. Despite communication with the patient being an integral part of the scan, in novel situations communication stops whilst the sonographer concentrates on the scan.

Stage VI sonographers are developing problem-solving techniques. Information is acquired before starting the scan in order to establish cues during image interpretation and to inform the decision-making process. These cues enable
sonographers to analyse situations as an ongoing part of performance. They are able to select the important cues and use these as a basis for decision making. As Benner (1984) notes, the proficient performer perceives situations as wholes. They note which aspects stand out as being important.

6.4. Stage VII learning experiences

Stage VII sonographers have been scanning as qualified sonographers for a minimum of five years, they have encountered a wide range of situations and are able to recount many significant learning events that have contributed to their scanning practice. In particular, their situation awareness and decision-making ability is based upon these past learning experiences. Narrative type is that of what might be called 'being' (expert), scanning is performed intuitively during stage VII and, whilst observations of practice have revealed insight into what happens, learners aren’t sufficiently aware of their actions to describe these.

Stage VII learners’ narratives reflect wide-ranging experiences in scanning and significant experiences that have contributed to their learning. The narratives reflect an overview of practice rather than detail on why particular actions were performed as practice is now performed intuitively.

Despite this, however, sonographers consciously interpret observations as part of decision making. They have situation awareness and this means relevant information is identified efficiently from the range of cues available to them. Experts are known to use cues more efficiently and diagnostically than early stage learners (Lipshitz and Shaul 1997). Accordingly, Benner (1984) suggests the expert practitioner has an intuitive grasp of the situation and is able to focus in on the problem without exploring the options.
6.4.1 Communication with the patient during stage VII learning

Communication, rather than consisting of standard phrases, is more relevant to the situational context than demonstrated in the previous stage of learning; however, this may be down to individual differences in communicating with the patient.

EQA, in response to my question about what had changed in the way she carries out her scans since qualifying:

Well I'm more confident. I talk to the patients more. I think the whole thing of scanning just becomes more automatic. But I'm wary that I don't want it to be too automatic. I feel I can scan automatically. I think you can get to a point where it's too automatic and you're not seeing things. But I think you should ask questions about what you're scanning. I've become quicker obviously ...

... I suppose it's with experience, that you see things at the moment you come across something ... and that you're sure that more than likely to have seen it further down the line, so you can make a decision.

As they gain experience, sonographers tend to provide constant feedback to the patient during the scan. Stage VII is also about assessing the patient's feelings and knowing how to engage with the patient at different levels of communication. For example, the whole situation is assessed and feedback provided in the context of the clinical situation. This is part of assessing the situation in order to predict and plan for future problems and includes assessing the mood of the patient at the first meeting, obtaining detailed information and continuing to ask questions during the scan.

EQB: I think at first, when you bring the patient into the room, you ask yourself, are they quite relaxed? Or are they quite nervous? If they are, try and coax them out of it. Why? If there's been something going on that they've not actually mentioned, have they been bleeding? Have they been having pains? Have they had previous problems and that's why they're a bit nervous or are they just a bit apprehensive 'cause they don't know what to expect? Because that can give you a clue as to what you're going to find. The patients will say, 'well I've actually been bleeding for a week' and you know you might find a non-viable pregnancy ...
Communication is more responsive to patients needs. Whilst there is evidence of scanning intuitively, there is also a conscious effort to interpret the findings and focus on the relevant information. Spying time on assessing the patient’s situation in this way is part of the decision-making ability.

6.4.2 Navigation skills relevant to stage VII learning

Sonographers scan intuitively and are not able to explain how they scan. The focus is on decision making and probe movement is an integral part of this process.

Sonographers adapt their technique as part of their schema.

During one scan, the stage VII sonographer observed her hand and probe during a challenging part of a scan: these actions are similar to stage I pre-qualified sonographers. The stage VII sonographer wasn’t aware of observing her hand and probe and we discussed this afterwards.

EQA: I don’t know really, I don’t know really what I was doing there because I was only really looking if the heart was in a better position. Which it was slightly but then it went better anyway didn’t it because it moved so it was fine ... so I suppose I was just looking where I was on her. But no real reason on that one I don’t think. No ... No ...

... But even though on that 20 weeker when I checked I was in the middle, I’m assuming that he [reference to previous scan] did the booking scan and checked it was in the middle ...

EQA then recounted a story from a previous significant learning event:

But that facial bit, you shouldn’t assume should you? Like the lady that transferred to here, you assume that another hospital has made sure it’s not outside the uterus. Of course they hadn’t had they? You know ...

... I got one once from another hospital. It was an early pregnancy, and she’d had a scan at 7 weeks and it was viable. And she was bleeding, and she came to our unit and it was 8 weeks and it was outside the uterus and she had been seen at an early pregnancy clinic, and yes it was viable, but it wasn’t in the uterus. So you know, it just shows you, doesn’t it?
Despite having considerable experience, there are still instances where the presenting situation is new or unusual so that experienced sonographers may revert to actions that resemble those from previous stages.

6.4.3 Image interpretation during stage VII learning

Stage VII sonographers link the information acquired about the patient before the scan with their interpretations of the image concurrently as they scan. Image interpretation is an integral part of the scan process and is combined with assessing the patient's feelings. Image interpretation is part of assessing the situation in order to predict problems and is combined with communication with the patient during the scan.

EQB:....Once I've started scanning it's..., have I got the equipment set up properly? Is this viable? Do I need to do something different with this lady? Do I need to do a TV scan? Am I going to get any further? Or is there a point at which I can only do so much on this lady today and she's going to have to come back on another day? And always having a list in my mind of all the things I'm checking on the baby......

So, fetal heartbeat ... fetal number ... all the various measurements if it's an anomaly scan. If I go back again to when I trained, and we had a check list of the report that you went down and put little ticks or crosses on what you'd seen so you just went down with the mouse now I could still reel that check list off to you because that's how I remember it ...

... So that's how I have to report it so that's how I go through everything in the anomaly scan, have I seen everything?..And I'm sort of mentally saying those things in my head; stomach, kidneys, bladder, abdo ... and I'm going down them all.

......As I've gone round them all I'm saying yes I've seen that, I've seen that, seen that. So it's just keeping it all there and remembering what you have done and what you haven't done and what you still need to cover.

Image interpretation, whilst not directly reported here, it is rather inferred that this forms part of assessing the situation and is rapidly performed as part of the decision-making ability.
6.4.4 Decision making during stage VII learning

EQB is able to ‘isolate’ the baby in a mental and situational construct, that is, to focus on the relevant features of the scan in a goal-centred context. Awareness of the situation and what key points are of importance are emphasised. The need to gather important information extends beyond the boundaries of scanning as she suggests that midwives can be helped to achieve this by using their palpation skills. This was a technique used by L.D.

EQB: I normally work the other way, I normally go head, abdo., femur. But I went the other way just because of its lie really. But otherwise, I’ve done the mistake before of letting the lady go out the room and then thinking I didn’t measure something, I didn’t look at something and having to get her back in. So experience has taught me that it is better to just keep it quite structured really. But knowing there’s that flexibility because otherwise you’re going to spend half an hour looking at the spine that you could have done everything else, sent the lady out for a walk round and got her back in and reduced your examination by 20 minutes. If you’re doing that, at least if you’ve got that structured list in your mind, even if you deviate from it in how you’re going round the baby, you’ve still got it in your mind to go through and think have I done this, have I done that and then go back to it if you haven’t.

GC: When you’ve actually got the probe on the mum’s abdomen, what are you thinking about? ... Are you using the monitor to follow the baby? And how are you following the baby? How do you know where it is and how it’s lying?

EQB: I am using the monitor. The reason that I know that’s evident is because when we’ve taught midwives, and the midwives have been struggling to relate to where the baby is and get the fetal lie, I sometimes suggest to them if it’s a later growth scan, I say well before you start scanning, palpate the lady’s abdomen because you can probably do it better that way, and then what you feel might relate a bit better to what you see on the screen and you might understand it a little bit better, you might think ah right yes, spine is that way. But because I don’t palpate abdomens that wouldn’t make any sense to me so I sort of map it out myself on the screen and then translate that for the lady into, the spine’s on the left and the liver’s on the right because I know that’s how the patients think of it, they want to know is its head here or is it on the right or is it on the left. But yes, I map it out on the screen.

EQB goes through her plan and has a range of options; she is aware of possible problems with the examination and is planning how she will deal with these. This
reflects how, in complex situations, sonographers spend much of their time assessing the situation in the clinical context and use cues as an integral part of the scan to assess the situation.

Yes. I think it does because to begin with you’re thinking is it me, is it the equipment, is there something I can do to make this easier and once you’ve got that experience you quickly realise right, well that bladder is not full enough, I might see a certain amount, I might be able to establish that yes it is viable, and at least we reassure the lady of that.

Despite difficult situations presenting during the scan, experienced sonographers will persevere if the important and relevant information can be obtained. In previous stages, there is a tendency to stop the scan and rescan the patient at a later opportunity.

EQB: Or if I need to get more she’ll have to fill up or have a TV scan and then it’s a decision as to which one is better, that particular [patient] had a retroverted uterus as well, so I could see that much so I thought well I could fill her and still not get very much further. So certainly given both options it has to be their decision but make them aware that they may well need a TV scan even if they fill up as well. Luckily that lady has had it before so she was quite willing to just go ahead with that. Whereas if they’ve not had it before they might you know, a few more questions, will it hurt, is it harming the baby and they might be more inclined to say well I’ll try and fill up and if I can’t fill up then fine we’ll do that. But they might be more edgy about it. But she was, because she’d had it done before she was quite happy to just go ahead with it. She was fine. She was easy in that way.

Experienced sonographers are able to adapt scanning performance easily. They are able to make decisions about changing the plan as an integral part of the scan performance. They know whether adaptations to the technique will result in the relevant structures being examined or whether it is unlikely to have the desired effect.

EQB: Yes...... The growth scan I did today I would normally usually start lower down in midline which is generally where the head is, but its head was in such a position that I couldn’t get it instantly so I went to something else ...

... So I tend to have a fixed structure of how I go round. Obviously you’ve got to be flexible in that way otherwise you could be there all
morning just trying to measure the head because it’s not going to be possible to do it so there does need to be some flexibility ... yes I try and have a structured way of doing it.

By stage VII, learners have considerable experience, which is used to process critical cues and ignore those of less relevance and this highlights the importance of planning the scan as part of the process of deriving these decisions.

Without automisation of scanning skills and the process of acquiring and processing information efficiently, sufficient cognitive resources would not be available to enable the sonographer to make informed decisions.

Interpretive abilities can aid in the identification of cues and categorise knowledge, allowing them to make rapid decisions.

6.4.5 Summary

Stage VII narrative type is that of ‘being’ (expert), narratives suggest sonographers in this stage of learning are confident and able to scan quickly and efficiently and able to plan and make decisions concurrently. They adapt their technique as part of their schema. They are able to make decisions based on a range of evidence presented.

By stage VII, sonographers demonstrate general characteristics of expertise. Whilst expert performance is domain-specific (Charness and Schultetus, 1999 p58) and to date there is no clear criteria on defining an expert sonographer, then these claims should be treated as conservative.

However, expertise may be classed as superior performance and, whilst superior performance may be described as reliable, it also includes problem-solving ability, being able to make informed decisions (Charness and Schultetus, 1999 p58) and situation awareness (Durso and Gronlund 1999). Expertise, however, is not just related to experience in terms of number of years of scanning, for example; rather, as Charness and Schultetus (1990 p59) point out, it involves focused, deliberate
'practice' and study linked with that practice. Activities considered deliberate practice may entail reading, problem solving, application of knowledge to develop understanding, teaching and learning, and developing meaning and refining skills. Experts may also provide consultation (Benner 1984) on practice. It is also recognised by some that reflection has a role in the application of knowledge to practice and problem-solving ability (Moon 2004).

Determining expertise in ultrasound warrants further work to develop a better knowledge and understanding of what is meant by an expert sonographer.

6.5 Summary

This chapter discussed stages V, VI and VII of learning ultrasound scanning. The outcomes at each stage of learning will be combined with stages I–IV to develop the Framework of Learning Experiences in Ultrasound Scanning presented in Chapter 7. Stage V narratives suggest sonographers experience a fall in confidence as newly qualified sonographers are now taking responsibility for the ultrasound examination. They slow down their scanning actions and often scan and rescan an area to feel confident in making a decision as the decision-making ability develops. There is a slight drop in their performance as they take on their new role. Whilst this pattern is similar to stage I, stage V narratives are more positive than the chaos narratives described in stage I. Stage V type narratives are what I call ‘being’ (inexperienced).

Stage VI narratives suggest sonographers in this stage of learning are confident in managing the scan. Sonographers are able to scan quickly and efficiently. They adapt their technique as part of their schema. In new situations, they are developing problem-solving techniques and they are still meeting situations in which decision
making has to be carefully considered. This is a stage of progress towards excellence and the narrative type is what I call ‘being’ (experienced).

Stage VII narratives suggest sonographers in this stage of learning are confident and able to scan quickly and efficiently and able to plan and make decisions concurrently. They adapt their technique as part of their schema. They are able to make decisions based on a range of evidence presented. This stage may be described as excellence in scanning and the narrative type is what might be called ‘being’ (expert). Table 7 provides a summary of stages of learning and defines narrative type.

Table 7 Summary of stages V-VII of learning and narrative type

<table>
<thead>
<tr>
<th>Stage of Learning</th>
<th>Narrative type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage V</td>
<td>Being (inexperienced)</td>
</tr>
<tr>
<td>Stage VI</td>
<td>Being (experienced)</td>
</tr>
<tr>
<td>Stage VII</td>
<td>Being (expert)</td>
</tr>
</tbody>
</table>
Chapter 7 The Framework of Learning Experiences

7.1 Introduction

This chapter is in two parts. The first part presents the Framework of Learning Experiences in Ultrasound Scanning, complete with characteristics derived from each theme for each stage of learning and narrative type at each stage of learning. Data was analysed as an integral part of the research (Mason 2002) and themes emerging from the data were compared for similarities and differences. Those themes that were dominant were selected for discussion in this thesis. Dominant themes were those that could be directly identified from the interview transcript and were those that the participant returned to on more than one occasion in the interview or that were shared across narratives within a stage or across stages. The dominant themes discussed in Chapter 4 and Chapter 5 could be related directly to interview transcripts, that is, they were referred to explicitly in the text and exemplars of these are presented in those chapters. Interpretation of themes followed and characteristics for each stage developed from these themes; these characteristics are offered in a framework for the purpose of this thesis.

During the analysis, differences between the pre-qualified and qualified themes became apparent and it was necessary to document these in a way that reflected these distinctions, which is why there is a different number of themes presented for pre- and qualified sonographers.

Whilst learners progressing towards competence relied on observation, practise and feedback to develop their skills to a level of competency, communication, navigation skills and image interpretation were shared themes across all stages; decision making developed out of image interpretation and became more important in qualified sonographers progressing towards excellence in scanning. The themes have been
presented in a way that demonstrates the characteristics of learning experiences during each stage of learning.

Narrative type describes narratives that contain accounts of similar events (Polkinghorne 1988 p167). In this thesis the type of narrative is described at each stage of learning and each description type has been developed as part of this study. Whilst stage I narrative type is closely mapped with Franks (1997) chaos narratives, and is therefore similarly described, there was no clear narrative type description in the literature that could be mapped to stages II -VII of learning in this thesis.

Descriptions of narrative type for stages II-IV have been developed to reflect the progress towards becoming qualified. Descriptions of narrative type for stages V-VII have been developed to reflect progress towards excellence in scanning.

The second part of this chapter provides a visual representation of progress in learning scanning. Each stage is visually represented by reflecting the pattern of changes in learning experiences and narrative type over time. These visual representations of learning experiences are shown for each of the seven stages and then combined to represent a visual landscape of learning.

Section 7.2 presents The Framework of Learning in Ultrasound Scanning. The Framework is a way of representing learning experiences in ultrasound scanning. It is divided broadly into pre-qualified and qualified experiences. Details of learning experiences are categorised by theme and narrative type is also described for each stage of learning.
7.2 The Framework of Learning Experiences in Ultrasound Scanning

This section presents the seven staged framework of learning experiences in ultrasound scanning. The framework is broadly divided into two parts, the pre-qualified part and qualified part of learning. The framework provides characteristics of learning for each theme within each stage of learning, together with a description of narrative type.
Table 8 The Framework of Learning Experiences in Ultrasound Scanning

<table>
<thead>
<tr>
<th>Stage</th>
<th>Themes</th>
<th>Learning experiences</th>
<th>Narrative Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREQUALIFIED</td>
<td>Stage I</td>
<td>1. Communication Engages in minimal communication with the patient at the beginning and at the end of the scan</td>
<td>Chaos narrative  Processes and scanning procedures are chaotic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Observation Observe sonographers scanning and attempt to link actions with the image</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Feedback Prefers to work with the same sonographer and receive regular feedback during and after the scan</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Practise Prefers practising on static structures and on easy, co-operative patients</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Image interpretation Uses major landmarks as beacons to guide scanning, e.g. fetal head, fetal body, fetal heart (movement), fetal limbs.</td>
<td></td>
</tr>
<tr>
<td>PREQUALIFIED</td>
<td>Stage II</td>
<td>1. Communication Engages in communication with the patient at the beginning and at the end of the scan. There is minimal communication during the scan, during which scanning is stopped. Standard phrases become part of communication with the patient.</td>
<td>‘getting it together’ narrative  Processes and scanning procedures start to become defined</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Observation Observe sonographers scanning, focusing on probe movement and measurements to reinforce knowledge.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Feedback Prefers to work with different sonographers and receive regular feedback during and after the scan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Practise Prefers practising on similar patient types, preferring easy, co-operative patients to scan as this helps to develop navigational strategies and to aid development towards finer hand movements.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Navigation Demonstrates smoother operation of probe as movements. Expected to complete first trimester and third trimester scans and are introduced to second trimester scanning. Starts using equipment controls.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Image interpretation Focus on obtaining the image and recognition of normal sonographic features develops.</td>
<td></td>
</tr>
<tr>
<td>Stage</td>
<td>Themes</td>
<td>Learning experiences</td>
<td>Narrative Type</td>
</tr>
<tr>
<td>-----------</td>
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<td>----------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>PRE</td>
<td>Stage III</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QUALIFIED</td>
<td>1. Communication</td>
<td>Engages in communication with the patient at the beginning and at the end of the scan. There is</td>
<td>'Becoming confident' narrative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>communication during the scan which involves standard phrases. More emphasis on communication at the</td>
<td>Processes and scanning procedures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>beginning of the scan which focuses upon obtaining a detailed medical history of the patient.</td>
<td>are automised</td>
</tr>
<tr>
<td></td>
<td>2. Observation</td>
<td>Observes sonographer in difficult or abnormal cases and where adaptation of technique is required.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Feedback</td>
<td>Attempts the scan then feeds back to sonographers afterwards</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Practise</td>
<td>Has developed motor skill control but needs to practise refining precise movements of the probe, e.g.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>for fetal heart scanning.</td>
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</tr>
<tr>
<td></td>
<td>5. Navigation</td>
<td>Demonstrates automised scanning characterised by smooth operation and continuous integrated movements</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>of the probe. Cannot easily adapt technique to new situations. Concentrate on</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>manipulating the equipment controls during the scan procedure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Image Interpretation</td>
<td>Focuses on obtaining the image. There is recognition of normal sonographic features and recognition of</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>abnormal sonographic features develops.</td>
<td></td>
</tr>
<tr>
<td>Stage IV</td>
<td>1. Communication</td>
<td>Communicates regularly with the patient. More emphasis on communication at the beginning of the scan,</td>
<td>'Becoming qualified' narrative</td>
</tr>
<tr>
<td>PRE</td>
<td></td>
<td>which focuses upon obtaining a detailed medical history of the patient and continues on this theme</td>
<td>Processes and scanning procedures</td>
</tr>
<tr>
<td>QUALIFIED</td>
<td></td>
<td>during the scan.</td>
<td>are automised. They manage the scan</td>
</tr>
<tr>
<td></td>
<td>2. Observation</td>
<td>Observes sonographer to compare outcomes of the scan.</td>
<td>and perform unobserved. Exhibit</td>
</tr>
<tr>
<td>QUALIFIED</td>
<td></td>
<td></td>
<td>anxieties about being responsible</td>
</tr>
<tr>
<td></td>
<td>3. Feedback</td>
<td>Scans the patient then confirms findings and measurements with the sonographers afterwards</td>
<td>in the future for the entire scan</td>
</tr>
<tr>
<td>QUALIFIED</td>
<td></td>
<td></td>
<td>and report once qualified.</td>
</tr>
<tr>
<td></td>
<td>4. Practise</td>
<td>Recognises the value of regular practice and experiences a drop in confidence if practise isn’t on a</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>regular basis.</td>
<td></td>
</tr>
<tr>
<td>QUALIFIED</td>
<td>5. Navigation</td>
<td>Demonstrates more effective scanning procedures than during previous stages; precise movements</td>
<td></td>
</tr>
<tr>
<td>QUALIFIED</td>
<td></td>
<td>have been refined and effective ways of recalling relevant information from memory have been</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>developed. Manipulate the equipment controls during the scan procedure. Begin to adapt their</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>knowledge and skills to new situations using a step by step approach</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Image Interpretation</td>
<td>Focuses on analysing and interpreting the image rather than just acquiring the image</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Stage</th>
<th>Learning experiences</th>
<th>Narrative Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>POST QUALIFIED</td>
<td><strong>Stage V</strong></td>
<td></td>
</tr>
<tr>
<td>1. Communication</td>
<td>Confidently communicates with patients, particularly during the planning and preparation of the scan and it is focused to patients' needs. Limited communication with the patient whilst scanning novel situations.</td>
<td>'Being' (inexperienced) narrative</td>
</tr>
<tr>
<td>2. Navigation</td>
<td>Demonstrates automated scanning actions as an integral part of performance; adaptation of technique continues to develop. Manipulating equipment controls are an integral part of the scan.</td>
<td></td>
</tr>
<tr>
<td>3. Image Interpretation</td>
<td>Focuses on analysing and interpreting the image rather than just acquiring the image.</td>
<td></td>
</tr>
<tr>
<td>4. Decision Making</td>
<td>Demonstrates a lack of confidence in decision making, because of having responsibility for the ultrasound examination and report; this results in a slow down in scanning actions (in comparison with stage IV). Often repeatedly scanning over the same region of interest. Need to develop decision-making skills and need more practice in dealing with complex situations.</td>
<td></td>
</tr>
<tr>
<td>POST QUALIFIED</td>
<td><strong>Stage VI</strong></td>
<td></td>
</tr>
<tr>
<td>1. Communication</td>
<td>Confidently communicate with patients, particularly during the planning and preparation of the scan and it is focused to patients' needs. Have developed awareness of what information needs to be acquired before communicating information to the patient. Patterns of information are recalled in response to frequently occurring patients' questions. Limited communication with the patient whilst scanning novel situations.</td>
<td>'Being' (experienced) narrative</td>
</tr>
<tr>
<td>2. Navigation</td>
<td>Adapts technique and responds more quickly than during previous stages to situations that require a change to their scanning plan. Fewer situations present where decision making has to be carefully considered.</td>
<td>Processes and scanning procedures are an integral part of the performance.</td>
</tr>
<tr>
<td>3. Image Interpretation</td>
<td>Focuses on analysing and interpreting the image rather than just acquiring the image. The information acquired during prescan preparation is used to provide expectations about the scan. These expectations focus the sonographer to particular cues in the image.</td>
<td></td>
</tr>
<tr>
<td>4. Decision Making</td>
<td>Starts to employ a wide range of information from before and during the scan. They are much more focused and actively search for key information in order to come to a decision. The information acquired during prescan preparation enables them to have expectations about the scan. Learners use their experience to interpret situations and predict future problems. There is appreciation of implications and predictions for future practice.</td>
<td></td>
</tr>
<tr>
<td>Stage</td>
<td>Learning experiences</td>
<td>Narrative Type</td>
</tr>
<tr>
<td>-------</td>
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<td>---------------</td>
</tr>
<tr>
<td>POST QUALIFIED</td>
<td><strong>Stage VII</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>1. Communication</strong></td>
<td>Confidently communicate with patients, is focussed to patients needs; provide constant feedback to the patient during the scan.</td>
</tr>
<tr>
<td></td>
<td><strong>2. Navigation</strong></td>
<td>Adapt technique and perform planning and decision making, concurrently. Provides an overview of practice rather than detail on why particular actions were performed.</td>
</tr>
<tr>
<td></td>
<td><strong>3. Image Interpretation</strong></td>
<td>Focus on analysing and interpreting the image. The focus is on particular cues in the image and scanning is intuitive, focussing on identifying what is important and interpreting relevant information.</td>
</tr>
<tr>
<td></td>
<td><strong>4. Decision Making</strong></td>
<td>Spends time on assessing the whole situation and make decisions based on a range of evidence presented, before, during and after the scan and synthesises the evidence to draw conclusions. Intuitive appreciation of implications and predictions for future practice.</td>
</tr>
</tbody>
</table>
This framework provides an insight into characteristics of learning experiences in ultrasound scanning across seven stages. Based on individual performances, it succeeds as a way of seeing progression from starting scanning to excellence in scanning practice.

The framework is situational and is based on longitudinal and cross-sectional data; themes from within and across narratives based on individual performances have been drawn together to provide a way of charting learning to scan. Despite the small sample size, it is these cross-contextual situated findings that provide the framework with some degree of generalisability (Mason 2002). However, it is possible to have underestimated the complexities of scanning by presenting thematic characteristics in seven stages.

Stage IV is characterised by some notable differences between stage III and stage V and, therefore, it is conceivable that this stage is relevant in finalising certain aspects of the scan performance before the learner is deemed fully competent. Competency in scanning is not defined here; rather, it is used as the accepted basis for all learners who successfully completed programme assessments. Stage IV is an important stage for developing adaptation of technique; learners need to adapt practice to show they are able to explore how they may adapt scanning practice in novel situations. This adaptation of technique was omitted from Fitts’s three-stage approach to skill acquisition and should not be ignored in complex skills such as ultrasound scanning. Thus, it is likely that a fourth stage of learning exists beyond that of skill automatisation in complex skill acquisition such as scanning.

Taken stage by stage, individual performance does not incrementally improve across all aspects explored in this thesis in a consistent fashion. Some skills develop rapidly and then performance levels off; for example, learning to use the equipment controls.
did not become significant until stage II but, once assimilated into the scan performance, no observable differences in activity were observed in subsequent stages. Communication with the patient, on the other hand, is an integral part of clinical practice and changes in communication skills have been documented across seven stages of learning. Practising skills in context is paramount to retaining knowledge and successful skill acquisition in the long term (Gentile 1998) and, according to Fitts (1964), leads to automatisation of skilled performance. Once competent, the practitioners’ daily practice constituted practise and was not mentioned by the qualified learners. Only due to lack of regular scanning, if they had been on leave for example, was a lack of confidence in scanning mentioned; however, this was not a dominant theme in this study and therefore practising was not included as a theme during stages V–VII.

This study set out to explore individual learning experiences and has explored these for uniqueness and similarities in order to present these in a framework. Learning is unique and based on prior experiences, and thus it may be useful to those health care practitioners who wish to learn certain aspects of scanning and who start learning from different levels of knowledge and experience in their field. The framework may go some way to identifying key characteristics that may be shared in learning in other fields of ultrasound.

Navigation in the context of scanning involves the ability to control the direction and speed of the probe to locate the area of interest, control the pressure of the probe and manipulate equipment controls to produce high-quality images. Fine-tuning the probe to ‘home in’ on the detail is the final phase of probe manipulation. The aim is to automise these navigational skills and, once this is achieved, cognitive resources can be focused on adapting technique based around developing decision-making skills.
Progress in navigation skills was evident across the seven stages of learning. To a lesser degree, so too were image interpretation skills when analysed across the first four stages of learning. Evidence (Durso and Gronlund 1999 p293) suggests that image interpretation is inextricably linked with decision-making skills, which are integral to situation awareness. The first part of image interpretation is pattern recognition, the ability to perceive information in a particular context that is meaningful. The framework showed the development of image interpretation skills during the first four stages of learning. During stages V–VII, data analysis centred around decision-making skills. In the context of scanning, situation awareness relates to how well the sonographer understands the context and implications of the information presented both before and during the scan and therefore impacts on the ability to predict likely outcomes (Durso and Gronlund 1999 p283). It is suggested that decision-making skills lead on from image interpretation and precede situation awareness. In complex situations, experts assess the circumstances using a variety of cues more efficiently than novices. It is likely that, through a process of decision making, sonographers progress to being able to analyse the situation efficiently and adapt scanning concurrently in the clinical situation. Decision-making skills are an integral component of expert practice in complex skilled performance (Durso and Gronlund 1999 p300). Accordingly, Benner (1984) recognises decision making as part of the competent practitioner’s role. Development of decision-making skills is shown across stages V–VII in the framework.

7.3 A visual representation of learning experiences in ultrasound scanning

The framework has revealed an insight into learning experiences in scanning. In the framework differences are shown between themes across seven stages which infer progress from starting to scan to excellence in scanning.
The purpose of this section is to provide a visual representation of this progress in learning by reflecting the pattern of changes in learning experiences and narrative type over time.

These visual representations of learning experiences are shown for each of the seven stages and then combined to represent a visual landscape of learning experiences. This is a tentative representation of narratives and learning over time and further work is required to explore this relationship further.
Stage I

During stage I, the pre-qualified sonographer learning experiences are characterised by chaos narrative types. Figure 5 provides a visual representation showing limited progress towards the learning goal during stage I.

The line starts part way up the y axis to show that the pre-qualified sonographers had prior knowledge and experiences in health care. The x axis shows a 3 month time scale for stage I.

**Figure 5 Visual representation of stage I learning and narrative type**

As pre-qualified sonographers, they are faced with a large amount of new information which they are not able to contextualise easily and, as a result part way through stage I they experience chaos as new knowledge is unstructured and holds little meaning. Once sonographic structures are identified, learners start developing navigational skills and are able to control the probe movement towards the target. This is the turning point and learners progress to stage II learning.
Stage II

During Stage II, the pre-qualified sonographer learning experiences are characterised by ‘getting it together’ narrative types. Figure 6 provides a visual representation showing a turning point in progress towards the learning goal during stage II.

The line starts as a continuum from stage I on the y axis to show that the pre-qualified sonographers start to make progress in learning. The x axis shows a 3 month time scale for stage II as they move through stage II in the 3-6 month period of learning.

**Figure 6 Visual representation of stage II learning and narrative type**

Learners are now clear about what they need to do to be able to perform a scan. Processes and scanning procedures start to become defined, yet they cannot accomplish fine movements sufficiently. They start to use equipment controls but cannot achieve these synchronously. They focus on obtaining the image and can recognise normal sonographic features.
Stage III

During Stage III, the pre-qualified sonographer learning experiences are characterised by ‘becoming confident’ narrative types. Figure 7 provides a visual representation showing steady progress towards the learning goal during stage III.

The line starts as a continuum from stage II on the y axis to show that the pre-qualified sonographers continue to make progress, but this tails off as they practise skills rather than acquire new skills at the same rate as they did during stage II. The x axis shows a 3 month time scale as they move through stage III in the 6-9 month period of learning.

Figure 7 Visual representation of stage III learning and narrative type

Stage III learning is characterised by processes and scanning procedures becoming automised. Scanning is characterised by a smooth operation of the probe. During stage III, navigation skills are refined through practise. They cannot easily adapt technique and require help in cases where imaging is difficult due to fetal position. Communication skills are also developing during this stage and learners speak with patients at regular intervals.
Stage IV

During Stage IV, the pre-qualified sonographer learning experiences are characterised by ‘becoming qualified’ narrative types. Figure 8 provides a visual representation showing steady progress towards the learning goal during stage IV.

The line starts as a continuum from stage III on the y axis to show that the pre-qualified sonographers continue to make progress but this levels off. The x axis shows a 3 month time scale as they move through stage IV in the 9-12 month period of learning.

Figure 8 Visual representation of stage IV learning and narrative type

Stage IV learning is characterised by automised processes and scanning procedures. Pre-qualified sonographers manage the scan and perform unobserved and start to think about how they can adapt their knowledge and skills in new situations using a step by step approach.
Stage V

During Stage V, the qualified sonographer learning experiences are characterised by ‘being’ (inexperienced) narrative types. Figure 9 provides a visual representation of stage V learning, the line starts as a continuum from stage IV on the y axis and shows a slight drop-off in performance as they lack confidence in decision-making skills. The x axis represents a 2.5 year timescale since qualification.

Figure 9 Visual representation of stage V learning and narrative type

During stage V qualified sonographers rescan an area several times before making a decision, this gives the appearance of a slight tail off in performance and hence a tail off in progress towards their goal.
Stage VI

During Stage VI, the qualified sonographer learning experiences are characterised by ‘being’ (experienced) narrative types. Figure 10 provides a visual representation of stage VI learning, the line starts as a continuum from stage V on the y axis and shows marked progress towards their goal. The x axis represents a 2.6-5 year timescale since qualification.

Figure 10 Visual representation of stage VI learning and narrative type

By stage VI, decision-making skills are executed more efficiently. The importance of prescan preparation and planning is recognised. Sonographers still scan to a plan but adapt technique and fewer situations present where decision making has to be carefully considered. New situations can still present some difficulties. There is an appreciation of implications and predictions for future practice.
Stage VII

During Stage VII, the qualified sonographer learning experiences are characterised by ‘being’ (experienced) narrative types. Figure 11 provides a visual representation of stage VII learning, the line starts as a continuum from stage VI on the y axis and shows marked progress towards their goal. The x axis represents a 5.1 years-over timescale since qualification.

Figure 11 Visual representation of stage VII learning and narrative type

![Diagram showing narrative type: 'being' (expert) narrative]

Adaptation of processes and scanning procedures are an integrated part of the performance and practice is performed intuitively. Communication is focussed on patient need. Adaptation of technique, planning and decision making are performed concurrently. Sonographers make decisions based on a range of evidence.

Figure 12 provides a visual representation of stages I-VII learning.
Figure 12 Visual representation of stages I- VII learning and narrative type
Each stage in figure 12 is visually represented by reflecting the pattern of changes in learning experiences and narrative type over time. These visual representations of learning experiences are shown for each of the seven stages and when combined represent a visual landscape of learning experiences in ultrasound scanning from starting scanning to excellence in scanning.

The overall trend is demonstrating progress towards excellence, however it also shows a slight fall in progress during stage I where pre-qualified sonographers experience chaos as they come to terms with being in new situations and having to deal with a lot of new information. There is also a slight fall in progress during stage V where newly qualified sonographers experience a drop in confidence as they take on 'new' responsibility for the scan.

7.4 Summary

The framework, which is a first attempt to document learners' experiences as they progress from novice to excellence in scanning, is a representation of learning ultrasound in a staged experiential framework. Whilst it provides an insight into how scanning skills are acquired over a period of time, the framework also has the potential to provide understanding as to what support might be needed and given at an appropriate stage in a practitioner's quest towards achieving excellence in scanning.

As it is a first attempt to categorise and represent learning scanning, it is possible that this framework under-represents the stages of learning and has oversimplified the complex nature of learning ultrasound scanning. Despite being developed from a relatively small sample size, following pre-qualified sonographers' longitudinal progress towards competency and including a cross section of qualified sonographers progressing towards excellence in scanning, the framework does provide a way of seeing progress across seven stages. The stages broadly map to Fitts's (1964) stages.

The framework provides a basis on which future knowledge may be built and therefore has the potential to change from what is currently known as tacit knowledge into identifying what support may be needed to support learning.

Stages I - VII of learning and narrative type have also been visually represented by reflecting the pattern of changes in learning experiences and narrative type over time. The visual landscape of learning experiences in ultrasound scanning spans from starting scanning to excellence in scanning and provides a visual representation of progress in learning scanning. This is a tentative representation of narratives and learning over time and further work is required.
Chapter 8 Evaluation

8.1 Introduction

This chapter discusses the evaluation processes in the construction of the Framework of Learning Experiences in Ultrasound Scanning.

The qualitative approach to this research brings with it challenges of representation, interpretation and authenticity and, as Clandinin and Connelly (1994) note, there is no way of simplifying this type of research process. Evaluation is an integral part of the research process and in this thesis it provides the opportunity to explore the contributions to the research process and analyse how these impact on the process and outcomes of the research (Lincoln and Guba 2000). Since no single method may be justified as being more useful for revealing a truth, it is the combination of method and interpretation processes that reveal new knowledge (Denzin and Lincoln 2003).

8.2 Evaluation processes in the construction of the framework

Evaluation of the study has been an integral part of the research process. A pilot study involving two learners was conducted before starting the main study. Whilst some may deem this to be unwarranted in qualitative research, I was relying on field notes and reflections on these notes as a record of observations of clinical practice. It was beneficial to practise observing practice and recording data and modifying my technique accordingly to develop a systematic approach to data collection.

I was also relying on interviews to generate conversation with each participant so that they may reveal an insight into their learning experiences through narrative. The pilot study provided an opportunity to practise interviewing and to reflect on the interview process.

Evaluation of data during each stage of the main study involved stakeholder participation, where the stakeholders are those participants involved as learners of
ultrasound scanning and myself as the researcher. Including stakeholder views was a necessary part of authenticating the observational and interview data (Lincoln and Guba 2003). As part of this process, field notes were shared with learners both during and at the end of each session. This was beneficial for two reasons: firstly, from an ethical dimension, sharing information in this way allowed learners to participate in the process and agree that the field notes were a reasonable representation of events; secondly, it fostered our relationship and provided reassurance to the learner about the nature and content of the data.

Opportunities to discuss data with participants after interview also formed part of the evaluation process. The purpose of sharing interview transcripts with each participant was to seek agreement that this was a representation of the interview (Clandinin and Connelly 1988). As part of these discussions, learners had opportunities to amend or delete content.

Once content had been agreed, the data was analysed to explore meaning. This relied on my interpretation of these accounts. Demonstrating authentication of the interpretation process presents challenges (Lincoln and Guba 2003). Clandinin and Connelly appreciated the challenges that the interpretation of narratives on teaching experiences presents early on in their work. Whilst recognising that there is no single truth, involving participants as part of the authentication process was part of this study as advocated by Clandinin and Connelly (1988). The focus of knowledge, past experiences and current reading provide the window to determining the 'view' of what is noticed, what is recorded and what is subsequently interpreted (Denzin and Lincoln 2003). Interviews were conducted with participants at the end of stage IV. The purpose of these interviews was to seek broad agreement on the themes that emerged as a result of my interpretations. Mindful of my role in generating and
interpreting the data, it was necessary to gain feedback in this way to establish that
what was presented was reasonable, based on the data generated.

A reflexive diary was useful in enabling me to reflect on my role in this research
(Gough 2003). Whilst critical of interpretive approaches, some argue that the role of
the researcher must be removed from the research process; however, in contrast with
this view, it may be argued that there is no unmediated view and therefore it is
preferable to acknowledge the contributory factors in the research process rather than
ignore them (Clandinin and Connelly 1994; Riessman 2002; Denzin 2002). Adopting
a reflexive approach provided the opportunity to explore my actions and revisit my
interpretations in the context of new knowledge. This is recognised as a valuable
approach for evaluating and authenticating qualitative research in context (Denzin
2002; Gough 2003). For example, my interview skills developed throughout the
duration of the study. Initially, I tried to follow my interview script rather
prescriptively as I was anxious to do the interview well. The interview schedule was
displayed in front of me for reference. This, however, turned the focus of the
interview onto the guidelines rather than the narratives the participants had to tell. As
my interviewing skills developed, however, I relied less on the schedule. I listened
more to the narrative in conversation and asked more probing questions. Non-verbal
cues such as smiling and nodding in agreement also enabled the conversation to flow
(Holstein and Gubrium 1998). During observation, pre-qualified sonographers felt
that my presence impacted on their performance. Learners told me that they felt more
nervous than usual because I was observing them. They felt their conversation at
times was stunted for fear of saying the wrong thing to the patient. It was this type of
feedback that raised my awareness of the issues associated with participant
observation and helped me to develop my approach.
Audio taping the interview also created hesitancy in both myself as the interviewer and the interviewee and often conversation was more open between us when the tape was switched off. I endeavoured to place the recorder strategically in less conspicuous positions to reduce its impact during interview.

A final part of the evaluation process in this thesis focuses on the framework. The framework has been compared with two models of skill acquisition, Fitts’s three-stage approach and Benner’s Model of Skill Acquisition in Nursing Practice. There are similarities between these published models of skill acquisition and stages I–VII in the Framework of Learning Experiences in Ultrasound Scanning.

Stages I - VII of learning and narrative type have also been visually represented by reflecting the pattern of changes in learning experiences and narrative type over time. The visual display provides a way of showing progress as a landscape of learning experiences in ultrasound scanning from starting to scan to excellence in scanning and provides a visual representation of progress in learning scanning. This is a tentative representation of narratives and learning over time and further work is required. Elements of the research process leading to the construct of the framework and the principle of a staged framework of learning experiences were presented at three international conferences (see Appendix 10): Crofts (2003) *Who am I?* discussed my paradigm shift and research identity and the issues around representing knowledge. Crofts (2003) *Narrative Analysis of Learning* … discussed the process of narrative analysis used in this thesis. Crofts (2004) *Narratives of Learning* … discussed the qualitative approach to this study and analysed learning through narrative. Crofts (2004) *The Role of Narrative* … critically examined the role of narrative in this study.

Later in 2004, two posters were presented at the British Medical Ultrasound Society Annual Conference (Crofts 2004); these discussed the qualitative approach to data
analysis in learning ultrasound scanning and presented an outline of the framework of learning experiences. Feedback from health care practitioners and sonographers on the framework showed that they acknowledged the themes and recognised the potential benefit of a staged approach to supporting learners. In addition, two pre-qualified sonographers, part-way through an ultrasound programme, recognised similarities with their experiences during the first and second stages of learning.

8.3 Summary

This chapter has outlined the evaluation processes that have contributed to the generation and interpretation of data and the construction of the framework of learning experiences.

The evaluation has focused on authenticating the content of data, evaluation of the data generation processes and authenticating the interpretation processes that have contributed to the development of the Framework of Learning Experiences in Ultrasound Scanning. The evaluation of data during each stage of the main study has involved stakeholder participation. Field notes and interview transcripts have been authenticated and a broad level of agreement sought on emerging themes.

Stages of the Framework in Learning Experiences in Ultrasound Scanning have been compared with stages of Fitts's (1967) three-staged approach to skill acquisition and the Benner (1984) Model of Skill Acquisition in Nursing Practice.
Chapter 9 Conclusion

9.1 Introduction

This chapter provides a summary of the thesis. A qualitative research approach has been used to explore learning experiences in ultrasound scanning. The key findings are outlined, together with the contribution to knowledge and recommendation for future work.

9.2 Findings

The aim of this study was to develop a Framework of Learning Experiences in Ultrasound Scanning, this has been achieved through a seven staged framework presented in chapter 7. Participant observation and semi-structured interviews have been used successfully to generate data of learning experiences in scanning. Narratives have been analysed alongside observational data. This combination has been successfully employed by others to explore the experiences of classroom teachers (Clandinin and Connelly 1988, 1994, 1995) and charting experiences in nursing practice (Benner 1984).

The sample size in this study is typical of a narrative study of experience as it is important to focus on a small number of participants in order to explore the richness of data that narrative provides. The longitudinal and cross-sectional data provide a degree of generalisability (Mason 2002) of the framework.

The framework of learning experiences is a representation of learning drawn from a body of literature from a range of disciplines other than medical imaging. Presenting the learning of ultrasound scanning in a framework is a new concept in medical imaging and there is the potential for this to be developed further. It is designed as a way of seeing progress in learning ultrasound scanning.
Whilst the framework of learning experiences in ultrasound scanning succeeds in representing scanning it provides only a snapshot of learning and may therefore underrepresent the complexities of ultrasound scanning.

The tendency to explore skilled learning from a positivist approach in the past has resulted in much research being laboratory-based; qualitative research approaches, however, provide another dimension that offers an insight into understanding the meaning of actions and experiences. As Clandinin and Connelly pointed out in their early works, experiences are unique to individuals and are about more than merely measuring outcomes; rather, it is through exploring the processes that lead to the outcomes that bring a better understanding of how progress in learning is achieved.

This thesis draws upon contextually situated data generated from interactions between the learner and the equipment in the presence of a patient in the real-world setting. This approach enables individuals to share their unique experiences and, rather than seeking a universal given truth, therefore, it is a way of recognising these shared experiences alongside the individual and unique experiences.

A visual representation of learning experiences and narrative type over time has shown a general progressive trend from starting to scan towards excellence in scanning. This is a tentative representation of narratives and learning over time and further work is required.

9.3 Contribution to knowledge

My contribution to knowledge is through the Framework of Learning Experiences in Ultrasound Scanning. This framework provides a way of seeing progress from starting to scan to excellence in scanning. It addresses the lack of research and assimilates literature and provides a structure for documentation related to learning ultrasound
scanning. Learning experiences are documented over seven stages and distinguishes between pre and post qualified sonographer experiences.

9.4 Recommendations for future work

The framework of learning is a starting point for future work on learning ultrasound scanning, how it might impact process, curriculum and service delivery. The framework I believe, also has the potential for a wider application in learning health care practice and for exploring clinical practice skills in disciplines beyond ultrasound scanning but with a requirement to scan.

As technological development continues to allow the expansion of ultrasound in health care provision, there is a demand for health care professionals to be trained to high standards in scanning. This framework provides a way of seeing progress and may have a role in identifying what support may be offered to learners in other areas of ultrasound scanning. The framework of learning in this thesis has concentrated on those learners who acquire basic skills in the field of obstetrics and gynaecology ultrasound. However ultrasound is used in a variety of areas and the framework has raised questions as to whether this particular area is the most suitable starting point for novices. This could be developed further and a larger sample size covering a wider range of hospitals could make the findings more generalisable, and determine what changes should be made to current curricula and training developments.

To begin to address some of these issues, the framework is currently being used as a research tool in a study to gain a better understanding of how musculoskeletal scanning skills are acquired. The sample consisting of 4 orthopaedic surgeons and 4 physiotherapists will be observed in practice and interviewed. Themes derived from the data will be compared with themes from stages I-IV of the framework developed in this study. The musculoskeletal study will show whether the framework has a
wider application in other areas of ultrasound scanning and will provide a comparison of data on learners acquiring skills on static structures with those in this study acquiring skills in obstetrics. It is intended that the outcomes from this study will inform the design of a short course in musculoskeletal ultrasound.

Some elements of the framework from stages I-IV around support of learning, for example, working with the same supervisor, and one to one feedback during very early stages of learning; working with a range of supervisors during later stages of learning, have underpinned the development and recent successful implementation of a mentoring model for health care professionals.

It is now planned to conduct a study on those that have failed in scanning to compare their narratives with the experiences contained within the framework.

Further work to study expert scanning performance is warranted to define the expert in ultrasound clearly and to provide detailed evidence to define excellence in scanning.

Analysis of the relationship between learning scanning and image analysis and decision making could be explored. This would allow image analysis and decision making to be explored in more detail and provide a clearer insight into their role in learning scanning.

A visual representation of learning experiences and narrative type shows a progressive trend from starting to scan towards excellence in scanning over time. This tentative representation of narratives and learning scanning over time requires further work and this would allow the professional landscape of scanning to be explored in more detail and provide a clearer insight into the relationships between the themes that emerged from the data.
It would also be beneficial to analyse mapping of the probe movements and compare maps of probe movements between pre-qualified and qualified sonographers. Similarities and differences in probe movements may be compared in terms of ballistic hand movements, homing movements and efficiency of scanning performance.

Exploring the teachers’ experiences in ultrasound practice and comparing these with learners’ experiences may identify areas for future development to enhance teaching, learning and support in ultrasound education. This could also provide an opportunity to explore the role of feedback and its impact on the sonographers who are supervising the pre-qualified sonographers in the workplace.

As co-collaborator I have recently been awarded a grant from The Medical Research Council (Grant ID: 90193, £100,000) to conduct a comparative study evaluating scanning in assessing bone quality and will be leading the scanning developments.

9.5 Summary

This thesis shows it is possible to represent learning to scan in stages. The narratives exhibit a staged progression, consistent across the sample and adequately track the developmental path as the pre-qualified sonographers become more experienced and the professionals take on their scanning as a matter of routine.

Further work is warranted to explore learning in pre-qualified stages in other areas of ultrasound scanning; exploring those that have failed in scanning; how qualified learners adapt their skills when presented with challenging and novel situations and how their experiences map to the framework; evaluating teaching and teachers experiences in the workplace and developing further the concept of presenting learning experiences and narrative type as a visual representation of learning.
The Framework of Learning Experiences in Ultrasound Scanning is the first framework which comprises research from learning to scan: It presents learning experiences in seven stages from pre-qualified sonographers starting to scan to post-qualified sonographers' excellence in scanning.
Appendices
### Appendix 1 Comparison of qualitative paradigms

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<th>Post-Positivism</th>
<th>Critical Theory</th>
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<td>• Reality shaped by ethnic, gender, social, political and cultural values that are modified over time</td>
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Appendix 2 Paradigm shift and reflexivity: Notes from my diary

During the design of this study, my long-held beliefs within positivism have dwindled. I have gradually realised that an object, for example, holds different meanings for different people, dependent upon factors such as gender, age, social/cultural background. Re-reading a book, for example, brings new meaning at every read. New knowledge is acquired and used to build on prior knowledge. This synthesis also happened during discussions of the same book with a (PhD) colleague. Through my naturally emerging beliefs, I have adopted a social constructionism paradigm for the conduct of this work. As my beliefs have changed, I have also become aware of my role in this research.

A reflexive approach underpins good-quality qualitative research, according to Temple and Edwards (2002), and a key strength of qualitative research is documenting the situational nature of the research process and the researcher. Drawing on Letherby (2002), as an example, she examines her role, representation of knowledge and power issues in her work on experiences of infertility and childlessness through reflexivity. Further, she distinguishes between 'descriptive reflexivity' and 'analytical reflexivity', where the latter is more in-depth and detailed than the former and demonstrates that being part of the research process can enhance the reflexivity in some participants.

Participants in this study reported benefits of describing their learning experiences and how this had helped them to reflect on their learning. Drawing on Letherby further (2002 paragraph 3.7), I am aware that my presence during the observation and interview process with the students was seen as a position of power.
During the preparation for the interview, I met with each participant; I explained I wanted them to tell their own story of learning, in their own way and that I wasn’t seeking a ‘correct’ answer. I wanted them to see me as equal in this relationship but actually knew this couldn’t be possible because of my professional background. Sharing field notes with participants, I endeavoured to demonstrate that I wasn’t ‘checking up’ on their practice; this was a positive step and beneficial in building our relationship.

The opportunity for each participant to see each interview transcript also played a role in enhancing our relationship. It was important for authenticating the research that content was agreed and, from a personal view, it provided credibility as participants gave me ‘permission’ to analyse the data.

I am not seeking an unmediated truth, nor checking the script for ‘accuracy’. The transcript is a document representing what had been said at a particular point in time, in a particular setting and context. It has two purposes: firstly, the participant has the opportunity to see what I as the researcher have privilege to and, secondly, to progress the relationship between myself as the researcher and the participant in an ethical way. I feel privileged that each participant has volunteered to become part of my research: without them, I would have nothing to report.

Like Smith (1999), keeping a reflexive diary of my thoughts and development of ideas through my research journey has been a useful exercise. It has enabled me to reflect on my contributions during the research process (Glaze 2002). I am aware of some of the effects of my role within this research process but over time those I have not considered will become apparent. I have endeavoured to examine closely and reflect upon my research activities and myself as a developing researcher at each step.
in this journey, as suggested by Merz (2002), in my endeavour to conduct this research authentically (Gergen and Gergen 2000).

In summary, it is still seen as a challenge in qualitative research to present the outcomes as credible evidence. In pursuing my claims for this work, I have adopted a reflexive approach. Through this process, I have sought to identify my role within the research process and thus my influences on the outcomes and representation of knowledge.

Reflexivity has an important role in qualitative research. Accordingly, Finlay (2003) points out that the process of reflexivity is the focus for discussion rather than arguing for the ‘need for reflexivity’. The reflexive researcher aims to assess the effects of the self (researcher) on and within the research process. I see reflexivity as part of the rigour underpinning the research process. I am part of the research process and my prior experiences cannot be removed. Holliday (2002) suggests the researcher should not profess to distance themselves from the research process, rather to account for the subjectivity wherever possible.

Data interpretation always includes a point of view (Hammersley and Gomm 1997); therefore, through the process of reflexivity, the researcher can critically examine his or her role within the research process.
Appendix 3
Appendix 3 Information sheet

Research into how ultrasound scanning is learnt

I am a lecturer in medical ultrasound from the University of Salford. I am carrying out a research project as part of my PhD into how students learn to perform an ultrasound scan.

What is the purpose of the study?
I want to find out how student sonographers learn to scan. The main focus is on how the equipment is used.

Who will take part in the study?
Student sonographers and qualified sonographers.

Student sonographers
You will be observed by the researcher, who will make notes on your activities during the scan. You will also be asked to provide a written account as soon as possible after the scan, but at a time and location suitable to you. Everything that is recorded will remain confidential and anonymous.

Qualified sonographers
You will take part in a recorded interview about your views on the skills that you possess and use when scanning. You will be asked to tell a story which will be tape recorded. This can be arranged at a time and place to suit you. Everything that you say will remain confidential and anonymous.

Patients
The researcher will observe the student carrying out your scan. Notes will be made about what activities they carry out and the equipment used; the student will also provide a set of notes for research purposes after the scan has finished. This means that the researcher will be in the scan room during your scan. You will not be asked to provide any information to the researcher. You can let the researcher know at any time that you do not want them to be present during your scan.

Will the information I provide be confidential?
Any information that you give will be kept confidential and your name will not be included in any reports.

What happens if I do not want to take part in the study?
You can let the researcher know at any time that you do not wish to take part in the study. You do NOT have to give a reason and it does not matter that you have signed the consent form.
If you would like more information please contact:
Gillian Crofts
School of Health Care Professions
Allerton Building
University of Salford
Salford M6 6PU
Phone: 0161 295 2154
Appendix 4 Participant consent proforma

Research into how ultrasound scanning is learnt

I agree to take part in the above study being carried out by Gillian Crofts, University of Salford.

My signature below shows that: please initial

- I have read and understood the information sheet provided and have had the chance to ask questions
- I understand that information on me will be confidential and anonymous; my name will not be mentioned in any report
- I understand that I take part in this project voluntarily. I can decide to withdraw from it at any time and I do not have to give any reasons
- I understand that I will be asked to take part in an interview on the skills that I possess to be able to scan; I know the interview will be recorded and I agree for the tape to be used for research purposes
- I would like to see the completed transcript, and have the opportunity to comment on the transcript
- I understand that information may be used anonymously in publications and presentations
- I have received information about what I should do if I require more information

Please sign below if you are willing to be involved with the study:

Signature: ...........................................

Name: ..............................................

Date: ................................................

Researcher: ...................................... Date: ...........................................
Appendix 5 Patient consent proforma

Research into how ultrasound scanning is learnt

I agree to take part in the above study being carried out by Gillian Crofts, University of Salford.

My signature below shows that:

- I have read and understood the information sheet provided and have had the chance to ask questions
- I understand that information on me will be confidential and anonymous; my name will not be mentioned in any report
- I understand that I take part in this project voluntarily. I can decide to withdraw from it at any time and I do not have to give any reasons
- I understand that there will be a researcher present during my scan and that notes will be made on the observations which will be used for research purposes
- I understand that information may be used anonymously in publications and presentations
- I have received information about what I should do if I require more information

Please sign below if you are willing to be involved with the study:

Signature: ..........................................................

Name: ............................................................

Date: .............................................................

Researcher: ............................................................ Date: .................................................
Appendix 6 Interview Schedule

Interview Schedule

Tell me about..........

1. How you felt the scanning session went this morning/afternoon?

2. What went well?
   a. What can you achieve now?
   b. Comment from field notes about what is different from last time.

3. What didn’t go well?

4. What you found difficult?
   a. What are you (still) finding difficult to scan?

5. Comment on the interaction with the probe.

6. Comment on the interaction with the equipment.

7. What type of feedback have you received?
   a. How useful has this been?

8. Any significant learning moments.

9. How have you learnt to scan so far?

10. What you are thinking when you scan?

11. What will you focus on next?

These questions are meant to be a guide for the interview.
Appendix 7 Two examples of narrative clauses in interview scripts.

Example of a Stage V narrative that closely follows Labov and Waletzky's framework of clauses.

Narratives clauses were identified from the interview transcripts using Labov and Waletzky's 1967 Framework.

NQB;

Abstract

"I certainly think that scanning is difficult, I think the ultrasound course is difficult, hard work".

Orientation

GC: "What's difficult about it?"

"There's a lot of work with a clinical component and getting to grips with actually scanning, hands on scanning as well as the extra studying is difficult. So,..... just the work load.

But I think scanning is one of those things that if you watch people doing it, it looks so easy and as a student you think oh this looks no problem this, until you've actually got the probe on and you see how difficult it is.

Complicating action

It's like I was saying to Dr A, he was saying how are you getting these views of the heart, how are you getting the views of the face and saggital spine and it's just practice. It's just keep practicing is the way to do it.

It's very......, I find it very frustrating at first when I was first training to get the views. I knew what I wanted to get but I just couldn't get, just that slight tipping of your hand, slight rotation, that slight movement is very difficult to get and it's very difficult to describe to somebody. It's like the outflow tract, trying to describe that slight movement is really difficult.

Evaluation

So in the end you have to give them hands on help. What I tend to do, what a lot of us tend to do is put our hand on the student's hand just to give them that rotation movement because it's so difficult to describe, it is just hands on practice that gets you there. Like I said I did find it very frustrating at first. Particularly things like AC, I used to really struggle with AC. Getting oblique section, not getting that nice stomach and AC, but getting a squashed version or an oblique version. I can remember definitely that AC and really struggling with it".

GC: "How did you overcome that? What happened to help you to achieve that?"
Resolution

"I think it is just practice. It’s one of those strange things that it happened but you don’t know when. It all slotted into place but I can’t, I couldn’t say that it happened the March, or it started February, it just all came together and it all just slotted into place.

Coda

But yes, it’s difficult". [learning to scan].
Example of a Stage V narrative that didn’t contain all Labov and Waletzky’s clauses.

NQA recalls her learning experiences with pre-qualified learners;

Orientation

“It’s only like five minutes ago but it seems like ages ago.

Complicating action

I suppose the most difficult thing was to get the pressure of the probe right on the mother’s abdomen and understanding which way the baby is lying. That was the most difficult with obstetric scanning, helping to get the orientation of the baby. So they were the first two things really.

I don’t know..., no one can really tell you how to scan can they? It’s really difficult. People give you tips don’t they? You can sort of look on the screen, yes I’m on the head now. And at first you don’t know how to get back to something else.

Evaluation

I think it just comes from sitting there and doing it time and time again, repeatedly. And eventually, you haven’t always remembered where to look.

You’ve got say, fingertips on the fetus, wherever you are, however the baby’s lying, you know eventually how to get from the head, down to the spine or round to the face. You don’t really know at first, but a little tweaking and constant playing, it becomes part of you as part of months of training........

Resolution

......I think it’s just practice, practice, practice and more practice. So there isn’t much point really if someone comes along and saying go right, go left, or go right, or slide across this way. There’s no point in that, ‘cause the baby’s on left. But on the other hand if you’re in a certain position, yes, I suppose there is a bit of planning time, cause I taught students to do it that way so, that’s why I tell them to do it.

‘Cause if your probe’s in a certain position, say in a transverse spine, then I’ll always tell the student “right you need to turn that probe 90 degrees”, to get into like a longitudinal section of the spine and then maybe go down the mother’s abdomen to get a saggital spine, coronal.

So there is some kind of pattern to the movements, but it’s going to be different each time ‘cause you’re going to be starting in a different position. It’s not relating to the mother’s abdomen at all, it relates to the baby. So what you’re actually seeing on the screen, you don’t even need
to look at the mother's abdomen, as long as you're on the mother's abdomen. Cause all I'm looking at is the screen".
Appendix 8 Presentations from this thesis


Crofts, G. (2004). *The Role of Narrative in the Construction of a Theoretical Framework of 'Learning to Ultrasound Scan'.* 5th Qualitative Research Conference in Health & Social Care, Bournemouth University, Bournemouth.


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