Radiography Mindlines: Reframing knowledge creation and sharing in clinical radiography education.

Kirsty Patel

September 2025

A dissertation submitted in partial fulfilment of the requirements of the degree

Doctor of Philosophy, PhD

Faculty of Health, Education and Life Sciences

Birmingham City University

This page left intentionally blank

Acknowledgements

During the depths of the Covid-19 pandemic, I stumbled upon a documentary by Brené Brown called *The Call to Courage*. Her interpretation of Theodore Roosevelt's "Man in the Arena" speech offered the idea that showing up and daring greatly matters more than perfection or a fear of failure. It was this idea which first led me down this path, and one which I held onto throughout the four years I spent working on this PhD. But whilst Brene's wise words got me in the arena, and kept me there, I could not have remained standing without the encouragement, support, and advice of the people around me.

Firstly, I would like to thank my incredibly supportive and generous supervisory team.

To my former Director of Studies, Dr Louise McKnight, thank you for your unwavering support and for always being there when I needed guidance or ethics applications to be signed off! You modelled such a passion for radiography research and an inspiring work ethic, one I hope to emulate for students in future.

Dr Thomas Hopkins, your quiet encouragement and wise critiques were always delivered thoughtfully and pushed me to consider alternative perspectives without feeling overwhelmed. I'm also especially grateful for you stepping into the Director of Studies role in my final year. Thank you.

Professor Fiona Cowdell, your knowledge and wisdom are profound, whilst still grounded. Your intellectual presence could have easily felt intimidating but instead was reassuring. I often held onto your belief in me and in this work, even when I doubted myself, and your influence runs through this thesis in more ways than I can articulate.

I would also like to thank Dr Julia Everitt for stepping in during my final year to see this thesis through to completion, and Dr Anthony Anderson for being my critical reader. Both your careful reading and diligent feedback helped me to focus my efforts and strengthen the final thesis in a meaningful way.

I am also deeply grateful to the radiography department, which served as the field site for this research, and to all who allowed me insight into their working lives. To the students, radiographers, and educators who shared their time to participate in the study, thank you. This thesis aims to give voice to your experiences, and I hope the stories I share reflect the richness of these experiences effectively. Special thanks to the field site gatekeeper who was instrumental in navigating institutional systems, advocating on my behalf, and persevering through the many practical issues that arose.

I could not have made it to this stage without my friends, Rochella and Nichi. You were there for me in the hardest times and when everything felt impossible. You never once judged or doubted me, and your ability to make me laugh (or cry) with the perfect meme or TikTok made me feel less alone.

To my parents, Lorna and Steve, thank you for your unconditional love and pride. You have never really understood what my work is about… but you didn't need to, to understand how much it means to me. Your encouragement and the promise of Dad crying at graduation have pushed me to this point.

Hitesh. As we know, acts of service is your love language, and you have demonstrated this every day of this journey. You have not only supported us financially but also given me space and time to throw myself into this PhD. You often listened to my endless monologues about theory and philosophy, and only occasionally asked me to stop. Thank you for sticking with me, even when I made it harder than it needed to be. For this, you have a claim to this thesis beyond us having the same surname.

Abstract

Research on undergraduate diagnostic radiography (UgDR) education in the UK has traditionally focused on developing pedagogical tools within academic settings. However, half of student radiographers' education occurs in a clinical learning environment (CLE), facilitated by diagnostic radiographers whose primary role is clinical, not educational. Furthermore, pedagogical research often isolates discrete types of knowledge or specific skills, whilst vital problem-solving and decision making are supported by the tacit interplay of different knowledge types. Existing theories of practice-based learning focus on the individual, and learning as the priority. However, there is limited exploration of the social, cultural, and organisational aspects of knowledge development in CLEs. This doctoral research therefore draws on knowledge mobilisation (KMb) theory, specifically mindlines, to explore how students and radiographers share and create knowledge within a CLE.

A critical constructivist epistemology and ethnographic methodology were adopted to account for, and benefit from, the researchers' experiences and positionality. 104 hours of participant observation were conducted with 71 actors in a UgDR CLE. Data were generated in the form of descriptive and reflexive field notes and 7 semi-structured interviews. Reflexive thematic analysis was utilised to identify codes and develop in-depth vignettes to communicate the heavily contextualised findings. Vignettes were then iteratively analysed alongside the interview transcripts and field notes to develop the two conceptual themes: *Knowledge seeking and sharing (KS/S) practices* and *Sociocultural conditions*. These themes depict the nonverbal and verbal practices that enable actors to share and seek knowledge, and the sociocultural conditions under which these practices occur. The findings and discussion inform the development of key recommendations to direct future research and educational priorities.

Finally, the thesis argues for the reconceptualisation of clinical UgDR education, from the pedagogical perspective of teaching and learning to organisational knowledge seeking and sharing. This challenges existing hierarchies and power structures, which hinder those perceived as less legitimate from accessing knowledge, ultimately impacting KMb across the wider profession.

This page left intentionally blank

Table of Contents

This page left intentionally blank

List of Figures

This page left intentionally blank

List of Tables

This page left intentionally blank

List of Boxes

This page left intentionally blank

List of Key Abbreviations

AdPr – Advanced practitioner

AP – Assistant practitioner

CLE – Clinical learning environment

CT – Computed tomography

CoR – College of Radiographers

CPD – Continuous professional development

EBP – Evidence-based practice

ED – Emergency department

FN – Field notes

HCPC – Health and Care Professions Council

HEI – Higher education institution

KELT – Kolb's experiential learning theory

KMb – Knowledge mobilisation

KS – Knowledge sharing

KS/S – Knowledge seeking and sharing

LPP – Legitimate peripheral participation

MiCLE – Mindlines in clinical learning environments

MRI – Magnetic resonance imaging

NHS – National Health Service

OKC – Organisational knowledge creation

PAL – Peer-assisted learning

PBL – Problem-based learning

PCC – Patient-centred care

PE – Practice educator

PIS – Participant information sheet

RIS – Radiology information system

RN – Reflexive notes

SBE – Simulation-based education

SECI – Socialisation, externalisation, combination, internalisation

SoR – Society of Radiographers

UgDR – Undergraduate diagnostic radiography

WLT – Work-based learning theory

1. Chapter 1: Introduction

"No rules can account for the way a good idea is found for starting an inquiry" – Michael Polanyi

(Polanyi, 1966: 1)

Prologue

I stand in front of the screen displaying an image of the X-ray the radiographer has just carried out on a patient's stomach. I gaze at the eerie, monochrome picture with various shapes and blurry forms. I think that's the spine in the middle, and there's, like, white and black blobs all over it too. The radiographer starts to touch the screen, quickly putting little letters in the corner and cropping the sides.

"What d'ya think then?" the radiographer looks to me expectantly. I have no idea what to say. I mean, it's cool that you can take a picture with that big camera thing, but how does anyone figure out if there is anything wrong with the patient just from this? I must have a perplexed look on my face as the radiographer huffs out a laugh, "So when there is a white area that means something is blocking the path of the X-rays, the denser…do you know what density is?"

"Yeah, it means how solid something is?" I reply cautiously. I think that's what it means anyway.

"Yep!" he says, and I smile in relief. "So, the denser something is, the whiter it will look on the X-ray. So, what do you think this is?" he points to some of the big black blobs in the middle of the picture. It just looks like someone's punched a load of holes in it.

"Uhm, that something is missing?" I respond.

He laughs gently again, "Yeah, kinda! It's air! It's in the bowel, so that's why the dark bits are joined up and look kinda like a snake. It's the outline of the bowel because it's full of gas."

I laugh and squirm a bit, thinking about how uncomfortable the patient must be with all that stuck in there.

"Come on," the radiographer says, getting me to walk back into the X-ray room with him, "we'll see loads more fun stuff today."

This tale was my first ever interaction with a radiographer. It was 2007. I was 17, and I was on a day of work experience, a requirement for applying to various diagnostic radiography courses. Although I have regretfully forgotten the radiographer's name, I will never forget how he made me feel that day. He was excited to show me everything about his job and made it all seem so fascinating.

After that, my experiences with radiography education in the clinical setting were varied. Navigating the unpredictable clinical learning environment (CLE), whether working with different radiographers, seeing different imaging procedures, or managing demanding patient interactions, was a constant challenge. Some days, radiographers would sit back, pushing me to do lots of X-rays whilst they idly watched and chatted amongst themselves. Other, more fulfilling, days were spent with radiographers similar to the one in the tale above, who seemed to enjoy the prospect of informally sharing their knowledge in the context of what was going on that day. On these days, I was gently cajoled, teased, and corrected when I made mistakes or got the answer wrong, lightly guided in developing my practice. Looking back, these initial experiences subtly shaped how I interacted with student radiographers when I qualified in 2011.

I always relished the chance to work with students. Their need for guidance and curiosity fed my performative nature and desire to “show off” my knowledge to help them develop into competent radiographers. Yet I was acutely aware that many radiographers did not feel the same, often referring students to me, giving the impression that they didn’t want the distraction or weren’t confident enough to guide them appropriately. These experiences have profoundly shaped my career. They inspired me to take on mentoring and administrative roles in clinical education, eventually becoming a training and development lead, and now undertaking this PhD and a teaching position at BCU. My research is therefore intrinsically linked to my own lived experiences, positionality, and the subsequent knowledge I have developed, which will be reflected on throughout this thesis.

1.1. Chapter introduction

In this chapter, I introduce the professional, educational, and conceptual context in which this research is situated. The personal narrative in the prologue demonstrates my early exposure to clinical education and how these informal, situated encounters can initiate and shape the development and sharing of knowledge. This early experience is not merely anecdotal but illustrates how my learning in the CLE has inspired and informed the research questions and theoretical positioning of this doctoral study.

In the following sections, I outline the broader landscape of the radiography profession, including the evolving scope of the radiographer's role and the complexity of the healthcare setting. I then narrow this discussion to how radiography education is traditionally conceptualised and studied, identifying an empirical research gap in the CLE setting. I introduce and question the disparities in formal pedagogical strategies and the reality of informal learning in a hospital setting, proposing a shift towards more socially and contextually aware perspectives of inquiry. These arguments underpin my rationale for adopting the knowledge mobilisation theory of mindlines to frame this research.

1.2. Background

1.2.1. Radiography landscape

Diagnostic radiography (DR) is an allied health profession regulated by the Health and Care Professions Council (HCPC) (HCPC, 2025b) and plays a critical role in modern healthcare, yet it faces key challenges and demands. Radiography is often described as indispensable to healthcare and is involved in over 90% of patient pathways (SoR, 2023). This figure alone emphasises the central role radiographers play in decision making and patient outcomes. Demand for diagnostic imaging continues to rise at an exponential rate. Nearly 50 million imaging tests are performed annually, with the highest activity remaining in 'general X-ray' imaging, compared with other modalities such as CT and MRI scanning (NHS England, 2025). There is also an increase in preventative screening services that rely on imaging, an ageing population, and increased prevalence of chronic illness (Age UK, 2024; Office for National Statistics, 2023; Richards et al., 2022). Additionally, workforce pressures, such as high vacancy rates, rising long-term sickness, and prolonged reliance on agency workers (NHS Pay Review Body, 2023; SoR, 2022), further compound these challenges. These points emphasise the central role that radiographers play in clinical decision making and patient outcomes, and the importance of developing an adaptable and efficient workforce.

Adaptability is particularly key, as radiography has evolved greatly since Roentgen's discovery of X-rays in 1885. With technology at the core of a radiographer's practice, the digital revolution and now the introduction of A.I. are set to be influential in changing the future landscape of the profession (Akudjedu et al., 2023; Körner et al., 2007; Price and Paterson, 2021). The role of a radiographer has evolved in tandem with these technological advances. Fundamentally, radiographers are healthcare professionals who aim to provide diagnostic imaging services with both competence and compassion (HCPC, 2023; Knapp and Courtier, 2021). Qualified radiographers commonly enter the workforce at 'practitioner' level (AFc band 5) and carry out a

wide range of imaging techniques, although the majority of these will be within the general X-ray modality (SoR, 2005, 2022). These procedures are the stereotypical X-ray images used to diagnose a range of illnesses from broken bones to chest infections. However, with the changing landscape of healthcare and imaging demand, there has been a move to expand radiographer roles to include broader activities, traditionally undertaken by clinicians, educators, and researchers. Radiographers now have the opportunity to become 'enhanced' or 'advanced' practitioners (AdPr), consultant radiographers, practice educators (PEs), or research radiographers (CoR, 2022b; SoR, 2025b). This diversification not only reflects the evolution of services but also requires radiographers to have a foundation for greater clinical reasoning, educational approaches, and research knowledge. The workforce, therefore, needs to be equipped to continuously develop its knowledge and experience to become competent, adaptable, and autonomous.

1.2.2. Educational landscape

The task of developing this dynamic workforce is primarily the responsibility of higher education institutions (HEIs), which provide radiographer education through apprenticeships, undergraduate, and postgraduate courses (National Careers Service, 2025; NHS, 2025). The majority of radiographers train through the undergraduate degree route, with 37 HEIs providing these courses across the UK (Complete University Guide, 2025). This results in over 1,000 students qualifying with eligibility for HCPC registration each year (CoR, 2022a).

Undergraduate diagnostic radiography education (UgDR) is shaped by national frameworks of the profession, including the HCPC Standards of Proficiency and the College of Radiographers Education and Careers Framework (CoR, 2022b; HCPC, 2023). While these frameworks aim for standardised outcomes, their application across HEIs varies widely in terms of the number of students, organisation of CLE placements, and curriculum design (England and McNulty, 2020; Wilkinson, 2023). Although HEIs have the overarching responsibility for course provision, UgDR comprises both academic *and* clinical learning, with the latter primarily taking place in hospitals acting as CLEs.

The split between these settings is typically 50/50, with HEI learning facilitated by radiographer lecturers and clinical radiographers responsible for this in CLEs (CoR, 2022b; McNulty et al., 2021; Prentakis et al., 2016; SoR, 2011). The opportunity to learn in both HEIs and CLEs enables students to consolidate academic theory and apply it in practice, often referred to as bridging the 'theory-practice gap' (Greenway et al., 2019; Hyde, 2015). Additionally, it embeds them in the profession's culture and unique practices, which is useful for transitioning from student to

qualified radiographer (Naylor et al., 2016). This process is central to the development of professional identity when students begin to embed the values, behaviours, and expectations of the profession (Adams et al., 2006; Decker, 2006). Poor CLE experiences are likely to disrupt this identity formation, contributing to feelings of disconnection, leading to higher attrition rates among students (McAnulla et al., 2020), which in turn creates implications for workforce stability. CLEs and the radiographer workforce within them are therefore significant factors in the initial knowledge and experience students gain during their formative professional years.

The CLE is a complex environment in which students encounter a range of situations and are taught by many radiographers with varying levels of experience, teaching skills, and competency. One of the founding ideas for this doctoral research is the limited understanding of the extent to which radiographers assist and participate in student learning in the CLE, which will be explored further in Chapter 2. However, professional codes state the need for radiographers to be "involved" in training, supervision, and mentoring for students (HCPC, 2023). Other frameworks go further, stating that radiographers must "facilitate" learning for students (CoR, 2022b). This demonstrates a range of expectations for radiographers regarding what constitutes teaching in the CLE. Furthermore, frameworks often articulate expectations for radiographers without specifying the mechanisms by which they should be met, leaving their practice ambiguous.

The introduction of practice educators (PEs) has been heralded as a solution to these challenges and to bridging the theory-practice gap. PEs have an enhanced responsibility for, and understanding of, the academic and practice-based needs of students (CoR, 2022b; Francis et al., 2016). However, some CLEs consider *all* radiographers working with students to be PEs (CoR, 2022a), a misconception that may stem from the lack of clarity in standards of practice and guidance. Although the suggestion that PEs should be undertaking postgraduate teaching qualifications should now reduce this confusion (CoR, 2022b). PEs are considered a positive addition to the wider culture of CLEs, however the ratio of 1 PE to 100 students in most institutions (CoR, 2022a) suggests that students are still more likely to have their learning facilitated by radiographers who do not have this additional educational knowledge.

These challenges point to a disconnect between the expectations outlined in professional guidance and everyday practice in a CLE. Although it is suggested that all radiographers contribute to student learning, formal educational training is not embedded in the standard radiography curriculum and is provided only to those few in specific roles. As a result, "teaching" may not be considered part of the role for many radiographers. Although the

presence of PEs is increasing, the ratio between them and students is still disproportionate, leaving students reliant on informal encounters with radiographers to develop their knowledge. The challenge then lies in exploring the delivery of clinical education within environments where radiographers lack the pedagogical tools or sense of formal responsibility for student learning.

1.2.3. Knowledge seeking and sharing in the CLE

The narrative literature review I present in Chapter 2 establishes that the language historically used around clinical education encourages a teacher/learner approach. This framing can alienate radiographers who believe they are "bad" at, or not responsible for, teaching, and it also fails to reflect the social and implicit ways in which knowledge is shared and developed in the CLE. Perhaps a shift in perspective is needed towards understanding how knowledge is sought and shared, rather than focusing primarily on formal teaching and learning. This allows for consideration of the more relational and organisational factors which influence learning in the CLE. The responsibility of radiographers to seek knowledge to maintain and improve patient outcomes and to share knowledge that constitutes best practice is clearly indicated through the process of continuing professional development (CPD) (CoR, 2022b; HCPC, 2023). However, processes and guidance on how this should be done are often lacking.

In Chapter 2, I explore the various methods by which students develop knowledge, which are widely recognised as learning through listening, observation, practical experience, and participating in challenging situations (Chamunyonga et al., 2020; Lundvall et al., 2021). These processes are largely implicit and represent *relational* forms of knowledge seeking and sharing that occur outside of traditional teaching methods. They often rely on organic encounters in the CLE for students to learn indirectly. Students, therefore, need to be in the right place at the right time, with the 'right' radiographer. However, given that the theory-practice gap is a central challenge in UgDR education, it is important to consider how this incidental learning is supplemented and enhanced by radiographers' own theoretical understanding.

The verbal and explicit processes of feedback and reflection are also considered helpful in developing student knowledge. Overt reflection by radiographers is considered immeasurably valuable for externalising expert knowledge and making sense of a situation (Hendry, 2020). This suggests that students make sense of practice, which they may have witnessed through more implicit learning processes, initiated by radiographer reflection. Students are also expected to reflect on their own practice, although it is suggested as a way to develop their own knowledge rather than to impart knowledge to radiographers (Lawal et al., 2021). Furthermore, radiographers are expected to provide feedback to students in the CLE, although the drive to do

so is sometimes lacking (Fowler and Wilford, 2016; Jackson, 2013). Despite feedback and reflection being more noticeably verbal and explicit than the implicit means of listening and observation, evidence suggests that these processes are not being maximised in the CLE. Exploring these factors through a knowledge sharing lens rather than a pedagogical one could highlight how these processes can be better integrated and valued in clinical education.

In summary, the vital role of diagnostic imaging and radiographers in modern healthcare is under pressure from multiple angles. Technological advances and evolving professional roles also demand that radiographers have greater adaptability, autonomy, and capacity for learning than ever before. UgDR delivered across academic and clinical settings is central to developing a workforce with the foundation for these skills. Although HEIs provide structured learning, facilitated by radiographers with educational expertise, the CLE remains variable and inconsistent in the support, experience, and knowledge radiographers provide. There are limitations in the current educational approaches within the CLE, particularly with the formal conceptualisation of teaching and learning in this setting. UgDR education would therefore benefit from the application of a new theoretical perspective, which accounts for the informal, relational, and hidden ways in which knowledge is sought and shared.

1.3. Rationale

In the next chapter, I explore the heavy emphasis placed on developing *pedagogical* processes for student knowledge development in the UgDR literature (Bain et al., 2017; England et al., 2016; Higgins, 2017; Holmström and Ahonen, 2016; Lawal et al., 2021). The prominence of this is unsurprising, given that HEIs are centres where academics not only deliver teaching but also hone their own and students' enquiry skills through research (Quality Assurance Agency for Higher Education (QAA), 2024). Consequently, formal pedagogical strategies within HEIs are more extensively documented than the informal knowledge sharing processes between radiographers and students in CLEs. This imbalance has important implications for UgDR. While the academic environment is deliberate and structured, the CLE can be conceptualised as more incidental and informal.

Whilst often used to explore and facilitate clinical learning in healthcare education, theories of practice-based learning (Eraut, 2004; Kolb, 1984; Lave and Wenger, 1991), can overlook crucial factors. Specifically, they do not fully account for social influences, the fluidity and transience of the CLE, and the function of the 'non-learner' or radiographer in this context. In other words, these models assume a stable learning environment that prioritises learning and can be directed and shaped to create the best learning opportunities. In the CLE, these opportunities

are limited as learning is fluid and contextual. Therefore, our lack of understanding of these processes inhibits our ability to harness and improve them.

Conversely, knowledge mobilisation (KMb) may offer an alternative framework for studying these factors. KMb is an umbrella term for approaches used to explore individual and organisational influences on knowledge use, access, and sharing in specific contexts (Marshall et al., 2024), and these approaches can be utilised to influence personal and socially embedded knowledge (Cowdell, 2019; Gabbay and le May, 2004; Wye et al., 2019). KMb considers knowledge to be dynamic, negotiated, and contextual, shared through multi-directional interactions. The KMb theory of *mindlines*, in particular, determines that individuals practice through internally developed and collectively reinforced lines of reasoning, rather than explicit guidelines which often lack context (Gabbay and le May, 2011). Mindlines, explored in more detail in Chapter 3 and my published paper (Patel, 2023a), are tacitly embedded and informed by experience, social interaction, context, and historical education, rather than direct instruction. This makes the application of this theory particularly relevant to this research exploring clinical education.

As stated, students are said to learn through the more informal and situational processes of observation, imitation, and participation. Mindlines theory is underpinned by organisational knowledge creation theory, where knowledge is said to oscillate across an explicit-tacit spectrum through the processes of socialisation, externalisation, combination and internalisation (SECI) (Nonaka and Takeuchi, 1995). Crucially, exploring knowledge creation and sharing in the CLE through these theories offers a way to view clinical education critically and holistically, beyond what is formally taught or assessed.

1.4. Research aim and questions

This research aimed to explore how knowledge is accessed, shared, and developed between students and radiographers in an NHS CLE. The research was guided by the following questions:

> **RQ1:** What are the motivations for students/radiographers to share and develop their knowledge?
>
> **RQ2:** How do students/radiographers seek and share new knowledge?
>
> **RQ3:** How does the culture of the CLE impact knowledge sharing between students/radiographers?

1.5. Theoretical positioning: defining knowledge and knowledge sharing

The literature on knowledge sharing in healthcare is vast (Davies et al., 2015). Numerous terms are used for this area of study, including knowledge transfer, knowledge translation, knowledge exchange, and knowledge mobilisation (KMb) (Graham et al., 2006; Ward, 2016). Unlike other models of knowledge sharing, KMb demonstrates flexibility in the boundaries and communities involved. KMb has been used to demonstrate and improve knowledge sharing, not only across organisations and professions but within and between them. Currie and White (2012) demonstrate that KMb is a social process rather than something that happens in isolation. In their study, factors such as hierarchical structures, identity, and organisational culture influenced KMb processes. KMb is inherently about continuous learning, knowledge sharing, and organisational development, and often suggests that knowledge is a resource, created, communicated, and internalised by individuals and further amplified by the organisation. Cowdell (2019:2) summarises this concept by stating, *"knowledge is perpetually produced and transformed as users interact, collaborate and learn"*. This perspective is distinct from traditional teaching and learning theories. Whilst pedagogical theories often focus and prioritise the student's development, KMb emphasises and accounts for how knowledge is negotiated and transformed between people in organisational contexts. In this respect, KMb offers a broader framework for understanding clinical education beyond formal educational encounters.

A key contribution to the KMb paradigm is *mindlines* theory, which has been used in healthcare research to understand knowledge use and sharing between stakeholders (Wieringa and Greenhalgh, 2015; Cowdell, 2018; King, 2019; Carrier, 2020; Gabbay and le May, 2023). The SECI spiral (Figure 1.1) underpins this theory and indicates the stages which enable knowledge to move between people and across the explicit-tacit spectrum. Gabbay and le May (2011) refer to the SECI spiral, explaining how each stage of the process was identified in their observations. This reasoning can be applied to explore knowledge sharing in the radiographer CLE as discussed below.

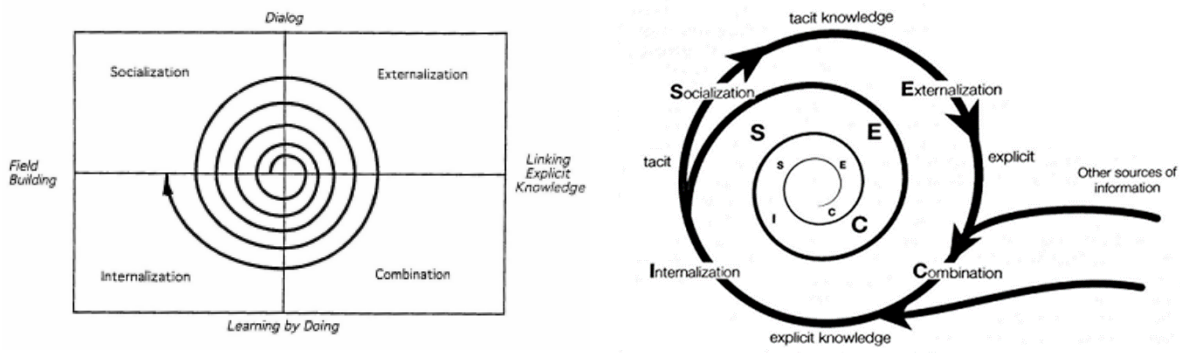

Figure 1.1. SECI Spiral

(Left) Organisational knowledge creation: SECI Spiral (Nonaka, 1994). (Right) Adaptation of the SECI spiral, including new knowledge through other sources of information (Gabbay & LeMay, 2011)

Tacit knowledge refers to intuitive, embodied or experience-based knowledge, which is difficult to articulate (Polanyi, 1966). In mindlines, it is shared in the *socialisation* stage, potentially through observation and imitation in the CLE (Gabbay and le May, 2011; Patel, 2023a). In contrast, explicit knowledge is easily categorised and verbalised, as in guidelines, policies, or literature. Tacit knowledge can be made explicit through the process of *externalisation* (Nonaka and Takeuchi, 1995). Reflection and feedback have been explored in the literature and are processes which enable *externalisation*. However, as discussed, if reflection and feedback are not consistently valued in the CLE (Fowler and Wilford, 2016; Jackson, 2013), students may have difficulty accessing radiographers' tacit knowledge (Patel, 2023a). Hendry (2020) states that reflection during clinical encounters can act as powerful teaching moments, implying the importance of externalisation. These instances of informal dialogue are key mechanisms through which tacit knowledge becomes more visible or explicit (Eraut, 2004). Therefore, when these moments are limited or devalued in the CLE, students' opportunities to internalise this knowledge may be hindered. *Combination* is used to synthesise different sources of explicit knowledge to gain new insights. It is difficult to identify where and how this process occurs in the CLE; however, critical thinking is considered a vital tool for students to analyse and integrate important information, and is often developed in the CLE (Patel, 2023a; Ramlaul, 2018). Finally, explicit knowledge is *internalised* so that it becomes tacitly embedded in individual mindlines (Gabbay and le May, 2011). This is key for students to bridge the theory-practice gap by contextualising their theoretical knowledge in their clinical experiences in the CLE.

Gabbay and le May (2011) introduce an additional aspect to the original SECI spiral, acknowledging the introduction of *new* knowledge (Figure 1.1). This process is context-dependent, signifying the importance of empirical research to identify processes specific to

each setting or profession. In UgDR education, it is unclear how and when new knowledge is accessed by both students and radiographers in the CLE. However, to improve the effectiveness of clinical UgDR education and ensure professional knowledge is up-to-date and evidence-based, it is important to understand how new knowledge is accessed and where this comes from.

1.6. Methodological Approach

KMb and mindlines are intrinsically constructivist due to the stance that knowledge is subjective and constructed by people in association with their physical and social environment (Gabbay and le May, 2011; Merriam and Tisdell, 2016). This also fundamentally aligns with my positionality, as well as the research aim and questions. Further to this, a key assumption of organisational knowledge creation theory is that knowledge is "justified true belief" (Polanyi, 1966; Nonaka and Takeuchi, 1995: 21). Whilst this notion has a long and contested history in epistemological debates, it is drawn on here to distinguish knowledge from mere information in an organisational context. In this sense, knowledge is not purely derived from belief and experience but is based on contextual and social justification within a specific community. This definition of knowledge naturally connects constructivism to the exploration of mindlines and further justifies its application in this research. However, the aim here is not to purely construct and disseminate knowledge on this topic, but rather to challenge the status quo and norms in the professional context, a key advantage of a critical constructivist approach (Kincheloe, 2005).

Gabbay and le May (2011) used ethnography to demonstrate that mindlines are developed and shared in specific contexts and are fundamentally shaped by social and cultural factors. The ability to explore a specific context, observing what people do and the challenges they face, is therefore crucial in this research project. Ethnographic methodologies originally arose from sociology and anthropology (Delamont and Atkinson, 2011); however, more recently, they have been used across disciplines to produce empirical accounts of complex settings, such as healthcare (Rea-Holloway and Hagelman, 2020). Despite this, ethnographic studies conducted within radiography departments remain limited. Furthermore, critical ethnography is used to critique norms in a specific context and to advocate for those who may be disadvantaged by them (Lune and Berg, 2017; Madison, 2020; O'Reilly, 2009). This approach will enable me to interrogate the organisational processes and structures which influence knowledge sharing in the CLE.

Ethnographers frequently refer to the 'field' when discussing their data collection (Coffey, 2018). The field in this research was a radiography CLE in 'Teaching Hospital', an acute general hospital located in an inner-city area. Teaching Hospital has links to the sponsoring HEI and is a provider of UgDR clinical education in the region. The foundation of most ethnographic research is observation in the field. I carried out an observer/participant role over 5 months, which enabled me to embed myself in the team and for my presence to become more routine in the setting. This, in turn, reduced the likelihood that actors would participate in performative ways associated with the observer effect (O'Reilly, 2009). This prolonged engagement allowed me to recognise taken-for-granted norms and reflexively examine how my own professional background and knowledge impacted my interpretations throughout the research.

Observational data consisted primarily of my field notes (FNs) (Emerson et al., 2011; Strudwick, 2011). Generating data in this way allowed me to record descriptive observations of CLE activity and personal thoughts, feelings, and reflexive insights, which facilitated interpretations and gave the data depth (Finlay and Gough, 2003; Strudwick, 2011). Further to this, interviews were used with key actors to contextualise and explain the observations and experiences encountered in the field. Informal interviews, more akin to clarification conversations, were also carried out during observation periods and recorded in FNs. Modified reflexive thematic analysis was used to code and group data both during and after data collection phases. This not only helped to guide further observation but also highlighted key factors to ask about in interviews. Narrative vignettes were then developed to aid in analysis and preserve the context and complexity of the data. Finally, two overarching themes were developed, along with subthemes and core concepts, to develop a framework for mindline development in the CLE.

1.7. Thesis Structure

In this chapter, I have so far outlined the key focus of this study: to explore knowledge sharing in clinical UgDR education. I have highlighted key themes and theories commonly used in this landscape and suggested a broader purpose for the thesis to demonstrate the benefits of applying KMb theory to the study of clinical education.

A narrative review of the literature on UgDR education will be presented in Chapter 2. I define key terminology and highlight the limited perception of knowledge in the literature, exploring how knowledge is deemed to be shared and by whom. I identify a tendency to codify knowledge into explicit topics, which limits how much it can be seen and applied in practice. Further to this, I highlight that although there is extensive work exploring pedagogical approaches in this field, empirical research on learning within the CLE is limited.

In Chapter 3, I provide the ontological and epistemological perspectives which underpin the study, demonstrating the inherent connection between KMb and mindlines. I present my theoretical framework, which is informed by my published paper (Patel, 2023a) and argue for the application of mindlines for this study. Furthermore, I provide a rationale for using ethnography and discuss my research methods, along with ethical and quality considerations.

Chapter 4 focuses on my fieldwork and interaction with data. From entry into the CLE, including a detailed description of the field and actors, followed by the ways in which data were collected and recorded. As data collection and analysis were inductive and iterative, this chapter also includes my data analysis processes. This includes my use of coding, thematic analysis and narrative vignettes. My findings are presented in Chapters 5 and 6 using the context of the vignettes, enhanced further with interview and FN data. Finally, I present how these findings relate to the wider literature and present suggestions and implications for practice in Chapter 7.

This page left intentionally blank

2. Chapter 2: Literature review

"To know what you know and what you do not know, that is true knowledge." – Confucius

(Long, 2022: 348)

2.1. Chapter introduction

I begin this chapter with a discussion of the rationale and methodology for this narrative review, which underpins the subsequent research. The purpose of the review was to critically explore how knowledge and knowledge sharing (KS) were portrayed in the UgDR education literature. This helped to further define research gaps and guide the research design. I justify the use of the narrative review methodology and define the review questions.

The review begins with critiques of how different types of knowledge are defined in the literature using the terms explicit and tacit associated with mindlines terminology. I then move on to discuss where knowledge is perceived to come from in UgDR education, examining what and who is considered a source of knowledge. Furthermore, I will highlight how knowledge is traditionally shared through teaching and learning processes. Finally, I move on to examine research exploring CLE settings, identifying the organisational structure of clinical learning, along with sociocultural factors that may be influential in KS processes in this context. This narrative review concludes with methodological and theoretical critiques of the research traditionally conducted in this setting. This chapter lays the foundation for the arguments made in Chapter 3, which will focus on the philosophical foundations and methodological design of my study.

2.2. The narrative approach

Aside from my paper, which introduces the concept of mindlines in the context of UgDR education (Patel, 2023a), the application of KMb to the radiography profession is novel. Due to the limited knowledge on this topic, I felt the need to take a broad approach to reviewing the literature. This process allowed me to critically examine gaps in the research to guide my research aims, questions, and approach.

Narrative reviews are useful in examining current knowledge within a topic area and can be used to explore diverse review questions (Efron and Ravid, 2018; Grant and Booth, 2009). Greenhalgh et al. (2018) also argue the need for more narrative reviews to make research more context-

sensitive and exploratory. This aligns with the aims and questions of this review, as I am interested not only in what is known but also in how this knowledge is framed, valued, and shared in a specific context. In contrast, systematic reviews are often presented as the ideal process for appraising the literature due to reduced bias, replicable methodology, and adherence to prescribed criteria (Murad et al., 2016). This privileging of systematic reviews has led to a widespread view that their methodology is superior to that of other forms of review (Greenhalgh et al., 2018). This is problematic, as reviews conducted with restricted criteria and protocols are better suited to narrowly defined questions and quantifiable outcomes than to broader, theoretical, or contextual topics (Boell and Cecez-Kecmanovic, 2014).

Bias is a critique often levied against narrative reviews, though it is not necessarily mitigated by a systematic methodology. As researchers initially frame and determine the questions they ask of the literature, bias can be apparent at the start of the review process (Greenhalgh et al. 2018). This is not to say a narrative review cannot be systematic or methodical in its conduct; the distinction lies in the researcher's priorities. Where a traditional systematic review aims to produce generalisable knowledge, a narrative approach prioritises critical interpretation and conceptual understanding (Greenhalgh et al., 2018). This also offers the researcher greater flexibility to utilise their prior knowledge and understanding of a topic, while acknowledging and accounting for potential bias (Boell and Cecez-Kecmanovic, 2014). This allows for discussion, based on both the literature under review and the author’s perception, experiences, and interpretations.

This perspective is consistent with the epistemological arguments made throughout this thesis, that individuals combine many different types of knowledge to inform their judgements and actions. My positionality, grounded in my experience as a student, radiographer, PhD student, and educator within a HEI, therefore, plays a large role in my interpretations and conclusions. The literature surrounding clinical UgDR education is diverse. A narrative approach, therefore, provides a flexible and epistemologically appropriate methodology for examining and critiquing the literature to answer the narrative review questions (NRQs).

2.2.1. Narrative review aim and questions

This review aimed to critically explore how knowledge and knowledge sharing (KS) are portrayed and explored in the UgDR education literature. To provide further structure and direction in achieving the review aim, the following narrative review questions (NRQs) were developed. Due to the narrative methodology, these questions were established iteratively as I read and reviewed the literature, and my lines of enquiry evolved.

NRQ1: How is radiographer knowledge defined and perceived in the UgDR literature?

NRQ2: Where does radiographer knowledge come from, and who/what holds knowledge in UgDR education?

NRQ3: How is radiographer knowledge developed and shared in UgDR education?

NRQ4: What factors impact KS in CLEs and what research methodologies have been used to explore these settings?

2.2.2. Searching the literature

Searches were conducted across the databases CINAHL, Scopus, Web of Science, PubMed, MEDLINE, and Google Scholar. These databases were chosen for their relevance to health, health education, and wider interdisciplinary research, and were supported by librarian recommendations and literature on review methodology (Boell and Cecez-Kecmanovic, 2014; Bramer et al., 2017).

To clarify, the extensive literature on healthcare education and clinical practice more broadly, including traditional sociological and ethnographic studies (Atkinson, 1995; Becker et al., 1961; Goffman, 1991), was not included in the conceptual boundaries of this review. The purpose of this review was not to synthesise the entirety of healthcare institutional or educational research. Rather, it was intentionally focused on contemporary UgDR education to maintain contextual specificity and direct alignment with the NRQs. Diagnostic radiography operates within distinct educational structures, professional expectations, and regulatory frameworks. Expanding the scope comprehensively to include medicine, nursing, or broader healthcare ethnographies would have shifted the analytical focus away from the specific knowledge practices and educational configurations central to this thesis. Where literature from other healthcare professions was included (NRQ4), this was to allow for exploration of methodology and theory in relation to contemporary and similarly structured CLEs. These sources were used to illuminate structural and cultural features of CLEs where radiography-specific research was limited, rather than to provide a cross-professional comparison. The primary analytical focus, therefore, remained on UgDR throughout.

Four structured searches, varying in depth and focus, were conducted during this doctoral project. This reflects the evolving nature of both the research as a whole and my own research skills. Table 2.1 outlines the search dates and terms in detail. Initial scoping searches were carried out in September 2021 to read broadly around UgDR education. The searches were then enhanced and repeated in June 2023 and December 2024, with more specific key terms.

Further searches were conducted by reviewing the reference lists of selected articles, and the process was repeated and refined throughout the PhD. The first three searches focused solely on UgDR education; this identified a gap in the literature regarding clinical education and the CLE context specifically. Therefore, to gain more contextual insights and to explore NRQ4, the fourth search (January 2025) was performed to include other healthcare professions which use CLEs for undergraduate clinical education.

The literature from this search was used only to broaden understanding of NRQ4 and was not integrated into the other NRQs, which are specific to the UgDR context. Whilst medical literature contains substantial work on CLEs, medicine operates under different curricular models, professional hierarchies, and role expectations. The intention was not to generalise across the whole of healthcare education, but to explore knowledge and KS within the specific structural and professional landscape of UgDR. Relevant professions were therefore used to illuminate contextual and methodological factors pertinent to the study of UgDR CLEs, rather than to address the research gap or questions.

In addition, further searches were carried out to develop knowledge and understanding of KMb and mindlines theory, detailed in Appendix 1. This literature not only provided depth in my understanding of KS, allowing for a more profound critique in this chapter, but also informs my theoretical framework in Chapter 3 and the interpretations and discussion across the whole thesis.

Table 2.1. Narrative review search dates and terms

Date Range	**Search Terms**
Sept 2021 – Feb 2022	"radiography education" AND undergraduate
Jun 2023 – Jul 2023	(radiography OR "medical imaging" OR "diagnostic imaging") AND (undergraduate OR "bachelor" OR "degree" OR student OR "placement") AND ("knowledge sharing" OR learning OR knowledge) AND (clinical OR placement OR "clinical learning" OR education OR university OR HEI)
Dec 2024 – Feb 2025	(radiography OR "medical imaging" OR "diagnostic imaging") AND (undergraduate OR "bachelor" OR "degree" OR student OR "placement") AND ("knowledge sharing" OR learning OR knowledge)

	AND (clinical OR placement OR "clinical learning" OR education OR university OR HEI) AND (UK OR "United Kingdom" OR "UKDN" OR "devolved nations" OR England OR Scotland OR Wales OR "Northern Ireland" OR "Britain" OR "Great Britain" OR "GB")
Jan 2025 – Apr 2025	(learning OR education OR knowledge) AND (nursing OR "radiography" OR "physiotherapy" OR "paramedic" OR "allied health professions") AND ("clinical education" OR "clinical placement" OR "clinical training") AND (NHS OR UK OR "United Kingdom")

2.2.3. Assessing and analysing the literature

Search results were added to a citation manager (Zotero, 2025), to remove duplicates, and titles and abstracts were assessed in line with the inclusion/exclusion criteria demonstrated in Table 2.2. These criteria are mapped against the NRQs due to the inclusion of different professions for NRQ4. Studies were included if they were UK-based or provided internationally relevant insights which were deemed transferable to the UK. This was determined when sufficient detail was provided to assess compatibility or applicability to a UK healthcare context. This would include alignment of radiographer roles, models of education, and similar healthcare structures.

Table 2.2. Narrative review inclusion/exclusion criteria

NRQs	Criterion Type	Inclusions	Exclusions
1-4	Geographic scope	UK based primary research / Primary research with inclusion and illustration of UK data / Or international secondary research which is transferable to UK	Primary research in a Non-UK-based setting
1-3	Educational level	Undergraduate Bachelor's Degrees	Postgraduate / Foundation degree / Apprenticeships
1-3	Professional focus	Diagnostic Radiography	Therapeutic Radiography / Radiology / Nuclear Medicine / Ultrasound / MRI only / CT only / Other professions
4	Professional focus	Healthcare professions trained through undergraduate	Medical courses

		degree programmes whose students attend a CLE, i.e. nursing and allied health professions	
1-4	Date range	From 2012	Pre 2012
1-4	Publication type	Primary research / Review Articles / Editorials / Book chapters / Doctoral Theses	Conference abstracts and proceedings
1-4	Language	English Language	Not English Language
1-4	Access	Full text available	Full text not available
1-3	Participant type	UgDR students, diagnostic radiographers (when the research focus is Ug education) / radiographers with educational roles, i.e. practice educators, and radiographer academics	Studies involving only staff or students from other professions or non-UgDR education contexts
4	Research environment	Research focused on interaction, experiences, or culture in a CLE	Research based on developing academic pedagogy, interaction/experiences in a HEI.

As the branches of radiography are split into *diagnostic* or *therapeutic*, with HEIs providing separate courses to cater to the different specialities (McNulty et al., 2017, 2021), NRQ1-3 discounted studies focusing on *therapeutic* radiography specifically. This ensures that the review findings are contextually focused, relevant, and applicable to the overall research. Further to this, despite the introduction of degree apprenticeships in radiography, the review remains focused on undergraduate bachelor's degrees, as this route forms the majority of radiography education for students (CoR, 2022a). Only literature with limited contextual depth and methodological detail to critique was excluded, i.e. conference proceedings and abstracts; other types of literature were included regardless of publication type, as it was deemed to add to potential perceptions and understanding of knowledge and KS in the profession. Although some state that narrative reviews should not include other narrative reviews (Ferrari, 2015), it was deemed appropriate to include them in this case, as they could provide key insights to the review questions.

Following the initial screening of abstracts, full texts were obtained for the remaining literature and further reviewed to ensure alignment with the criteria and relevance to the NRQs (Aveyard, 2018; Ferrari, 2015). Although some state the importance of quality appraisal of studies in reviews, this is not always necessary (Ferrari, 2015; Grant and Booth, 2009). In this case, all

included literature, by way of being published (peer-reviewed) or publicly available (grey literature), was deemed to have the potential to impact professional perceptions and traditions regardless of its quality. Instead, I aimed to make sense of the literature and assess its relevance (Wong et al., 2013). After excluding studies that did not meet the stated criteria (Table 2.2), abstracts were screened and included only if they mentioned, in some capacity, students' learning or knowledge development, teaching and learning in UgDR, either academic or clinical, or discussion of the radiographer CLE. As searches were repeated, additional literature was added, assessed, and similarly excluded. Table 2.3 provides a summary of the results of each of the literature searches and screening processes.

Table 2.3. Literature search outcomes and screening

Date Range	Databases and results	Screening
Sept 2021 – Feb 2022	Google Scholar (n = 480) CINAHL (n = 17) Scopus (n = 17)	Excl Titles/Abstracts/Duplicates (n = 461) Full Text Read (n = 53) Excl (n = 21) **Incl (n = 32)**
Jun 2023 – Jul 2023	PubMed (n = 273) WoS (n = 117) Scopus (n = 265) CINAHL (n = 190) MEDLINE (n = 4)	Excl Titles/Abstracts/Duplicates (n = 816) Full Text Read (n = 33) Excl (n = 15) **Incl (n = 18)**
Dec 2024 – Feb 2025	PubMed (n = 81) WoS (n = 135) Scopus (n = 68) CINAHL (n = 39) MEDLINE (n = 18)	Excl Titles/Abstracts/Duplicates (n = 323) Full Text Read (n = 18) Excl (n = 5) **Incl (n = 13)**
Jan 2025 – Apr 2025	PubMed (n = 204) WoS (n = 157) Scopus (n = 347)	Excl Titles/Abstracts/Duplicates (n = 654) Full Text Read (n = 54) Excl (n = 43) **Incl (n = 11)**

Due to the vast amount of diverse literature obtained, synthesis of the studies was developed with a critical and conceptual narrative (Grant and Booth, 2009). Papers were read for key aims, methods, and findings, and then critically assessed for their usefulness in answering the NRQs. This process was iterative over the period of the study, and themes were developed both inductively, according to the outcomes of the studies, but also deductively in line with the review questions (Hewitt-Taylor, 2017). I endeavoured to follow guidance on writing narrative reviews to ensure that the research questions are grounded in reasonable assertions and that the research outcomes are trustworthy (Lincoln and Guba, 1985). I therefore followed the 'Scale

for the Assessment of Narrative Review Articles' (SANRA) framework, which outlines the need for clear justification of importance, review questions, and descriptions of searches, along with appropriate referencing, reasoning, and the presentation of data (Baethge et al., 2019).

2.3. NRQ1: How is knowledge defined and perceived in the literature?

To explore how knowledge is developed and shared by students and radiographers, it is first necessary to consider how knowledge is traditionally defined in this context. I will discuss key definitions of knowledge in relation to the terminology summarised in Section 1.5. *Explicit* knowledge, which is easily categorised and transferred through verbal and written means, and tacit knowledge, which is potentially 'hidden', difficult to assess and codify, but plays a crucial role in clinical practice. I also explore how both types of knowledge are thought to be integrated and used in combination. It is important to note that this section is not an attempt to articulate my own epistemological views about the inherent nature of these knowledge types but rather to examine how they are traditionally framed and valued in the literature. Whilst I acknowledge, through my theoretical discussions, that all domains are socially situated and enacted in practice, the literature review reveals an implied knowledge hierarchy that requires further interrogation.

2.3.1. The dominance of explicit knowledge in UgDR

Students begin developing their knowledge of radiography practice by learning theoretical concepts and topics, such as anatomy, physiology, and physics, in the HEI setting (Sá dos Reis et al., 2018). These foundational concepts form the basis of the technical knowledge required to produce high-quality radiographic images in practice and are considered highly valuable to both radiographers, academics, and students (Sá dos Reis et al., 2018). This categorisation of knowledge is echoed in the Radiographer's Standards of Proficiency (HCPC, 2023), which outlines radiographic imaging skills and legislation as key knowledge for students to develop early in their education (Wilkinson et al., 2024a, 2024b). In their doctoral study, Jackson (2013) explores how knowledge is perceived and experienced within the radiography education community. This community is conceptualised through the theories of situated learning, legitimate peripheral participation (LPP), and communities of practice (CoP) (Lave and Wenger, 1991) and study participants included students, academics, and clinical educators. Through semi-structured interviews, participants identified knowledge such as anatomy, physics, and radiographic technique, which was categorised as explicit scientific and theoretical knowledge (Jackson, 2013). It could be argued this study demonstrates a tendency to prioritise theoretical

knowledge, however due to the explicit nature of scientific and technical knowledge, it may be more easily identified and verbalised by participants in an interview-based setting.

In addition, communication, patient care, and professionalism are knowledge domains considered important in the literature (Jackson, 2013; Sá dos Reis et al., 2018; Wilkinson, Gill and Hardy, 2024a, 2024b). These types of knowledge are sometimes considered soft skills, which, in discussions about developing compassion in students, are explicitly contrasted with "knowledge and technical skills" (Hendry, 2019: 270). The use of the word 'knowledge' in contrast to 'soft skills' suggests that soft skills are not considered a form of knowledge. Alternatively, it may imply that something is knowledge only if it is associated with facts and information rather than with values, experiences, or perceptions. However, it is clear that this more subjective knowledge is highly valued in practice, with empathy and communication seen as highly desirable for radiographer managers when recruiting students (Sloane and Miller, 2017). This suggests that, despite these types of knowledge being based less on objective theory and more on subjective experience and practice, there is a similar tendency toward categorisation.

This habit of categorising knowledge may pervade to allow for more efficient knowledge transfer and assessment in formal academic settings. Elliott, (2021) carried out a case study/intervention on the benefit of distributing task-specific presentations to students during the Covid-19 pandemic. The task-specific nature of the educational material indicates that knowledge was again categorised and then delivered to students. The intervention was found to increase student assessment literacy; however, the author concluded that it was not possible to determine whether the knowledge was fully internalised. This suggests that students absorbed the knowledge needed and used it to pass assessments, but there is limited understanding of whether knowledge acquired in this way is internalised, combined with other knowledge, and used in clinical practice.

Assessments have traditionally been recognised as a means of determining students' knowledge, understanding, and practical competency (MacDonald, 2020). A literature review on student learning by Holmström and Ahonen (2016) substantiates the categorisation of knowledge in assessments, concluding that methods tend to focus on learning specific competencies, such as anatomy and image interpretation skills. However, traditional examinations are also used to assess more subjective, context-dependent knowledge, such as patient safety (England et al., 2016). Some suggest that these assessments often result in students being evaluated similarly and that knowledge is demonstrated in a standardised way

(Manning, 2017). The use of these traditional assessment methods for more subjective and tacit knowledge may then limit how knowledge is perceived and foster a desire for explicit, objective forms of knowledge, which are more easily appraised.

2.3.2. Challenges in valuing and developing tacit knowledge

Whilst knowledge appears to be valued according to how easily it can be categorised into explicit domains, there is also an acknowledgement by Jackson (2013) of the less accessible and identifiable knowledge which is entangled with personal experiences, beliefs, and values. Hendry (2020: 240) highlights the vast amount of knowledge that radiographers use in everyday practice, stating that, "*decision making, skill adaptation, and creativity utilised to solve clinical problems or complications can appear intuitive, and based on tacit knowledge".* Further to this, Winter and Linehan (2014: 58) explore the "tacit rules" students follow when interpreting radiographic images. Although it is useful to understand these rules, there is a focus on the specific task of image interpretation within the HEI environment and how the tacit knowledge affects the ability to carry out that task. This reduces the generalisability of their study to the CLE, where students will be carrying out these tasks in a more complex and often pressurised setting. Winter's (2019) doctoral thesis deepens the idea of tacit knowledge in radiographer image interpretation, concluding that despite the supposed ideal of objective and systematic knowledge in the radiographer profession, practical tasks are carried out through embodied and tacit processes. Furthermore, they indicate that tacit knowledge is developed not only through a combination of more explicit theoretical knowledge and personal experience, but also through social influences and cultural contexts, such as workforce and workload pressures (Winter, 2019). These studies show that students, and subsequently radiographers, create their own contextualised knowledge to develop as competent practitioners. However, these studies focus on identifying the tacit knowledge required to carry out a specific task of image interpretation, rather than exploring how more holistic tacit knowledge is developed and subsequently shared.

Other studies imply, rather than directly state, the development of tacit knowledge and skills through practical experience and the integration of different knowledge sources. Hyde and Hardy (2021) explore the perceptions of students and academics in the delivery of patient-centred care (PCC) through survey and discussion-based methods. Both groups of participants indicated that personalised care required radiographers to incorporate various sociodemographic factors of patients into their decision making (Hyde and Hardy, 2021). However, it could be argued that this would be open to interpretation depending on the experiences or tacit knowledge of the individual practitioner. These challenges are echoed when

teaching students to consider inclusivity factors in communication with transgender or non-binary patients (Morrow and Mackay, 2024). These factors could be linked with emotional intelligence, which is considered to develop throughout student training and is influenced by both theoretical and practical knowledge (Mackay *et al.*, 2015). These domains of patient care, communication, and emotional intelligence, being more social and contextual, are complex, dependent on previous experience and personal factors, which suggests their tacit nature.

2.3.3. Navigating the theory-practice gap through knowledge integration

Both explicit and tacit knowledge have an important part to play in radiographer practice; however, even more essential is the way in which they are transformed from one to another and subsequently integrated into an individual's expertise. Exploring this knowledge integration highlights broader themes around the theory-practice gap, decision making, and critical thinking.

The literature suggests that students can struggle to translate and envision theoretical concepts in practice when they enter the CLE. They often feel conflicted as practice regularly differs from the theoretical concepts taught in the academic setting, and they often do not know "who to believe" (Bwanga and Lidster, 2019: 372). This suggests that students are looking for objective knowledge which is *right,* which can be difficult when different practitioners are likely to work in different ways based on their own tacit knowledge and the cultural norms in a specific setting. McAnulla (2018) reveals that the transient organisation of clinical education, with students required to work with many different radiographers and different areas, leads to challenges for students when applying theory to practice. This further indicates that students are initially unaware of the complex relationship between practice and theory and that they fall into binary thought processes.

This difficulty in translating theory into practice is often termed the theory-practice gap, and literature debates various ways to bridge this gap (Hyde, 2015). There have been efforts to do this through research-informed teaching (RiTe), a pedagogy that encourages students to discuss explicit research evidence and socially create meaning from it, which they can then use in practice (Higgins et al., 2014). This suggests an aim to integrate explicit knowledge, or evidence, with more tacit knowledge, which is socially and practically developed. Further research by Higgins (2017) then explores clinical and academic staff perceptions of RiTe, noting that students who have experienced RiTe show greater awareness of theoretical concepts but remain hesitant to demonstrate this knowledge in clinical practice. Considering that this pedagogy was designed to specifically translate theory into practice by contextualising new

information (Higgins et al., 2014), this suggests that a different perspective may be needed to address this issue. Across the literature discussing the theory-practice gap, there is a suggestion that theoretical knowledge is superior and that efforts need to be made to bring practice in line with theory. Considering the previous discussion that tacit knowledge is developed in the clinical environment (Jackson, 2013), it is suggested that adopting new academic-based pedagogy alone may not resolve the theory-practice gap. An alternative interpretation is that the limited impact of RiTE may not stem from flaws with the pedagogy itself, but from insufficient attention to the relational and organisational conditions required for its effectiveness.

Jackson (2013) challenged the concept of the theory-practice gap, arguing that the phrase suggests the two types of knowledge are separate and that this falsely represents the use of knowledge in a clinical setting. One suggestion is to replace the theory-practice *gap* with a "theory-practice spiral" (Cunningham et al. 2015: 265), in which knowledge acquisition is iterative and developed through experience, reflection, and role modelling. This may well acknowledge the dynamism of clinical practice where knowledge is constantly created and negotiated within the radiography education community (Jackson, 2013). However, even with the addition of the spiral concept, both terms still reinforce that theory and practice are dichotomous. This risks overlooking the extent to which theoretical knowledge is embedded within practice, hidden away under layers of tacit processing. Studies exploring students' application of what could be considered the seemingly explicit knowledge of image interpretation and radiation safety have highlighted difficulties in students' practical application of this knowledge (Wareing and Henderson, 2015; Davies et al., 2022). These findings suggest that even knowledge that is perceived as heavily theoretical and objective becomes contextually bound in practice. Perhaps this can be attributed to the need to make a decision as to when to use the theoretical knowledge, as students are said to understand theory but lack the readiness to apply it (Davies et al. 2022).

Ramlaul et al. (2021) link decision making with the ability to think critically, a type of knowledge that they state is developed predominantly in the CLE. Doctoral work on student and academic perceptions of critical thinking claims that this skill is tacitly developed (Ramlaul, 2018). Despite this, it is still categorised and assessed explicitly through means such as written assignments (Ramlaul, 2018), suggesting it to be an academic skill rather than a practical one. Critical thinking is also stated to be important for the development of the profession and to advance research in radiography (McKnight, 2022). This links to the development of EBP, which is also reliant on radiographers having the ability to critically analyse new knowledge and then

implement this into their practice (Sá dos Reis et al., 2018). Further to this, radiographer managers expect students to understand and take into account wider contextual and organisational factors when working in the clinical environment (Sloane and Miller, 2017). The tacit ability to critically analyse knowledge is clearly significant in radiographer practice, and there is an indication here that this is predominantly developed within complex environments, such as the CLE, rather than in the controlled academic setting. However, the conflation of critical thinking with academic knowledge and the desire to assess this explicitly may overlook how it is used, developed, and shared in the CLE. Given that decision making and critical thinking are often internalised in practice, it is suggested that radiographers verbalise their thought processes to identify to students how explicit and tacit knowledge have been used to reach clinical decisions (Hendry, 2020; Jackson, 2013). Although these suggestions are often directed at dedicated practice educators (PEs), who are radiographers with specific education training or responsibilities, rather than radiographers in general.

2.3.4. NRQ1: Summary

In this section, I indicate that knowledge in the UgDR education literature is predominantly conceptualised as explicit, with an emphasis on more objective theoretical domains such as positioning technique, anatomy, and physics principles. Categorisation of knowledge into specific domains allows for clearer knowledge transfer and assessment of students. However, it feeds an implicit hierarchy where objectivity and explicit knowledge are favoured in both education and research, as it can be more easily verbalised. Some authors have challenged this traditional narrative as it overlooks the complex nature of clinical practice and the valuable tacit knowledge which is used by radiographers. This is thought to develop through experience, reflection, and social interaction, and is influenced by personal traits, values, and context. However, empirical evidence on this type of knowledge and on how students understand and develop it themselves is scarce.

The challenges in integrating explicit and tacit knowledge in UgDR can be linked to the theory-practice gap. Pedagogical solutions have been suggested to facilitate bridging this gap, but these often fall short of addressing contextual factors that influence knowledge integration in the CLE. In addition, the theory-practice gap reinforces the notion of a knowledge hierarchy through the use of binary terminology. Knowledge integration can be envisaged through the processes of critical thinking and decision making, but it is unclear how students and radiographers develop and navigate these processes in the CLE. These factors suggest a need to move beyond the categorisation of knowledge towards a more holistic, dynamic, socially and

subjectively constructed knowledge and, subsequently, research that perceives and explores knowledge in this way.

2.4. NRQ2: Where does radiographer knowledge come from and who/what holds knowledge in UgDR education?

Having a clear picture of where knowledge is sourced from is central to exploring student knowledge development and sharing in UgDR. There are multiple intersecting sources of knowledge, including, but not limited to, the curriculum, research, the CLE, and individuals. The types of knowledge and perceived value of the knowledge from each source will now be discussed, along with how these sources are experienced by students.

2.4.1. Shaping knowledge through curriculum and formal frameworks

A key source, or more so, a framework of knowledge is the UgDR curriculum. Key considerations in developing the curriculum are to maintain workforce capacity and ensure that training is consistent with the latest clinical demands of a radiographer (England et al., 2017). These demands need to be achieved within the three-year period of the Bachelor's level degree in the UK, and Strudwick and Taylor (2017) state that HEIs tend to prioritise certain topics and omit those which are offered as postgraduate courses. McNulty et al. (2017) suggest that there needs to be consideration of whether graduates will be fit for purpose not only when they qualify but for the rest of their careers. This suggests that even if curricula are designed with current professional requirements in mind, graduates may not have the skills and attributes required for them to keep pace with the evolution of the profession. This further emphasises the tension between students being fit for practice at graduation or fit for lifelong learning (McKnight, 2022). The curriculum, therefore, is designed to teach students theoretical and practice-based knowledge for immediate employability, yet may be limited in developing knowledge which allows them to be prepared for and embed future changes in practice.

This rigidity in the curriculum is further supported by the tendency for UgDR courses to design their teaching around imaging modalities or types of radiographic imaging. In UgDR, students are expected to achieve competence in carrying out certain imaging procedures (Paterson, 2012). These competencies are often centred around modalities such as projectional radiography, which is traditional ‘X-ray’ imaging, or CT scanning (Sloane and Miller, 2017). The focus in UgDR is usually traditional X-ray, with time spent on other modalities being limited (Bwanga and Lidster, 2019). This curricular model is further influenced by the HCPC standards of proficiency (HCPC, 2023), which determine the types of knowledge expected of registered radiographers. However, there has been debate around expectations of students, particularly

with regard to what stage different imaging modalities, such as CT and MRI, should be taught (Wilkinson et al., 2024a, 2024b). This approach to curriculum design, in terms of modalities or soft skills, laid out in the previous section, has been challenged. Paterson (2012) argues the need for a patient-pathway focused curriculum, suggesting this would help to develop a more holistic understanding of health and well-being. Another argument for changing curriculum design is to target different radiographer roles and demand (Sloane and Miller, 2017). As stated, students often become competent in projectional radiography, later gaining a basic understanding of other modalities such as CT and MRI. Radiographers who go on to practice full-time in these modalities must do so through further postgraduate or in-house training (Sá dos Reis et al., 2018). Traditionally, X-ray imaging has been the most commonly used modality in radiography departments, but as service demands diversify and technology evolves, areas such as CT and MRI will no doubt show increasing demand. The argument that the UgDR curriculum needs to adapt to these service-led changes by offering a condensed X-ray curriculum over 2 years, with a final year for more specialised education in another modality of interest, therefore seems reasonable (Sloane and Miller, 2017). However, continuing to shape the curriculum around the technical skills needed to be competent in particular modalities may further limit the ability of radiographers to remain patient-focused rather than technology-focused.

Curriculum design and change inevitably come with an element of bureaucracy. UgDR curriculum is driven by national guidelines written by commissioning groups that concentrate on workforce and developmental needs (England et al., 2016). Further debate around curriculum design asserts that soft skills such as patient-centred care can be undermined by the curriculum (Hyde and Hardy, 2021). Furthermore, students themselves are keen to have a wider variety of experiences in specialised modalities (Hizzett and Snaith, 2022). This suggests that current national standards, which influence curriculum design, are potentially inhibiting the breadth of knowledge that is afforded to students and that they are keen to develop their own knowledge to further their careers and the profession. Although a national standard is required, there are likely local idiosyncrasies which impact the way in which this knowledge is used and adapted, and perhaps more flexibility in the curriculum is required.

2.4.2. Research and EBP as hidden or deprioritised knowledge

Increasing scrutiny is being placed on the need for research and EBP to have more visibility and impact on the curriculum. As previously discussed, exposing students to research is important for the development of both critical thinking skills and EBP (McKnight, 2022). However, due to the stated time limitations in radiographer courses, England and McNulty (2020) debate how

much research-based knowledge to include in the UgDR curriculum. McKnight's (2019) doctoral work on research pedagogy in one UK HEI aims to understand students' and academics' perspectives of how research is embedded within the radiographer curriculum. The author calls for research to be made more explicit in the curriculum for it to be normalised in the profession. This suggests that research and EBP may currently be hidden knowledge which needs to be made more visible. England and McNulty (2020) state that inclusion of research varies widely across UK HEIs and that research culture has changed dramatically over recent years. Furthermore, with research-based modules often being offered at Postgraduate and Master's level (England and McNulty, 2020), research knowledge may be deprioritised for UgDR due to the previously discussed time constraints in the curriculum. Research knowledge and subsequently the ability to implement EBP are therefore perceived as hidden in UgDR. This, with the current tendency to prioritise explicit knowledge, which is more easily verbalised, may be a limitation to students' ability to utilise research knowledge in their practice. Additionally, the culture within CLEs may impact how susceptible students are to developing research and EBP knowledge. This is supported as students are said to be unaware of research findings being used in practice (Holmström and Ahonen, 2016), suggesting that radiographers may be overlooking this type of knowledge in the CLE. This connects to the previous arguments and discussion of the theory-practice gap, in that research knowledge may actually be utilised, but it is done so tacitly and non-verbally, making it more difficult for students to identify it, as they are used to having explicit knowledge delivered to them. However, as the desire and structures for explicit knowledge sharing are deeply rooted, it is important to explore mechanisms to make this knowledge more explicit and sharable to ensure practice remains evidence based.

2.4.3. The CLE as a valuable but variable knowledge source

The CLE, similarly to the UgDR curriculum, forms a key source of knowledge for students. However, in opposition to the curriculum, knowledge is offered through organic experiences rather than structured content (Wilkinson et al., 2024a). Despite the variation in clinical education across the UK, on average, students spend up to 50% of their time in a CLE (SoR, 2011; England et al., 2017; McNulty et al., 2021). This balance of time suggests that academic and clinical environments are professionally valued as equal influences on student knowledge development. However, there is research to suggest the CLE has more of an influence on practice-based knowledge than the HEI.

Hizzett and Snaith (2022) discuss the way in which students' experiences in the CLE greatly influence students' career choices, stating that limited experiences in some modalities would deter students from working in that area in future. Furthermore, if opportunities arise to observe

and apply specific theoretical knowledge in the CLE, there is a greater likelihood that students will feel confident and embed this knowledge in their future practice (Potts and White, 2024). Additionally, the critical thinking skills so important in knowledge integration are considered to be greatly motivated by experience in the CLE (Ramlaul et al., 2021). These studies point to the CLE as essential in developing early professional identity and embedding key knowledge and skills through practical experiences. However, because this knowledge is often tacit, fluid, and contextual, it is not easily categorisable or aligned with formal academic requirements. As such, it may be perceived as less legitimate within an implicit knowledge hierarchy.

Despite the CLE being a key source of this tacit knowledge, there are factors which limit the knowledge available for students. Various limitations for clinical UgDR have been identified as limited CLE capacity, radiographer workforce deficits, and high clinical workloads (Wilkinson, 2023; Wilkinson et al., 2024a). CLE organisation and culture will be discussed further in Section 2.6, but the issue of staffing and clinical workloads is essential to the amount of knowledge and the quality of knowledge available to students. As Morrow and Mackay (2024) suggest, clinical supervisors are significant in student knowledge development, and if students witness inconsistencies in practice, it can knock their confidence and delay competence. With staff shortages and clinical workloads taking precedence over student learning, this may limit and create inconsistencies in the knowledge available in the CLE. It is therefore important not to consider the CLE as a latent source of knowledge where students attend and absorb knowledge organically.

2.4.4. People as knowledge holders

Some radiographers in the CLE have specific responsibilities or roles in relation to clinical education and are positioned in the literature as key sources of knowledge in the CLE. These radiographers are labelled with a variety of descriptors, such as practice educators (PEs), clinical liaison radiographers, or clinical supervisors, but will hereafter be termed PEs. England et al. (2017) demonstrate that supervision of student activity forms a large part of PE roles, alongside clinical teaching and assessment of student competency. These roles suggest that the PE is there as the knowledge holder, tasked with observing the student and intervening to impart knowledge to the student when needed. Despite this assertion that PEs are holders of knowledge, students and radiographers have identified academic staff, such as lecturers, as the primary source of radiographic knowledge in UgDR education (Jackson, 2013). Furthermore, students are said to value PEs who hold both academic and clinical roles (Khine et al., 2024). However, the career framework for radiographers states that all registered radiographers, regardless of their role, must contribute to clinical education and hold and share appropriate

knowledge, understanding, and skills (CoR, 2022b). The perceived authority of academic staff in relation to knowledge may reflect a broader belief in the superiority of theoretical and explicit knowledge, often reinforced in curriculum and assessment frameworks. Alternatively, it may indicate a lack of recognition or understanding of tacit and less articulated knowledge and the ways in which this is shared in practice.

The indication that students are knowledge consumers is implicitly reinforced throughout the literature. However, Hyde and Hardy (2021) argue that they are often 'impartial observers' within the CLE, and have a purer sense of knowledge, untainted by organisational or professional culture, unlike that of qualified radiographers. Manning (2017) also suggests that the tacit knowledge of students is key to guiding learning and knowledge development, which is shown in learner-centred teaching where students guide their own knowledge creation through their motivations, experiences, and values. MacDonald (2020) expands on the potential value of students as knowledge holders, discussing the process of students creating knowledge through internal feedback, which gives them the ability to assess and direct their own learning. Student feedback was also used in a study to implement technology-enhanced learning (St John-Matthews et al., 2013). This recognises that student knowledge is useful in developing new processes and promotes innovation. Despite these studies demonstrating the unique contribution to knowledge that students may have, they are contextually bound by the HEI setting. Practice based knowledge in the CLE is suggested to flow one way in the literature, from lecturers, PEs, or radiographers, to the student; there is yet to be any empirical research exploring if students have the opportunity to share and influence other knowledge in the CLE.

2.4.5. NRQ2: Summary

In this section, I discuss the multiple, intersecting knowledge sources considered in the UgDR literature. There is a complex interaction among: the curriculum, which serves as a framework for explicit knowledge; research, which provides a foundation for EBP; the CLE, which offers opportunities for the development of tacit knowledge; and individuals, who serve as a repository and outlet for all of the above. The CLE, in particular, is identified as a valuable space for students to access critical tacit knowledge. Yet this knowledge appears to be undervalued within formal academic processes, perhaps because of its contextual, tacit, and subjective nature. Whilst academic staff and PEs are widely recognised as legitimate knowledge holders, the value of students' knowledge is contested. Where students *are* valued in the HEI context is in offering feedback on academic processes and in identifying gaps in their own knowledge to guide their learning. However, this is not seen to extend to shaping knowledge or practice in the CLE. These perspectives suggest a largely unilateral flow of knowledge from educator to

student; however, empirical exploration of how far these dynamics extend into the CLE is limited.

2.5. NRQ3: How is knowledge developed and shared in UgDR education?

In this section, the literature will be explored to identify the processes radiographers and students use for developing and sharing knowledge. Knowledge sharing (KS) is often conceptualised through pedagogical processes in UgDR. These processes are not necessarily transferable to the CLE, which is more dynamic and has differing organisational priorities and challenges. Processes of reflection and feedback will be examined to identify how these are utilised for knowledge creation and sharing in both academic and clinical environments. Finally, more social processes of KS will be explored, which are more applicable to the CLE but underrepresented in the UgDR literature.

2.5.1. Pedagogical strategies and the dominance of the HEI

Knowledge sharing within radiographer education is facilitated or structured through academic pedagogy. As previously stated, various authors have asserted that HEI teaching is often traditional, didactic, and focused on competency and information transfer (England et al., 2016; Hendry, 2019; Holmström and Ahonen, 2016). However, this approach has recently been challenged by MacDonald (2020), who states that knowledge development in UgDR is a social endeavour and acknowledges that knowledge is co-constructed between people. This transition from more didactic to more social approaches to learning is appreciated by students, who state that certain methods, such as interprofessional learning, peer learning, and RiTe, are seen as beneficial to their development (Holmström and Ahonen, 2016). This suggestion is contradictory to the more recent research by Lawal et al. (2021), who found that students often expect tutors to deliver information to them, which can create a lack of autonomy and a reduction in motivation and engagement. This inconsistent stance in the literature perhaps shows a state of transformation in UgDR, with a move towards appreciation of social knowledge creation, but an inclination to fall back onto traditional thoughts and ideas of KS.

Various types of pedagogy have been explored in the literature, which show a range of knowledge sharing strategies. Some of these teaching strategies have been briefly touched upon in the previous section. An example is RiTe, where explicit knowledge is shared by the academic facilitator of the session, and students share knowledge between each other to create their own meaning of the research knowledge (Higgins et al., 2014). This process of KS encourages students to internalise and make meaning of research knowledge when it is discussed in a social environment. A further strategy is problem-based learning (PBL), which

echoes the importance of the social factors of knowledge sharing. In PBL, lecturers are encouraged to adopt a 'knowledge broker' role, over the traditional 'knowledge giver', whilst students take responsibility to gather and share the knowledge needed to make clinical decisions (Lawal et al. 2021). PBL therefore places emphasis on students sharing knowledge between each other, but there is also an 'outside' source of knowledge, the lecturer, whose benefits from the knowledge sharing process are not identified. Conversely, peer-assisted learning (PAL) as a pedagogical strategy appreciates the value of KS for both the perceived knowledge holder and knowledge consumer. In PAL, senior students support more junior students in developing knowledge and skills (Meertens, 2016). Both groups are said to benefit and develop knowledge from these interactions, with reciprocal learning happening through informal discussions (Bain et al., 2017; Kay and Brogan, 2024). In these studies, PAL is facilitated by final year students, close to qualification, acting in the role of knowledge holder, and therefore, this approach may replicate how KS happens in a CLE between students and newly qualified radiographers. However, as PAL is often conducted within the HEI setting, as opposed to a CLE, it could be argued that potential power imbalances due to hierarchical structures in clinical organisations are not apparent.

A similar dialogic pedagogical approach of storytelling has been identified as relevant and beneficial to UgDR education. Robertson (2019) adopts a two-phased meta-ethnographic and action research approach to explore storytelling in their doctoral thesis. In their work, they argue that deep reflection and collaborative meaning-making are fostered through the process of telling stories, particularly where knowledge is situated and experiential. This aligns with the assertion that knowledge in UgDR education is co-constructed rather than simply transmitted in a one-directional way (MacDonald, 2020). Robertson's (2019) work focuses on the theoretical application of storytelling and the perceived value of it in the HEI setting to various stakeholders in the UgDR community. Therefore, there is room to further explore how storytelling is relevant in the CLE, considering its social and practical nature. Other pedagogical strategies, such as service-user directed teaching, demonstrate the positive influence that patient groups can have on KS and student knowledge development (Strudwick and Harvey-Lloyd, 2013; Naylor et al., 2015; Hendry, 2019). Whilst service-users may not hold technical or theoretical radiography knowledge, their experiential insights represent an important addition to professional knowledge. This more subjective and atheoretical form of knowledge should not be devalued and can be meaningfully integrated into students' understanding of how to practice effectively. This is important to consider when challenging the value of knowledge in clinical practice. These pedagogical approaches, which are structured for effective knowledge development, may not

be transferable to the CLE setting as learning in the CLE is often shaped by opportunity and immersion in clinical tasks (Cunningham et al., 2015; Khine et al., 2024). Furthermore, the issues around workforce, CLE capacity, and clinical workloads (Wilkinson, 2023) may suggest that radiographers may not prioritise student learning. Although structured pedagogical strategies such as RiTe, PBL, and PAL may have a place in teaching more explicit knowledge in the HEI, it can be presumed that the CLE has different approaches to KS, which need further exploration.

One of the most widely discussed pedagogical approaches in UgDR is simulation-based education (SBE). The benefits of SBE have been widely accepted as an opportunity to learn skills and knowledge in a safe environment, prepare students for clinical placements, and develop the skills needed, such as critical thinking, to progress the profession as a whole (Shiner, 2018; Shiner and Howard, 2019; England and McNulty, 2020; Hazell et al., 2020). Subsequently, it has been reasoned as an ideal way to bridge the theory-practice gap (Shiner, 2018). In SBE, students can utilise the theory learned in the classroom to formulate solutions to clinical problems in a controlled environment (England and McNulty, 2020). Shiner and Howard (2019) explore the use of SBE by applying prosthetic injuries to actors, so students could experience what it is like to treat patients with open fractures before attending the CLE. They discuss the opportunity for students to deconstruct the experience and develop embedded knowledge of a situation, which can be used in the future. However, it is not just the exposure to the situation which helps students develop this practice-based knowledge, as activities are carefully curated to provide the tools to create meaning from the experience (Chau et al., 2022). SBE activities include multiple pedagogical components, including briefing, intervention, reflection, feedback, and debriefing (Adamson et al., 2023; Chau et al., 2022; Partner et al., 2022; Shiner, 2018). A theme explored in a qualitative review of SBE was that of providing an authentic environment embedded in the context of the profession, suggesting that SBE activities provide students with a holistic experience which mimics clinical practice (Hazell et al., 2020). However, it could be argued that this perception overlooks the inherently pedagogical nature of SBE and lacks some of the unpredictability and contextual nuance apparent in a CLE.

SBE has at times been perceived to be the answer to the challenges in CLE learning, particularly with regard to limited capacity (Partner et al., 2022). However, there is recognition that SBE should be used as an adjunct rather than a replacement for experience in the CLE (Chau et al., 2022). SBE facilitates and mimics experiences which are as close as possible to genuine clinical situations. However, the KS processes used in SBE, i.e. reflection, feedback, and debriefing, still echo those used in the HEI. Despite the benefits of SBE and the impact these activities can have

on students' confidence and clinical readiness, there are still aspects of clinical practice and KS that cannot be simulated in this way. Consequently, these simulated experiences could potentially add to the confusion that students experience in the CLE when navigating the theory-practice gap, particularly if situations that have been simulated in SBE are managed differently in the CLE.

2.5.2. Formal vs social reflection and feedback

Reflective practice is perceived to be a tool for knowledge sharing and development in UgDR and is particularly useful when bridging theory with practice. In the radiographer professional code of conduct, reflective practice is stated as a tool to monitor the quality of individual practice (SoR, 2025a). Further to this, reflection is expected to be demonstrated throughout all radiographer roles, to identify an individual's limitations in their practice through the use of reflective models (CoR, 2022b). In addition, reflective practice is often aligned with continuous professional development (CPD), which may encourage the idea that it is an explicit written process for a CPD portfolio (HCPC, 2023). These professional perspectives set the stage to suggest that reflection is a formal and individualistic approach whereby radiographers should undertake reflection in isolation from others.

However, in UgDR literature, more informal and social modes of reflection are presented as key KS mechanisms. Students have been said to show greater understanding of new knowledge when they reflect on the activity that they have undertaken (Lawal et al., 2021). Similarly, confidence and competence are enhanced when students reflect on the practical applications of theoretical knowledge in the CLE (Potts and White, 2024). However, the aforementioned random and dynamic nature of the CLE may then inhibit these occasions for this reflection (Wilkinson et al., 2024a; 2024b). To support reflection in the CLE, Hendry (2020: 240) discusses how radiographers may actively unpick and verbalise their reasoning for students to observe theory being used and make sense of a situation, *"This 'expert opinion' or synthesis of formal knowledge and clinical expertise can be carefully 'unpicked' by the practitioner, not only for their own reflection and learning, but as a teachable moment."* This quote suggests that a radiographer should not only be continuously reflecting on their practice but should use their reflections as a process of KS for students to develop contextualised knowledge. Yet this more social method of reflection may not be considered as *reflection* by radiographers and therefore is perhaps more implicit in the literature. Meertens (2016) suggests that peer discussions facilitated through mentee questioning have been identified as a way for students to reflect and verbalise their experiences socially. Hendry (2020) similarly frames this process of questioning as a multi-directional approach to KS whereby both parties can develop knowledge through the

other's inquiry. These more social processes of reflection are therefore likely to allow both students and radiographers to understand how knowledge links and aligns with their own and others' experiences.

Studies focusing on SBE, previously discussed, also indicate that reflective discussions and debriefing are a critical part of knowledge development and sharing (Kay and Brogan, 2024; Meertens, 2016). These sense-making moments of social reflection are said to be key in being able to tacitly embed knowledge, particularly when this is on more subjective concepts such as compassion (Hendry, 2019). Despite the benefits, students do not identify reflective practice as a skill or aspect of knowledge which is required in radiography practice (Jackson, 2013), although there is a paucity of more recent literature to substantiate this. Although this perception may be influenced by the traditional view of reflection as a formal process with the use of frameworks as suggested by the professional literature (CoR, 2022b; SoR, 2025a). There is therefore an argument to explore the use of more informal social aspects of reflection in the CLE to understand how this impacts knowledge development and sharing for UgDR.

Similar to reflection, feedback is considered a key process for knowledge development in the radiographer profession. There is an expectation for radiographers to both seek and act on feedback to develop their own practice (CoR, 2022b; HCPC, 2023; SoR, 2025a). Despite this, the delivery of feedback in the CLE is not stated as a required skill or attribute at the practitioner or junior radiographer level (CoR, 2022b). In the HEI, feedback is visible and specific. For example, in SBE, feedback is delivered immediately, giving students a clear understanding of their practice and performance (Partner et al., 2022; Wilkinson and Cadogan, 2023), and written feedback is offered on critical thinking through formal academic assessments (Ramlaul et al., 2021). In the CLE, Bwanga (2020) suggests that the ideal environment would be one where students and radiographers respect each other and are equals in the feedback process. Although they concede that radiographers have conflicting priorities between patient care and student education, this hinders their ability to give timely and constructive feedback. This is echoed by Fowler and Wilford's (2016) findings that students feel that radiographers do not have the time to give formal feedback in the CLE, which limits students' ability to direct their development needs. Similarly, Jackson (2013) identified that PEs, who have a greater responsibility for student development in the CLE, did not often deliver feedback, which illustrates a lack of this type of KS. However, in the previously mentioned two studies, students are seen as the recipients of feedback for clinical knowledge development, although student feedback *is* seen as valuable to improve the educational environment (Bwanga, 2020b; Fowler and Wilford, 2016). Although feedback is a professional expectation for improving individual

practice and is used in pedagogical approaches, there is a limited understanding of how consistently it is used in the CLE.

Feedback has intrinsic links to social reflection in that it is often a symbiotic interactive process. Partner et al. (2022) studied the use of a one-week SBE placement to replace experience in the CLE through analysis of participant blogs. In their study, they identified that feedback was offered informally throughout SBE activities by peers, which, in turn, was said to develop confidence in giving feedback. Furthermore, the social processes of seeking help and the previously mentioned storytelling were identified as key facilitators in the feedback-reflection process (Robertson, 2019; Partner et al., 2022; Wilkinson et al., 2024a). Kay and Brogan's (2024) study, which explored how students access feedback in the CLE through questionnaires, further highlights that when feedback is given between participants with peer relationships, students more readily reflect and build confidence in their practice and communication. These studies suggest a shift towards a more social and reciprocal approach to feedback; however, evidence is provided through participant perspectives of the CLE or through HEI approaches such as SBE. More research is therefore required to explore the dynamic between reflection and feedback and how these processes occur in the CLE.

2.5.3. Leadership, role modelling, and social interaction

Knowledge creation can be seen to be influenced by leadership, role modelling, and social factors. Leadership can be defined as behaviour which directs and influences activities and motivates KS between 'leaders' and 'followers' (Hendry, 2013). However, this definition is based on the context of academic lecturers as leaders and therefore may not be recognised in the CLE. The professional standards of proficiency in radiography do not define leadership but state that it can be demonstrated at all levels of practice (HCPC, 2023). Furthermore, leadership is one of the four pillars of clinical practice, which is expected to be demonstrated to different degrees in all radiographer roles (CoR, 2022b). It is further stated that transformational leaders influence others to emulate their values, beliefs, and behaviours (Hendry, 2013), which, as previously argued, are types of tacit knowledge. There is a suggestion that students could potentially share tacit knowledge through leadership behaviours. For example, Higgins et al. (2014) suggest that students should develop transformational leadership skills to encourage them to challenge practice, which is redundant and counterproductive to EBP. Despite this, many senior radiographers and PEs believe that leadership knowledge is too advanced for students, additionally showing a lack of clarity on what leadership actually is (Wilkinson et al., 2024b). Although leadership can be a key influence on KS, there is limited understanding of how this manifests and is demonstrated by students and radiographers in the CLE.

In addition to leadership skills, the standards of proficiency also state the requirement for role modelling as a registered radiographer (HCPC, 2023). This can be linked to leadership, as role modelling is expected to encourage desirable attitudes or actions in all radiographer professionals (CoR, 2022b). Hadwen et al. (2020) recognise that the identification of positive role models in both the academic and clinical settings is key to professional growth. Students are often seen to identify these role models and are drawn to radiographers with confidence and experience in their roles (Ramlaul, 2018). It has also been found that students' attitudes and career intentions are heavily influenced by individual radiographers seen as role models in the CLE (Hizzett and Snaith, 2022). Furthermore, role modelling is shown to be an influential factor in students linking explicit patient-centred care (PCC) knowledge with practice (Hyde and Hardy, 2021). This is again suggestive of the need to explore tacit processes of KS, such as role modelling, as a potential solution for bridging the theory-practice gap.

Key characteristics are shown to be indicative of a valued role model in the CLE. Certain aspects, such as clinical competence, technical knowledge and decision making skills (Cunningham et al., 2015; Khine et al., 2024), can be attributed to practice-based knowledge. However, approachability, communication skills, and a willingness to share experiences (Cunningham et al., 2015) are inherently more social traits. Consequently, those who demonstrate these characteristics are more likely to engage in KS processes with others. Students have been said to learn effectively when they have developed informal, reciprocal relationships with others (Kay and Brogan, 2024). Additionally, when students feel like part of a team, they are more likely to ask questions (Khine et al., 2024), which is likely to encourage verbal KS through reflection and storytelling. Wonnacott et al. (2023) echo the need for these authentic relationships, which facilitate both KS and the embedding of knowledge in the long term.

2.5.4. NRQ3: Summary

In this review question, I demonstrate that knowledge creation and sharing in UgDR are commonly explored and delivered through structured pedagogical methods. Despite the traditional didactic approach to academic education, there is an acknowledgement of the social nature of knowledge creation through methods such as RiTE, PBL and PAL. However, these methods are still set in the HEI, which provides a structured environment which prioritises learning. Conversely, learning in the CLE is dynamic, opportunistic, and transient, and prioritises clinical workloads over structured KS with students. Although SBE has been used to emulate this environment, the process used to facilitate knowledge creation and KS, such as reflection, feedback, and debriefing, is structured and facilitated by educators. This reflects

professional perspectives of reflection and feedback as formal rather than social processes. In addition, reflection is considered an individual endeavour and feedback is a one-directional process from radiographers to students. This, despite the discussion of the benefits of reciprocal and social attitudes towards reflection and feedback in UgDR. Finally, leadership and role modelling have been shown to facilitate tacit KS for students, although personal traits and social relationships heavily influence this. As knowledge sharing in UgDR has traditionally focused on pedagogical perspectives, there is scope to explore the more social and organisational processes of KS, which are likely present in the CLE.

2.6. NRQ4: What factors impact KS in CLEs and what research methodologies have been used to explore these settings?

As discussed, the CLE is a crucial aspect of UgDR education. It provides students with the opportunity to apply theory to practice and develop tacit knowledge, which underpins their practice for the rest of their career. However, the literature in NRQs 1-3 demonstrates a tendency to research the HEI setting, pedagogical strategies, and student perceptions and experiences of the CLE. This left an empirical gap on how knowledge is shared in a CLE, the factors which impact these processes, and how researchers explore these topics. To gain insight and provide further depth to the UgDR literature, a wider search was carried out to include other healthcare professions which use CLEs, as discussed and justified in Section 2.2.

In this section, I begin by exploring the structural and organisational influences which shape how students learn in a CLE. I discuss the variable and transient nature of placements in CLEs, along with how practice PE roles and clinical portfolios support learning. I then discuss the sociocultural influences at play, identifying how social safety is crucial in effective KS and how power dynamics can be detrimental. Finally, I critique the methodological and theoretical approaches to researching clinical education in the CLE, arguing that the methods traditionally used are often narrow or epistemologically flawed. This section distinguishes the rationale for the theoretical and methodological approach taken in this doctoral research, which will be discussed in the following chapter.

2.6.1. Structural and professional barriers to KS

As discussed, learning in a CLE is a crucial aspect of knowledge development in UgDR, although the structure and organisation of these environments are varied across the NHS. The HCPC outlines that practice-based learning must be carried out and that CLEs should be effective, supported, and appropriately staffed for student learning (HCPC, 2025a). Accreditation is required to offer practice placements, which are a source of income to CLEs

through clinical tariff funding (NHSE, 2024). However, there is no specific advice on how to assess CLEs against the Society of Radiographers' (SoRs') (2012) potentially outdated quality standards for practice placements. It can be argued that guidance and provision of placement hours in the CLE are equally unreliable. The SoR (2012) is unclear on how many hours students should spend in CLEs, which differs from other healthcare professions, such as nursing (NMC, 2023). Although literature suggests that students spend up to 50% of their time in a CLE (England et al., 2017; McNulty et al., 2021), a recent UK-wide survey shows that placement duration can differ by up to 900 hours, across a 3-year BSc between HEIs (Wilkinson, 2023). Furthermore, the ongoing workforce shortages, increases in student numbers, and CLE capacity issues have caused some providers to replace a small amount of CLE time with SBE and non-patient facing activities (Partner et al., 2022; Wilkinson, 2023). There may be an argument that the quality of experience is more important than the quantity of time in the CLE. However, in Green et al's (2022) study, student participants stated that they believe those on the recently introduced degree apprenticeship, who work and train full-time in the CLE, are at an advantage due to the extra time they have in comparison to BSc students. The variation amongst providers, coupled with arguably brief and ambiguous standards, is therefore interpreted differently by different HEIs and CLEs across the UK.

Additionally, there is no specific guidance on how to structure the time spent in the CLE. Many providers offer placement in 'blocks' where students spend several weeks in the HEI for academic sessions, followed by several weeks in a CLE following a rota, similar to radiographer staff (Wilkinson, 2023). A review of clinical education in nursing defined the 'block' approach to placement, where the student rotates around departments as a "traditional model" (Forber et al., 2016: 10). The majority of competencies and knowledge for UgDR and newly qualified radiographers revolves around traditional X-ray imaging (HCPC, 2023; Wilkinson et al., 2024b). Despite this, to broaden knowledge and in some respects tackle some of the challenges with CLE capacity, students move around imaging departments into other modalities, such as CT, MRI, and ultrasound (Hyde, 2015; Wilkinson, 2023). However, when students are expected to move into different areas every week, they see this as detrimental to their learning and sense of belonging (Hyde, 2015). Whilst this traditional block model is widely and flexibly used in UgDR, some aspects, such as continuity and quantity of time spent in the CLE, may have a detrimental impact on knowledge development and sharing for students.

There are efforts to improve placement experience and outcomes for students, generally in terms of the support from radiographer staff and the provision of PEs. The PE role is designed to act as a facilitator for students to integrate both academic and clinical aspects of knowledge in

accordance with the HEI (CoR, 2022b). PEs are therefore likely to have in-depth awareness of the knowledge students are learning in a HEI and be involved in cross-organisational discussions to coordinate activities accordingly. The traditional model of nursing placement involves a more centralised PE figure overseeing logistics, with other clinical staff guiding day-to-day learning for students (Forber et al., 2016). As previously stated, the ratio of PEs to students in any one CLE is likely to be 1 PE to 100 students (CoR, 2022a). This suggests that whilst PEs in UgDR are expected to have this awareness and interaction with students, they may assume more of a coordinator role rather than a consistent clinical presence in the CLE.

Finally, the development and assessment of knowledge is commonly guided by the use of portfolios in the CLE. HEIs often develop portfolios and allow students to gather evidence of their competency, record feedback, and develop reflections which are guided by the curriculum (Ng, 2015). As students are expected to know their own learning outcomes and take responsibility for meeting these (SoR, 2012), a portfolio can serve as a reminder and guide whilst they are on placement. Whilst portfolios are used to guide and monitor knowledge development, there is yet to be any clear evidence on how these impact knowledge sharing.

2.6.2. Organisational culture, social dynamics, and the limits of student knowledge

Sociocultural factors, such as organisational priorities, personal attitudes and experience, social interactions and power dynamics, are highly influential in knowledge development and sharing in the CLE. The literature demonstrates that organisational culture can play a large part in KS and student experiences of the CLE. Professional standards suggest that teaching and supporting students are key responsibilities for radiographers (CoR, 2022b; SoR, 2011). This is coupled with governance procedures for placements, such as ensuring educational issues are a standing item on meeting agendas (SoR, 2012). However, there are various organisational issues which can impact the prioritisation of student education. Cunningham et al's (2015) review on clinical radiographer education suggests that education may be treated as a secondary objective, with clinical workload taking priority. This could lead to students having to learn through more indirect methods of KS, such as observation, leaving more tacit knowledge unexplained. The pressures faced by radiographers in the CLE, such as resource and time constraints, could also exacerbate this conflict in priorities (Sloane and Hyde, 2019; Bwanga, 2020a; Wilkinson et al., 2024b). There is a wider issue here in that not only will students be less exposed to key knowledge, but they could potentially adopt these modelled behaviours, attitudes, and priorities.

The impact both radiographer attitudes and clinical competence have on student development is highlighted throughout the literature. McAnulla's (2018) mixed methods doctoral study on student attrition demonstrates that students perceive radiographers to be unwilling to teach and support learning in the CLE. This is further supported by evidence from student participants who stated a discrepancy in the levels of help received from different radiographers (Hyde, 2015). These attitudes are not restricted to UgDR as they have been demonstrated in therapeutic radiography CLEs and shown to prevent students from seeking out knowledge through questioning (McPake, 2021). Staff attitudes towards supporting learning are clearly influential, but this is also coupled with how experienced radiographers are. Khine et al. (2024) suggest that students value supervision from those radiographers who are perceived to be more clinically proficient. Whilst this preference could be pragmatic, seeking guidance from those with more expertise, it may also suggest a tendency to position experienced radiographers as authoritative knowledge holders. This potentially reinforces the implicit knowledge hierarchy, where those with less experience are seen as less valuable or their knowledge as less legitimate. Cunningham et al. (2015) suggest that students should not be the sole learners in the CLE and that radiographers should be continuously improving and modifying their practice based on up-to-date knowledge. However, Hadwen et al. (2020: 87) suggest that as radiographers practice and become more socialised within the profession, they pick up an idea of “the way things are done”, or the norms of practice which students then perpetuate. This is supported by Jackson (2013), who states that students are often criticised when demonstrating techniques that were misaligned with the supervising radiographer’s practice. These factors point to the impact that collective attitudes, perceived experience, and socialisation have on KS in the CLE.

Whilst there is limited empirical inquiry on the informal social interactions between students and radiographers in the CLE, there are indicators that these play a critical role in students' access to knowledge. Whilst students are identified as naturally curious, with a strong desire to interact with people in the CLE (Strudwick and Harvey-Lloyd, 2013), some report that the environment feels hostile to this type of communication (Holmström and Ahonen, 2016). This is likely linked to the attitudes discussed above, which further the barriers to KS processes such as questioning and reciprocal reflection (Hendry, 2020; Jackson, 2013). Studies have shown that this learning and knowledge development is boosted when strong relationships are apparent between students, particularly when discussing peer feedback (Kay and Brogan, 2024). This is echoed in wider professional literature, as being included in informal social interactions in a CLE was shown to enhance confidence and knowledge seeking behaviours,

whilst isolation diminished students' capacity for knowledge development (Adamson et al., 2018; Clouder and Adefila, 2017; McAvoy and Waite, 2019). Although the need for social inclusion has been identified, there is limited evidence which explores whether this happens in the CLE. Additionally, some literature demonstrates that students often fear judgement or correction from radiographers (Jackson, 2013), suggesting that students do not feel safe in the CLE. Some narratives shift the responsibility for social interaction onto students, as Hyde (2015) suggests that communication difficulties can be overcome by students building more resilience to be able to ask questions and admit their limitations. However, as placement standards suggest, it is the responsibility of the CLE provider to ensure a conducive environment for learning (SoR, 2012), which, as suggested, should then include opportunities for social inclusion. Although HEIs have more capacity to equip students with the tools needed to develop social bonds with radiographers, further insight is needed to understand how factors in the CLE influence these interactions.

Limitations in social interaction between students and radiographers could potentially cause issues with the directional nature of KS and further inhibit the ability for students to challenge and evolve practice. Students are said to desire a learning environment where two-way communication is practised amongst all stakeholders and where they are made to feel welcome and comfortable (Holmström and Ahonen, 2016). This is supported by students' suggestions, when asked to discuss their perceptions of the radiographer apprenticeship course, that apprentices are advantaged in developing relationships with staff as they spend more time working in the CLE (Green et al., 2022). Students have also been considered as a key tool in sharing current developments and practice in UgDR (Cunningham et al. 2015). However, if students do not feel socially included, they may find difficulty in being able to share this knowledge effectively, which will subsequently impact the evolution of practice.

Throughout this review, I have suggested that an implicit knowledge hierarchy plays a key role in many KS factors in the CLE. Power dynamics are particularly influential when considering this hierarchy and informal social interactions. Jackson (2013) argues that students' knowledge is often devalued in favour of the dominant power, which, in their study, is suggested to be the PE. This implicit rule reinforces the idea that students should not challenge or question practice and mindlessly follow and embed the knowledge demonstrated by these individuals. Therapeutic radiography students are more inclined to seek knowledge from those on a peer level, such as other students, rather than the radiographer, if possible (McPake, 2021). Additionally, in nursing, power dynamics are further compounded by the idea that speaking up may have a detrimental effect on students' assessment outcomes (Jack et al., 2021). Clinical

staff are acutely aware of these dynamics and the power they have over students, who are dependent on them to complete assessment and portfolio documents (Brown et al., 2020; Clouder and Adefila, 2017). Power is therefore a complex interplay between student reliance, perceptions of knowledge assets, and one's role in the CLE, and shapes access to, and sharing of, knowledge for all members of the community.

2.6.3. Methodological gaps in the CLE literature

To fully answer NRQ4, it is important to consider the methodological and theoretical perspectives which have guided research on the CLE. Primary research on clinical UgDR education discussed in this review has traditionally focused on collecting qualitative data directly from students and radiographers to gain an insight into their perspectives and experiences (Jackson, 2013; Hyde, 2015; Fowler and Wilford, 2016; Khine et al., 2024; Potts and White, 2024). Further studies have used mixed-method survey designs in an attempt to get a broader picture of the clinical education landscape in radiography (England et al., 2017; Sá dos Reis et al., 2018; Wilkinson, 2023), although only Wilkinson's (2023) study focuses exclusively on the UK context. The review articles included in this chapter also aim to get a broader, more generalisable picture of clinical education to guide practice, such as Cunningham et al. (2015) and Bwanga and Lidster (2019). Whilst both reviews provide valuable overviews and conceptual ideas relevant to NRQ1-3, they synthesise international studies which may simplify or overlook key contextual influences (Lincoln and Guba, 1985), which shape student learning in the CLE.

Qualitative data collection in the included studies is commonly carried out through interviews, focus groups, or open-ended survey questions (Jackson, 2013; Hyde, 2015; Fowler and Wilford, 2016; Wilkinson, 2023; Khine et al., 2024). Many studies in the wider healthcare literature for this NRQ also follow the trend of exploring student, educator, and practitioner perceptions through qualitative interviews or focus groups (Hinton, 2016; Clouder and Adefila, 2017; McAvoy and Waite, 2019; Brown et al., 2020; McPake, 2021). Despite the assertion in some research that tacit knowledge and processes are embedded in the CLE (Jackson, 2013), interview methods are reliant on participants being able to verbalise the knowledge they are sharing and may inhibit deeper exploration of this hidden knowledge (Polanyi, 1966). Furthermore, any experiences which make participants feel vulnerable or identify poor practice on their part, such as being complicit in negative KS behaviours, may not be shared due to self-preservation (Bergen and Labonté, 2020; Junior, 2022). These factors may then imbue the evidence base with knowledge, which is skewed towards explicit codified knowledge, which is more readily verbalised, limiting the exploration of more complex, interactional, and unspoken processes which underpin expertise in clinical practice.

The studies from other professions do demonstrate more diverse methodologies and methods, which may be more productive in harnessing the intricacy of these processes. Thomas et al. (2015) aimed to explore the socialisation of nurses on placement through grounded theory and the use of participants' reflective diaries. This provided detailed accounts of emotions and experiences, with an open approach to asking participants to talk about anything and everything that happened on placement. However, this method is still limited to what the participant wishes to explicitly share with the researcher. It overlooks other methods of identifying tacit knowledge, such as observation and socialisation with participants (Hammersley and Atkinson, 2019).

Conversely, Kell (2014) utilises observations of physiotherapy students to identify how learning and knowledge manifest in the placement setting. The observational approach allowed the researcher to witness real interactions between patients, students, and staff members, and map their day-to-day experiences and practices. However, each student was only followed for 2 days, with the researcher recording conversations and drawing the movements of participants. Although this gives a rich insight into participant interactions, the overt nature of this approach and the limited time spent in the setting may limit the credibility of the study (Lincoln and Guba, 1985). This is due to participants potentially experiencing the Hawthorne effect, or acting out of the norm, when being observed in this way (Oswald et al., 2014).

Another key study which uses ethnography in a CLE is based on therapeutic radiography students learning on placement (Sutton, 2013). This study uses non-participant observation, interviews and focus groups, and identifies the barriers and facilitators to students' socialisation into the setting. It also unpicks a hierarchy between students and clinical staff, which clearly indicates the prioritisation of service provision over education. However, the non-participant approach to observation limits the depth to which the researcher can be embedded socially within the setting (Gold, 1958), and as a result, the amount of tacit understanding they may have developed. Despite the clear benefits of using ethnographic methods to explore complex cultural factors and tacit knowledge, they are scarcely utilised in diagnostic radiography, although there are significant ethnographies conducted to broadly explore radiography culture (Strudwick, 2011), and the use of technology (Barley, 1990; Hayre, 2016). Furthermore, image interpretation education for students has been explored through video ethnography, although this is based in the classroom setting rather than the CLE (Winter, 2019). The use of ethnographic methods is therefore significant and novel in exploring knowledge development and sharing in clinical UgDR, due to its capacity for exploring the tacit knowledge which is crucial in bridging the theory-practice gap.

Theoretical approaches used in clinical UgDR research have often delivered idealistic perspectives with limited conceptualisations of knowledge. Interprofessional learning is stated as a strategy which facilitates learning through collaboration with others in a healthcare setting and is often underpinned by Kolb's experiential learning theory (KELT) (Fewster-Thuente and Batteson, 2018; Ng, 2015; Yardley et al., 2012). KELT frames learning through experience, similarly to much of the UgDR literature, as a cycle of reflection, conceptualisation, and practice (Kolb, 1984). Portfolios and pedagogies, such as SBE, are clearly shaped around these ideas and guide students through these steps. Whilst KELT acknowledges that there will be variations in learners' engagement with reflection, its application often assumes that structured reflection will be undertaken effectively and consistently by all students. This risks privileging those with more reflective learning styles whilst overlooking the influence of social and organisational factors which shape how this reflection is enacted in practice.

Research considering these sociocultural dynamics is often conducted using the theories of LPP and CoPs (Lave and Wenger, 1991; Wenger, 1998). A CoP can be defined as a group of individuals who share and create knowledge and experiences through mutual sustained participation in activities (Wenger, 1998). LPP considers learners to develop their membership to the CoP through a gradual transition from peripheral to core participation (Lave and Wenger, 1991). Both Jackson (2013) and Sutton (2013) use these theories to argue that social inclusion is key in integrating students into the CLE community, which in turn is crucial in learning. However, joint endeavour, motivation, and priorities amongst members are key, along with the sustained engagement aspect (Barab et al., 2006). As discussed, clinical UgDR education is inherently transient, so there is an argument that students will never achieve full membership of the CLE CoP in their student role. Missing in the literature is theoretically grounded research encompassing cultural, social, and individual factors that impact the informal ways in which both tacit and explicit knowledge is shared in the CLE.

2.6.4. NRQ4: Summary

In this review question, I argue that the structural and professional factors influencing clinical education are often inconsistent and limited by tensions in service provision and workforce challenges. While tools such as PEs, block placements, and portfolios are used to direct and facilitate learning, there is no empirical research which explores how these are used in the CLE. Additionally, sociocultural factors such as professional norms, attitudes, and social interactions, which are founded on power and hierarchical dynamics, clearly play a large part in how comfortable students are in seeking and sharing knowledge. Furthermore, existing research on these topics is methodologically and theoretically limited and privileges knowledge

which can be easily verbalised. This is detrimental to our efforts to bridge the theory-practice gap, as previously asserted arguments show that tacit knowledge is crucial in this endeavour. This section, therefore, identifies a clear rationale for more observational research, grounded in organisational theories of KS.

2.7. Chapter summary

In this chapter, I have presented my narrative review, which critically explored the vast landscape of UgDR literature to identify how knowledge is defined, sourced, developed, and shared in UgDR education. I argue that knowledge is predominantly framed as explicit and measurable, aligned with curricula and professional standards, a framing that fundamentally marginalises the more tacit, experiential knowledge crucial in clinical practice. Furthermore, I identified that the development of pedagogical processes in the HEI dominates the literature, whilst the complex and dynamic nature of KS in the CLE is relatively under-researched. Finally, I have reported on the bias towards self-reported, verbal and interview-based research methods, which limit the ability to capture more tacit and embodied processes. These findings create a significant gap in professional understanding, which demands further investigation to more holistically capture knowledge development and sharing in UgDR education, specifically in the CLE.

As with all narrative reviews, there are limitations in my own interpretations of the literature, and potential for subjectivity in literature selection. As this is a doctoral project, I was the sole researcher and therefore unable to collaborate with others on the study selection. However, I mitigate this through my transparent and iterative methodology discussed at the beginning of this chapter. The key strength of this review lies in its flexibility and conceptual depth, which has allowed for integration of diverse literature along with my own critical perspectives as a radiographer and educator. The insights from this chapter directly inform the rationale in Chapter 1, and the methodological and theoretical decisions which will now be discussed in Chapter 3.

3. Chapter 3: Research foundations and design

"Mindlines are not just internalised instructions for what to do. Mindlines are what we share, including the facts we know and the issues we care about." – Trisha Greenhalgh

(Greenhalgh, 2023)

3.1. Chapter introduction

Due to the iterative nature of this research, the methodological approach will be discussed across both Chapters 3 and 4 as shown in Figure 3.1. In this chapter, I focus on the rationale for the philosophical, theoretical, and methodological foundations that underpin this research. I first present the research aim and questions before exploring my ontological and epistemological positioning, which draws on critical constructivist perspectives. I develop my theoretical framework, based on my published paper, which discusses KMb, mindlines, and organisational knowledge creation theory (OKC) in the context of UgDR education (a copy of the paper is provided in Appendix 2b). This framework, along with my research questions, informs my choice of ethnography as the methodological approach, which is essential for exploring everyday KS practices in the CLE. Data generation methods, including participant observation and interviews, are justified along with the ethical considerations and approvals made. Finally, I discuss the importance of quality in ethnographic research, how I have designed the study to ensure trustworthiness in the findings, and how I used reflexivity as a tool for deeper understanding. The application of these methods and data analysis will be demonstrated in Chapter 4.

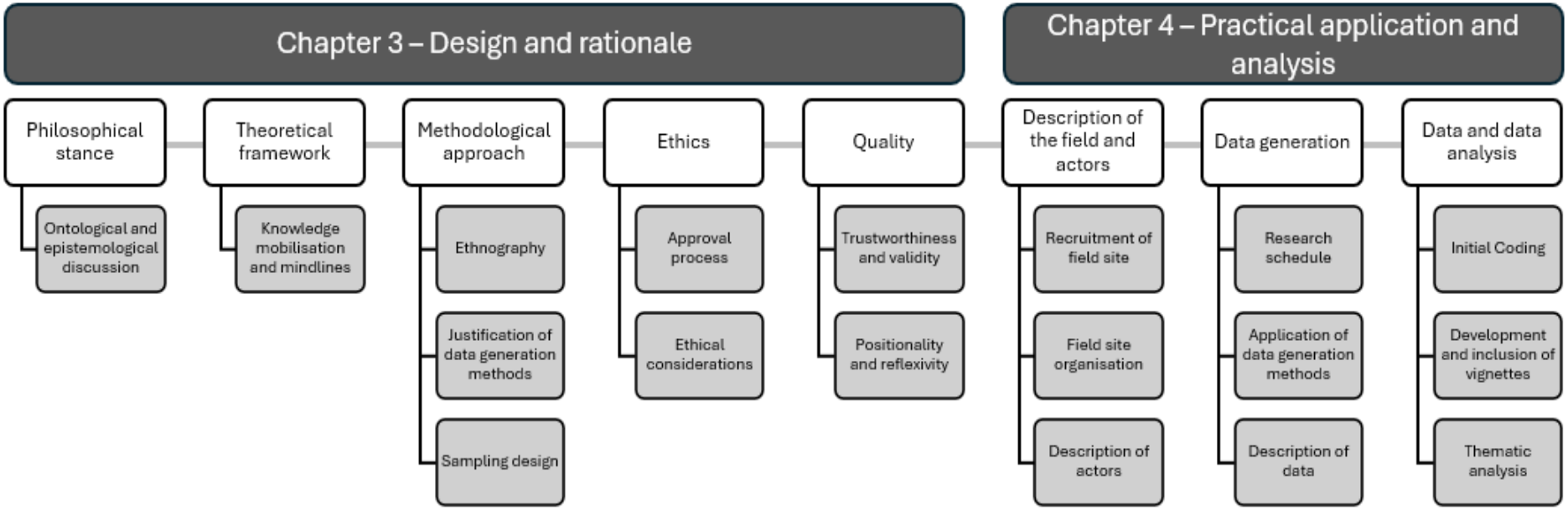

Figure 3.1. Methodology chapters navigation

3.2. Research aim and questions

The aim of this research was to explore how knowledge is accessed, shared, and developed between students and radiographers in an NHS CLE. The following questions guided the research:

> **RQ1:** What are the motivations for students/radiographers to share and develop their knowledge?
>
> **RQ2:** How do students/radiographers seek and share new knowledge?
>
> **RQ3:** How does the culture of the CLE impact knowledge sharing between students/radiographers?

3.3. Philosophical and theoretical underpinnings

3.3.1. Ontology and epistemology

Research must be designed with close consideration of the researcher's view of the nature of reality or *ontology*, the nature of knowledge or *epistemology*, and their *positionality* through reflexivity (Green and Thorogood, 2018; Merriam and Tisdell, 2016). When researchers ask questions, they need to know under what conditions they seek the answers, and that the knowledge acquired is considered reasonable when examined by others (Keogh et al., 2023). Terminology use in ontological debates is diverse and often inconsistent; however, the relationship between these theoretical perspectives and the conduct of research through methodology must be consistent to ensure trustworthiness in research findings (Alasuutari et al., 2008; Lincoln and Guba, 1985).

Generally, ontological positions can be categorised as objective, in the case of positivist approaches seeking to discover truth independent of thought, beliefs, or values (Howell, 2013; Jacobsen, 2020). In contrast, subjective positions are attended to through constructivist ideas, where our reality is seen to change, evolve, and be constructed through people's experiences and dialogue (Howell, 2013). These ontological standpoints are foundational to the way in which knowledge is perceived to be either acquired or created. Through a positivist point of view, knowledge is latent in the world, waiting to be collected by the researcher, whilst constructivists believe knowledge has to be created between people, requiring more social and dialectic methods (Daniel and Harland, 2017; Howell, 2013). Additionally, a researcher already has ideas, beliefs, and experiences, which also impact the way in which reality and knowledge are perceived. As previously stated, I have extensive experience in various roles in radiography,

which are likely to influence my perceptions of this topic. Through constructivism, this "bias" or a researcher's positionality is accepted and mitigated through reflexivity (Finlay and Gough, 2003; Merriam and Tisdell, 2016), which will be further discussed in Section 3.6.2. The tension between positivism and constructivism is reflected in the UgDR discourse discussed in Chapter 2. The privileging of explicit or codified knowledge in favour of tacit or more personalised knowledge echoes a more positivist mindset in radiography. This strengthens the rationale for adopting a constructivist stance to surface these hidden hierarchies of knowledge further.

These philosophical musings are not only important for researchers to learn and be aware of, but they are also inherently linked to my research, which aims to explore how knowledge is created and shared in a CLE. As I was initially provided with the topic of KMb in radiography education for this doctoral study, I feel somewhat fortunate that the phenomenon under examination is knowledge creation and sharing itself. The arguments made in Chapter 2 around how knowledge is defined and negotiated socially in practice can be effortlessly drawn upon here to justify my ontological and epistemological perspectives. If the knowledge used in radiographic practice is founded on tacit understanding, through experience, social interaction, and driven by individual values, then inquiry into how this knowledge is shared needs to be founded on subjective ontological ideals. Furthermore, my own positionality as a radiographer and UgDR educator, and my experiences in these roles, need to be considered. Ontologically, then, constructivism is consistent (Merriam and Tisdell, 2016), as it is through constructivism that our efforts to obtain knowledge become acts of knowledge creation.

To build on this subjective constructivist ontology, my research is founded on a critical constructivist epistemological perspective, which gives attention to how culture, power, and hierarchical ideas shape KS in the CLE. Kincheloe (2005) emphasises how knowledge is guided by the dominant powers in society and any given context, and that, as researchers, we should always question these systems and ideologies. This stance allows for a deeper exploration of knowledge through exploration of who produces knowledge, who gets to share that knowledge, and whose interests it serves. Further to this, in terms of education, it is argued that through critical constructivism, students can be seen as integral to the knowledge production process rather than passive consumers (Kincheloe, 2005). This idea resonates with the critiques posited in the literature review in that students are often positioned as passive knowledge consumers rather than valuable contributors. Further debate suggests how everyday practices and discourse feed into ideas of who is sanctioned to know and to share that knowledge (Kincheloe and McLaren, 2011). Furthermore, this perspective challenges the notion of knowledge being neutral and transferable, suggesting that it is ever changing through social and political

discourse (Bentley et al., 2007). Critical constructivism, therefore, recognises the social factors which are clearly influential in how knowledge is developed and allows for deeper reflection on broader ideological systems.

3.3.2. Theoretical framework

Where critical constructivism is often framed within educational research (Bentley et al., 2007; Kincheloe, 2005), mindlines theory offers a lens grounded in healthcare research, which interrogates how knowledge is negotiated between people (Gabbay and le May, 2004, 2011, 2023). The original ethnographic work informing the mindlines theory revealed the tacit knowledge which practitioners sought out, negotiated, and relied on in practice (Gabbay and le May, 2004). In my paper, provided in Appendix 2b, I introduced the argument that utilising mindlines as a theoretical lens in clinical UgDR research would challenge the dominant focus of explicit and codifiable knowledge we currently see in UgDR research (Patel, 2023a). Here, I summarise and extend that argument by positioning mindlines alongside and against traditional educational theories. Thus, highlighting why organisational approaches offer a more flexible and context-sensitive lens for KS in the CLE than pedagogical ones.

The distinction between the terms explicit and tacit knowledge has been introduced earlier in this thesis. However, to build a robust theoretical framework for this study, it is also necessary to examine what is meant by 'knowledge' and how it differs from, or relates to, associated terms such as 'evidence' and 'information'. In my paper (Patel, 2023a), I discuss the various authors and frameworks which aim to define these terms, which are often used synonymously (Ackoff, 1989; Crilly et al., 2013; Dammann, 2018; Graham et al., 2006). This discussion identifies that research evidence, which is considered explicit, is often referred to as knowledge, when others consider knowledge to be tacit 'know-how', gained through communication and experience (Ackoff, 1989; Dammann, 2018; Patel, 2023a). The latter definition is aligned with the perspective used throughout this thesis, that the knowledge radiographers use, and students develop in the CLE, is a combination of both explicit information/evidence, and tacit understanding. Therefore, utilising a theory which recognises both the interplay between explicit and tacit knowledge and is adaptable to specific contexts is essential for this study.

Previously used theories in healthcare education research were identified in Section 2.6.3 and include KELT, CoP, and LPP (Kolb, 1984; Lave and Wenger, 1991; Wenger, 1998). These theories have provided valuable insights into the role of experience, reflection, and social participation in workplace learning (Fewster-Thuente and Batteson, 2018; Jackson, 2013; Sutton, 2013; Yardley et al., 2012). However, these studies and frameworks can overlook the cultural and

organisational factors that shape student learning, and assume that individuals will have sustained participation, which is not always apparent or achievable in clinical UgDR education. These limitations further emphasise the need for a different theoretical perspective and justify the move to more organisational KS theories.

3.3.2.1. Knowledge Mobilisation

The literature on knowledge sharing in healthcare is vast, with multiple theories, frameworks and models (Davies et al., 2015; Ward, 2016). Numerous terms are used for this area of enquiry, including knowledge translation, knowledge exchange, and knowledge mobilisation (Graham et al., 2006; Ward, 2016). In organisational literature, the term knowledge management is often used to explore these topics (McEvoy et al., 2017), which suggests that knowledge can be controlled and regulated for specific purposes. Each of these terms and ideas holds its own assumptions about the nature of knowledge and the mechanisms by which it moves between people and contexts.

Knowledge translation has become a particularly prominent concept in promoting EBP in healthcare (Davies et al., 2015), although Greenhalgh and Wieringa (2011) critique the approach for its tendency to frame knowledge as a product which can be pushed into practice. Instead, a more sociological and organisational approach is encouraged where knowledge is conceptualised as "collectively negotiated" and "embodied" (Greenhalgh and Wieringa, 2011: 501). Previously, I have argued that the CLE offers the opportunity for multiple types of knowledge to be shared, interpreted, and adapted by radiographers and students, rather than purely transferring explicit information. This suggests that knowledge translation and other frameworks which prioritise the implementation of evidence into practice are unsuitable for this study.

Conversely, KMb has been proposed as a more flexible and contextually responsive alternative to knowledge translation (Crilly et al., 2013; Ferlie et al., 2012). While these frameworks are still concerned with bridging the research-practice gap, KMb also acknowledges the relational and cultural aspects of knowledge use, both across organisations, groups and within teams (Cowdell, 2019; Currie and White, 2012). However, the discourse around KMb is often situated at policy, commissioning, or organisational level, and emphasises leadership, governance, and cross-organisation partnerships as central to KMb success (Currie and White, 2012; Wye et al., 2020, 2021). While these insights have clear value, at times, they can render KMb as abstract, focusing on the conditions for knowledge sharing rather than the mechanisms used by individuals in their everyday practice.

3.3.2.2. Mindlines and the SECI spiral

Mindlines theory builds on these broad KMb principles and provides suggestions and processes as to how knowledge is shared and created in specific environments. First introduced by Gabbay and le May (2004: 76), following their ethnographic study of GP practices, mindlines were described as "internalised, collectively reinforced, often tacit guidelines". They go on to discuss how this knowledge is developed and modified from multiple sources and through interaction and experience. Mindlines theory is founded on organisational knowledge creation (OKC) theory, which depicts a spiral model of knowledge development called the 'SECI' spiral (Nonaka, 1994), for which I provided an overview in Section 1.5. This model offers a framework for the ways in which knowledge flows back and forth across a tacit-explicit spectrum through the processes of socialisation, externalisation, combination, and internalisation. I argue that the UgDR CLE is an environment rich with opportunity for these processes to be enacted and for knowledge to be mobilised between students and radiographers, although there is limited empirical evidence to demonstrate these processes (Patel, 2023a). Table 3.1 defines and summarises my conclusions about the individual SECI practices and identifies key research gaps apparent in the context of the UgDR CLE.

Table 3.1. SECI processes and associated research gaps in the UgDR CLE
(adapted from Patel (2023a))

SECI Process	Definition	Illustrative KS practices in the CLE	Research gaps in the CLE
Socialisation	Where tacit knowledge is developed and shared through collective experience, often in a non-verbal way.	• Observation • Imitation	• How does implicit communication, shared experience and observation shape tacit knowledge in the CLE?
Externalisation	When tacit knowledge is made explicit through dialogue.	• Metaphor • Reflection • Storytelling	• How does informal reflection/feedback occur and influence knowledge development in the CLE? • Do interactions such as jokes and storytelling play a part in sharing tacit knowledge?
Combination	Where explicit knowledge is synthesised with other knowledge, and new knowledge is sought out	• Use of policy and guidelines • Advice from peers	• How, when and why is knowledge sought out in the CLE? • What are the organisational

			barriers/facilitators to access knowledge?
Internalisation	Where explicit knowledge is tacitly transformed and embedded into practice	• Learning by doing	• How do CLEs facilitate internalisation of explicit knowledge? • How do internalisation processes impact the theory-practice gap?

The use of mindlines and OKC theory offers a novel and philosophically consistent framework to explore the research aim in this study. The flexibility and sensitivity to context allow for exploration of the informal mechanisms and organisational processes through which knowledge is developed and shared in the CLE. It also directly responds to the research gaps I have identified both in Chapter 2 and my paper (Patel, 2023a) (Table 3.1). This theoretical framework informs my methodological choices, which will now be explored further.

3.4. Methodological approach

3.4.1. Alignment of ethnography

The research questions and associated philosophical foundations of this study require a methodological approach which accounts for the subjective and hidden nature of tacit knowledge, social interaction, and cultural norms. Qualitative research is used to explore the social realities of people within specific contexts, and different frameworks can be used to achieve this (Liamputtong, 2023; Teherani et al., 2015). The qualitative approach of ethnography particularly aligns with the ontological and epistemological approach to this study, as it is a way to understand how social worlds are interpreted and impacted by culture and how group members find meaning in these contexts (Emerson et al., 2011). Furthermore, ethnography was used by Gabbay and le May (2011) to develop the theory of mindlines.

Ethnographic methodologies originally arising from sociology and anthropology (Delamont and Atkinson, 2011) have recently been used in different disciplines to gain empirical accounts of complex settings such as healthcare (Cowdell, 2019; Rea-Holloway and Hagelman, 2020). At the core of most ethnographic work is participant observation, where an ethnographer embeds themselves into the research setting or field to collect insights into the reality of a specific group (Have, 2004). This engagement in the field allows for tacit knowledge and processes to be observed by the researcher, where participants may not be consciously aware of them to verbalise them in an interview setting. Further to this, ethnography is considered useful in exploring education and the theory-practice gap in healthcare, as ethnographers themselves

are said to oscillate between the boundary of theoretical concepts and clinical practice (Goodson and Vassar, 2011; Cubellis et al., 2021). This dual position of ethnographers is then both methodological and experiential as their knowledge and understanding, alongside participants', is shaped by the field. In this sense, the mindlines model itself can be considered an epistemological tool in research and, in combination with immersive data generation methods, will be invaluable in surfacing the tacit knowledge and processes critical for this study. In this sense, the ethnographic process embodies that of the development of mindlines, as the researcher is socialised into the setting and can develop and share their tacit knowledge as part of the community.

Despite the strengths of ethnography in understanding tacit knowledge in complex social settings, I note in Chapter 2 the lack of ethnographic studies carried out within radiographer departments. The propensity for radiography research to lean towards a more scientific and positivist approach, over a more sociological and constructivist one, is likely a factor in this (Bleiker et al., 2019). There are also logistical factors which may dissuade researchers from choosing ethnography, such as the length of time needed and gaining access to the field (Have, 2004). Gaining NHS ethical approval can also be an inhibiting factor in healthcare research (Lee et al., 2021). However, as researchers, our job is to understand and apply the tools required to develop knowledge in the most appropriate way aligned to our research questions, not to choose the most convenient approach. Hayre and Strudwick (2019) are prominent ethnographers in the radiography profession who have begun to challenge more radiographers to use ethnography in their studies to offer new perspectives on how people work in these settings. Their individual ethnographic work has demonstrated hidden relationships and behaviours that are prevalent in radiography departments; however, they are focused on professional practice rather than education in this setting (Hayre, 2016; Strudwick, 2011). This demonstrates a methodological gap which this study will address.

The traditional approach to ethnography can be further extended to address power and hierarchical dynamics in the field. Critical ethnography is used to critique the norms in a specific context and advocate for those who may be disadvantaged by these norms (Lune and Berg, 2017; Madison, 2020; O'Reilly, 2009). Students are a group identified to be marginalised, facing challenges and injustices due to their cultural position (Thomas, 1993). This supports the arguments I made in the narrative review, which suggest students can be seen as consumers of knowledge rather than as valuable co-producers. What is distinctive about critical ethnography is the stance of the researcher to identify what could be possible for those who may be disadvantaged in a specific setting (Madison, 2020). Using a critical approach in this research,

therefore, considers not only students who may lack the agency to share and co-produce knowledge in the CLE, but also patients and service users whose care may be disadvantaged through obstructions in effective KS. Ethnography is then consistent with both the philosophical framework I discussed in the previous section and offers a robust approach to exploring the complexity of knowledge sharing in the UgDR CLE.

3.4.2. Justification of data generation methods

The term 'data collection' is often used to discuss the process of using research methods to acquire data in research. However, to align with the previously discussed philosophical and theoretical perspectives and ethnographic discourse, the term data *generation* will be applied throughout the thesis (Coffey, 2018; Emerson et al., 2011). This is more consistent with the idea that knowledge is socially constructed rather than innate, waiting to be collected in the field. Ethnographic methods are traditionally fluid, iterative, and inductive, and often involve observational and interview methods (Coffey, 2018). Ethnographers often play an active part in the field, co-producing data and developing meaning from observations, conversations, and interactions with participants or more commonly termed *actors* (Emerson et al., 2011). The following discussions offer the justification for the data generation methods used in this study; the application of these methods will be discussed further in Section 4.3.

3.4.2.1. Participant observation and observer role

Participant observation is central to the ethnographic approach and the theoretical framework in this study. Prolonged, immersive engagement with the field enables the researcher to develop a deep understanding of the everyday routines and tacit norms apparent to outsiders in a setting (Fetterman, 1998). Importantly for this study, the idea of generating data on what actors actually do, rather than what they say they do, was key (Coffey, 2018). This is not only due to the importance of recognising tacit knowledge and KS but also to highlight the potential power dynamics and hierarchies discussed in previous chapters.

The topic of observer roles is keenly debated within ethnographic groups, specifically, how involved or detached one should be (Delamont and Atkinson, 2011). Traditional observer roles are defined on a spectrum between a complete observer and a complete participant, with the hybrid roles of observer as participant and participant as observer, bridging these positions (Gold, 1958). An ethnographer can be considered an outsider in the field due to their research purpose and limited time in the setting (Bukamal, 2022). However, if they have previous experiences in a similar context or hold professional knowledge, they also have a degree of insider status (Yeo and Dopson, 2018). In this research, I bridged these two paradoxical

positionalities and therefore needed to manage this through careful reflexivity (Angrosino, 2007), discussed further in Section 3.6.2. My experiences as a radiographer and educator provided me with an insider's understanding of cultural terminology and practical expertise. In contrast, my theoretical knowledge, lack of consistent presence in the field, and research purpose positioned me as an outsider.

As ethnographers seek to gain insider perspectives (O'Reilly, 2009), a complete observer stance was considered detrimental to rapport building, particularly given that actors would be aware of my radiographer background. Conversely, a full covert participant role, acting as an embedded radiographer, risked limiting access to conversations between actors whilst carrying out clinical tasks, and would introduce ethical concerns (Beauchamp and Childress, 2001). As determined by Strudwick (2021) in a radiography field, ethnographers acting as participant radiographers would mean that they spent more time isolated in X-ray rooms carrying out X-rays than focusing on the interactions and dynamics between actors in the field. Therefore, I assumed an observer-as-participant stance to ensure I could focus on the research whilst also developing rapport and embedding myself within the setting.

3.4.2.2. Field notes

During observation, ethnographers write field notes (FNs) to capture the knowledge they are developing in the field and generate data which can later be analysed. FNs consist of both descriptive and analytic insights to be recorded by ethnographers, demonstrating what happens, with whom, and through what processes (Emerson et al., 2011). This is flexible and inductive and allows the researcher to use their insider and outsider position to generate the data (Angrosino, 2007). Developing FNs as soon as possible in the field is important due to the dynamic and fleeting nature of experience (Coffey, 2018). However, the format of FNs can vary and guidance on developing them is open to interpretation.

FN generation is critical in ethnography; however, how this is done is flexible and dependent on the field, the ethnographer, and logistics. Emerson et al. (2011) offer key principles for balancing the writing of descriptive FNs, which depict social happenings and discourse, with reflexive notes which detail the interpretations and understandings the ethnographer has from these experiences. However, writing extensive descriptive FNs can highlight the observer status of the ethnographer and therefore remind the actors that they are being observed (Emerson et al., 2011). This can impact and exacerbate the Hawthorne effect, where actors behave in a different way when the observer is watching them, which can subsequently impact the trustworthiness of the study (Lincoln and Guba, 1985; Oswald et al., 2014). I therefore planned to carry a small

pocket notebook allowing for brief jottings to be made, which consisted of key words and statements (Emerson et al., 2011), to remind me of the situation or conversation I was involved in. These would then be elaborated on during data management time planned into my observation schedule, which will be discussed in Section 4.3.

3.4.2.3. Interviews

Interviews are often used in addition to participant observation to enhance trustworthiness and further clarify emerging insights. Fetterman (1998) states that interviews are a key supplementary method in ethnographic research to contextualise and explain observations from the field. Angrosino (2007) further supports the value of interviews in the triangulation of data and findings. This not only improves credibility and sensitivity to context (Lincoln and Guba, 1985; Yardley, 2000) but also offers actors a chance to explain their actions and decisions (Angrosino, 2007), increasing confirmability (Lincoln and Guba, 1985). Interviews, therefore, deepen the understanding of factors related to the research questions.

Interviews can be considered simply as a process of asking questions and listening (O'Reilly, 2009), and due to the immersive nature of ethnography, happen at different times and in differing formats throughout an ethnographic project. During observational periods, ethnographers have conversations with actors which are akin to informal and spontaneous interviews (Hammersley and Atkinson, 2019). Furthermore, semi-structured interview formats can be utilised to allow for recorded conversations, which add depth and meaning to the observational data (Strudwick, 2021). Ethnographic interviews differ from interviews founded in other methodologies, due to the relationships built between actor and ethnographer (O'Reilly, 2009), which ultimately aids in the exploration of the research questions. In this study, both informal conversations and semi-structured interviews were conducted to provide depth to the data and opportunities for triangulation.

3.4.3. Sampling

Sampling in qualitative research, ethnography in particular, is based on depth and immersion, rather than breadth and representativeness. Mason (2010) explains the difficulty of projecting sample size in qualitative research due to the importance of reaching data saturation, where no new insights are found in the data during analysis. In ethnographic research specifically, there is limited guidance on minimum sample sizes needed to meet data saturation (Wutich et al., 2024). However, the concept of data saturation has been challenged in relation to predicting sample sizes due to the lack of transparency and how to apply this with more iterative and theory-informed research approaches (Braun and Clarke, 2021). In ethnographies, sampling

can be considered to be context-driven rather than actor-driven due to the aims of exploring culture rather than individual lived experiences (Angrosino, 2007). Therefore, the difficulty in determining sample size can be considered the same as determining the length of time required in the field. Sampling discussions in this study, therefore, consider both the actors and the field itself.

A more appropriate concept than data saturation in this study is that of information power, proposed by Malterud et al. (2016). Information power suggests that the adequacy of the sample must be determined by the capacity of the data to address the research questions meaningfully and is based on five factors, which have been applied to this study (Malterud et al., 2016). Firstly, the aim of the study is narrow in terms of its focus on UgDR education and KS in this environment. Secondly, the sample itself is specific in terms of the field, a UgDR CLE, and the actors, students and radiographers. Thirdly, the study is heavily theoretical, informed by mindlines and OKC theory. Fourthly, the quality of dialogue with actors is ensured by prolonged immersion in the field, interviews, and informal conversations. Finally, the analysis is based on the in-depth data generated from one field site. These factors provide a baseline of higher information power as determined by Malterud et al. (2016).

3.4.3.1. Negotiating access to the field

As the phenomenon under scrutiny, knowledge creation and sharing, is embedded in the CLE and socially observable, sampling began with the recruitment of an appropriate field site. The site needed to be a CLE for students studying at the sponsoring HEI. This was justified as it allowed for access to students through the sponsoring HEI and provided logistical access to field sites through professional networks. Site characteristics influence research outcomes (Fetterman, 1998); however, qualitative research aims for potential transferability of outcomes rather than generalisability (Lincoln and Guba, 1985). I have therefore provided a detailed description of the field site and actors in Section 4.2 to ensure readers can evaluate transferability and plausibility. I therefore approached an UgDR CLE, 'Teaching Hospital', which met these specifications, to determine their interest in the study.

To gain and maintain access to the field, ethnographers must develop and hone relationships with key actors, or gatekeepers, who facilitate their engagement. This is further supported by the suggestion that gatekeepers not only negotiate access to the field but also develop attitudes amongst other actors towards the researcher (Fetterman, 1998). I initially contacted a gatekeeper at Teaching Hospital to ascertain their interest in the project and to advise on logistical factors which were needed for me to complete ethics applications. I carried out

various online meetings, which provided me with the opportunity to talk through my research purpose, and in turn, I was offered information that supported research decisions, ethical applications, and organisational procedures.

3.4.3.2. Sampling of actors

In planning the study, it was important to recognise individuals in the field not merely as sources of data, but as actors who shape the social interactions and dynamics, so crucial to the research aim. In this study, actors would be both radiographer staff and students who work together in the CLE. Although the focus was on qualified radiographers, the sample was not limited to this, as there were likely to be influential interactions between other ancillary staff and students in the field. Therefore, the sample includes students, radiographers, assistant practitioners (APs)[1], advanced practitioners (AdPr)[2], PEs, radiographer managers, and consultant radiographers[3]. A detailed list of actors and their roles is discussed in Section 4.2.3.

Sampling needed to be adaptive to the situations arising in the field to allow for insights to develop and for theoretical leads to be followed (Fetterman, 1998). Therefore, convenience purposive sampling was used for logistical ease and to ensure the actor sample was relevant to the focus of the study (Hammersley and Atkinson, 2019; Strudwick, 2021). To aid in ensuring the purposeful nature of the sample, inclusion and exclusion criteria were developed (Palinkas et al., 2015), detailed in Table 3.2. Actors were included if they consented to be observed in the field. At Teaching Hospital, there was potential for students studying from other HEIs; these would be excluded due to ethical approval only being granted from the sponsoring HEI. Students at all levels of study, from first to third year (or level four to six), were to be included. This was deemed to potentially add insight into differences in approach to KS depending on the students' experience level. Various levels of radiographer staff were included; this was also deemed to potentially add to the understanding of power dynamics or organisational hierarchies.

[1] APs – Staff who perform clinical radiographic tasks defined by a narrow scope of practice, generally supervised by qualified radiographers.
[2] AdPr – Qualified radiographers who have undertaken postgraduate education to carry out tasks traditionally performed by a radiologist such as reporting on X-ray images.
[3] Consultant radiographers – Increased level of autonomy and responsibility to AdPr's to uphold four pillars of advanced practice, clinical expertise, research, education, and leadership. Working towards doctorate level qualification.

Table 3.2. Sampling inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Student radiographers who consent to be observed studying at levels 4, 5 or 6 at the sponsoring HEI	Students studying at other HEIs Students who are not allocated to the participating CLE Students who do not consent or withdraw consent to be observed
Staff who consent to be observed in the CLE, including (but not limited to): • Radiographers • APs • AdPrs • PEs • Consultant radiographers • DR Managers	Staff solely working in modalities such as CT/MRI/Ultrasound. Staff who do not consent or withdraw consent to be observed

3.5. Ethics and Research Integrity

3.5.1. Approval process

Ethical considerations for ethnographic research are particularly complex in healthcare settings due to the prolonged engagement required by the researcher. Unlike more controlled quantitative methods, qualitative research and in particular ethnography, is less predictable in terms of the ethical issues which may arise (Hammersley and Atkinson, 2019). Researchers are also likely to encounter potentially vulnerable groups, which increases the likelihood of ethically ambiguous situations in the field (O'Reilly, 2009). Ethnographers in healthcare settings and, in this case, an educational one, can therefore be presented with practices which challenge the ethical principles laid out by guidelines (Tolich and Tumilty, 2020). Despite this, the procedural process of ethical approval is needed to protect the safety and rights of participants and the public (UKRI, 2024). Ethical considerations were navigated through the four ethical principles of autonomy, justice, non-maleficence, and beneficence (Beauchamp and Childress, 2001), which are discussed below. However, due to the ongoing contact with actors in the field, I also embraced "ethics-in-practice" through reflexivity and discussions with actors and doctoral supervisors throughout (Guillemin and Gillam, 2004).

The ethics application process is detailed in Figure 3.2 and was lengthy due to various ethical queries and prolonged communication with the field site. The study received ethical approval from BCU FAEC in March 2023 (Appendix 3). Discussions with Teaching Hospital's research and development (R&D) department highlighted the need for NHS research ethics committee (REC)

approval due to the time I would be spending around patients and patient data. Once the application was submitted through the integrated research application system (IRAS), there were concerns raised about the potential for me to witness confidential patient information. This was mitigated through discussions with the gatekeepers and information governance (IG) department at the Trust, who stated that an honorary contract and my professional registration as a radiographer would suffice to ensure patient confidentiality was procedurally maintained. NHS REC approval was obtained in September 2023 (Appendix 4), with various tasks related to site set up extending the commencement of data generation to February 2024. This process was also detailed and disseminated at the UK Imaging and Oncology Conference (UKIO) 2024 in a conference poster (Patel, 2024) provided in Appendix 2d.

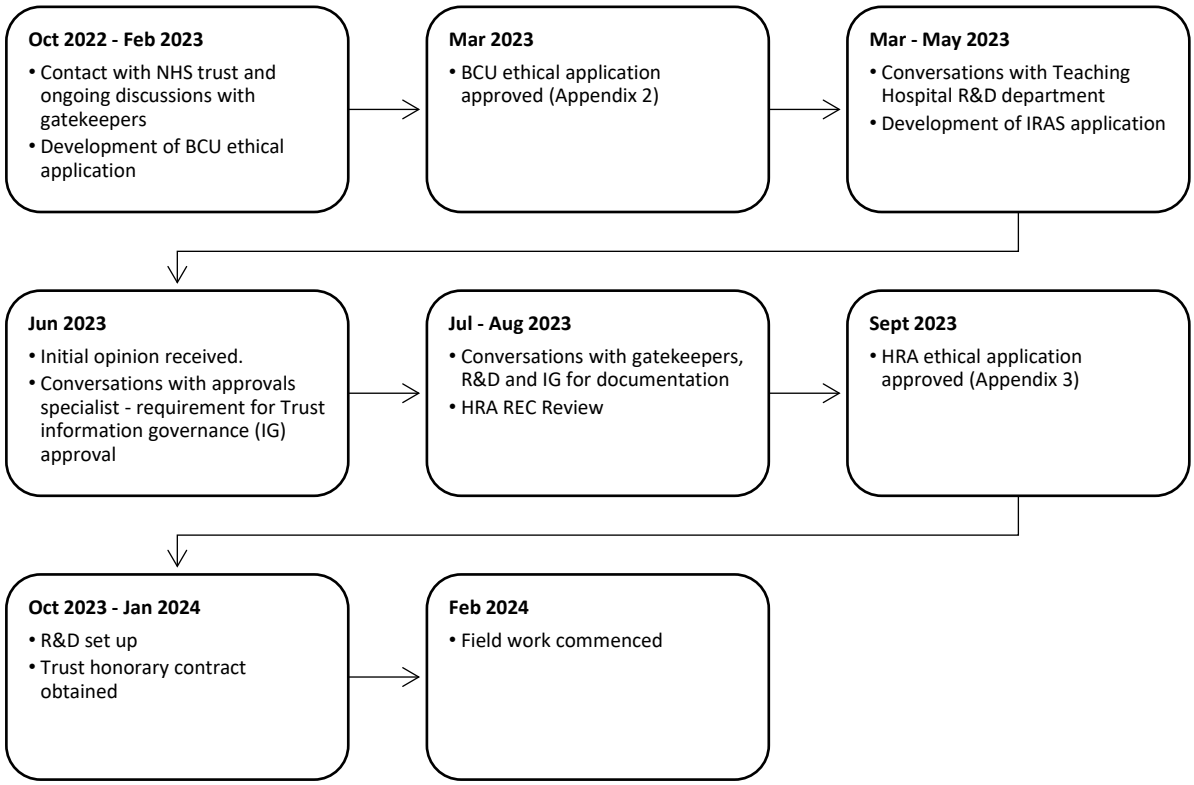

Figure 3.2. Ethical approval timeline

3.5.2. Ethical considerations and mitigations

Having outlined the formal approval process, I will now discuss the ethical considerations which guided the study design and conduct. As previously stated, ethics was an active part of my research practice and required ongoing thought and negotiation in the field. Whilst this Chapter is primarily concerned with the design and justification of the research, some reference will be made to specific situations which required me to make ethical decisions in practice. This includes navigating moments of consent, confidentiality, and witnessing questionable practice.

3.5.2.1. Autonomy

Gaining informed consent is key in protecting participants' rights and autonomous choice (Beauchamp and Childress, 2001). Ethical boards often request that participant information sheets (PIS) be provided along with consent forms to ensure this process has been carried out. Participant information was designed in the form of two separate PIS (Appendix 5 and 6), emailed to potential actors and placed in the CLE before my arrival. These provided slightly different information to both students and radiographers to ensure that the information would be relevant to their roles. I talked through these PIS in research briefings and offered the opportunity for any questions. In addition, I designed research posters to put up in staff areas and public areas (Appendix 7 and 8). When entering the field, there were still individuals who were unaware of my purpose, and in these instances, I talked through my aims and offered them the chance to read the PIS and ask further questions.

Advanced consent in a written format is often considered to be problematic and sometimes referred to as 'deceptive' in ethnographic work (Bell, 2014; De Koning et al., 2019). The Association of Social Anthropologists (ASA) (2021) explain the issues with collecting consent in advance, due to the flexible, long-term, and evolving nature of ethnography, and also the tendency to conflate consent with *written* consent. Some research ethics organisations argue that insisting on written consent can feel like an attempt to legalise or formalise the consenting process for actors (Canadian Interagency Advisory Panel on Research Ethics, 2020). It can also be argued that asking for consent in this way could feel official and final for actors, indicating that this is a singular process rather than one which was to be ongoing throughout months of observations and before interviews. As ethnographic research progresses, so do the research objectives (Hammersley and Atkinson, 2019); as such, a consent form signed at the outset of a study may not detail these altered priorities months later. Equally, an actor may not be able to fully comprehend the impact observational research will have on them at the outset of a project.

Consequently, the consent process in this study was ongoing, and the discussions I had with actors about my objectives evolved and changed, ensuring that they were fully informed. This is aligned with the principle of process consent (Tolich and Tumilty, 2020). This allowed for study aims, design, ethical implications, and risks to be stated at the start of the study in participant information and briefings, but were also refined throughout, through ongoing dialogue. This approach was used to give actors a sense of autonomy and interest in the research through understanding how their input was directing the research priorities, which is considered a strength of ethnographic research (O'Reilly, 2009). However, ethnographers have to balance this

transparency and ongoing consent process with immersion in the field and ensuring actors are not reacting to being observed (Hammersley and Atkinson, 2019). Considering these factors, an 'opt-out' approach to consent was taken and informed consent was gained verbally when I first met actors, and then again if I hadn't seen them in the field for a few weeks (Association of Social Anthropologists, 2021; Cardillo et al., 2018). I maintained a conscious approach to observations, whereby if I had the sense that someone did not want to be observed or there was a particularly stressful situation, I would either move away from that area or again verbally confirm consent to observe. Written informed consent was gained using consent forms (Appendix 9) before semi-structured interviews, as these instances of data generation were more isolated and concerned specific themes.

Through participant observation, there are instances where people other than the actor sample enter the field and, as such, the observational vicinity (Strudwick, 2021). In this study, the public, patients, carers, and other healthcare workers moved in and out of the CLE all the time. The issue of autonomy for the public is addressed by the Royal College of Nursing (RCN) (2009), which states that, in some instances, written consent is not practical with people coming into the observational setting. Ethnographic researchers often counteract this with the use of informative posters in the field setting, which were used in this study (King, 2019) (Appendix 7 and 8). In instances where patients were interacting with actors under observation, for example, during an X-ray examination, consent to observe the examination was sought by me, asking the patient if I could observe their procedure. When asked for further information, I would state that I was a qualified radiographer and researcher, that the focus of the observation was on staff and students only, and that no data concerning the patient was to be collected.

It was made clear to all potential actors that they were under no obligation to take part in the research and that they could withdraw at any time. I was initially concerned about the potential for people to withdraw their consent, as this is known to cause difficulties in ethnographic research, as actors work within a collective, so withdrawal can mean observation of the collective is impacted (Delamont and Atkinson, 2018). However, there were no withdrawals throughout my time in the field, and actors were keen to participate and discuss their experiences.

3.5.2.2. Justice

Research must be conducted in a way which promotes fairness, avoids exploitation, and ensures equity amongst participants (Orb et al., 2000; Beauchamp and Childress, 2001). In ethnography, specifically, power relations and hierarchies need to be accounted for more

stringently, particularly in health and education settings (Hammersley and Atkinson, 2019). Researchers must also be conscious of how their own positionality may impact the actors' sense of autonomy in deciding to participate in the study (Karnieli-Miller et al., 2009). In this study, I was reflexively aware of the potential for actors to feel obliged to participate due to my assistant lecturer and radiographer roles. In my teaching role, I predominantly taught on foundation and postgraduate courses in which students are not part of the sample for my study. However, I did conduct a nominal amount of teaching and assessment with the UgDR students, potentially encouraging students to perceive me as their teacher. Although this was a possibility, few student actors remembered me teaching them and more so 'knew of' me, mitigating for the potential power dynamics which may have arisen if I were a more prominent teaching figure. Contrary to this, as a PhD student and 'outsider' to the CLE, there seemed to be a feeling of solidarity with the students, which assisted in building a rapport and gaining critical insights into the outcomes of this research. Similarly, during observations, I was conscious of CLE staff feeling as though they were being assessed in their clinical radiography practice and ability. I feel this was a concern at times when I first met individuals; however, I assured them through PIS, research briefings, and consenting discussions that my focus was on the KS interactions between them and students.

3.5.2.3. Non-maleficence and beneficence

The ethical principle of nonmaleficence requires researchers to avoid causing harm to participants, whether physical, psychological, or social. This principle is especially complex in ethnographic research within healthcare and educational settings, where the researcher is immersed in the field over extended periods and witnesses unfiltered behaviours. As a registered diagnostic radiographer, I am aware of the ethical principles of beneficence and non-maleficence (Beauchamp and Childress, 2001), however, doing no harm is an interesting concept in social science research. Harm in observational research is likely to be emotional or psychological, rather than physical (Green and Thorogood, 2018). Furthermore, De Koning et al. (2019) argue that vulnerable members of a group may come to experience this harm if those in power positions are not questioned or challenged in their processes or beliefs. In this instance, they state that a researcher's responsibility lies with those in marginalised groups. Through this research, I experienced questionable opinions or practices which disadvantage students, staff, and patients in the CLE. In these cases, I practised reflexivity and discussed them with my supervisors, and although none of these cases warranted challenging in the moment, I aim to advocate for these groups through the outcomes of my research.

I was conscious that there may be other instances during observation which required me to intervene, through my professional and ethical obligations (HCPC, 2023). I had extensive discussions with gatekeepers to outline the circumstances where I would raise concerns. It was concluded that if there were patient safety concerns or a risk to the public, staff, or students, I would intervene and report this to the gatekeepers and/or the clinical site lead in the CLE. Fortunately, there were no instances where I had to directly intervene, although there were instances of questionable practice that I raised with the clinical site lead. The PIS documents informed actors of this obligation, and it was further instilled in the participant briefings.

I was also perceptive to sensitive situations and actor cues, which required observations to be curtailed during particularly strained situations and resumed at an alternative time (Rea-Holloway and Hagelman, 2020). I was also prepared to adapt interviews or stop them if actors became distressed due to the discussion of sensitive or traumatic experiences; however, this was not required. Support was offered to actors in the form of contact information for the supervisory team on the PIS. Student actors also had access to placement liaison tutors and personal tutors who were all made aware of the research, and radiographer actors were able to speak to the gatekeepers if required.

Risks to actors' privacy were minimised due to an extensive data management plan. Data was generated and managed in accordance with relevant policies (BCU, 2023; Data Protection Act, 2018; GDPR, 2018). As per GDPR (2018), the collection of personal data was adequate, relevant, and limited to what was necessary. Personal data collected was limited to names, radiographer roles, and student year of study. Only when an actor expressed interest in participating in an interview were email addresses stored. All personal identifiable data was stored in a password protected spreadsheet on a secure OneDrive folder set up by the doctoral research college at BCU (BCU, 2020). Written field jottings were anonymised, with no personal identifiable data, as actors and organisation names were pseudonymised. Digitised field notes were again stored on the secure OneDrive, and anonymity was maintained through pseudonyms.

All interviews were voice recorded with the permission of the actors. One interview was carried out and transcribed through MS Teams; the remaining interviews were carried out in private locations in the CLE. An encrypted dictaphone provided by BCU was used to record these. When interviews were completed, BCU technicians downloaded the data, stored it on the secure OneDrive, and deleted the recordings. I transcribed the recordings and again saved them on the OneDrive. During data analysis, quotes or observations that I felt would identify

individuals due to particularly identifiable phrasing, statements, or actions were considered as not suitable for presenting as part of the findings to further ensure anonymity. In line with BCU's data retention schedule, personally identifiable data will be disposed of on completion of the project, and all non-identifiable data will be retained for 10 years after the completion of the project (BCU, 2024).

As stated, there were potential risks highlighted by the NHS REC, in that I would be exposed to non-actor and patient information in the CLE. For example, patient X-rays and personal information were visible in X-ray rooms where observations were taking place. Risk in this case was minimised by not recording any of this patient information and keeping this confidential as per my professional standards (HCPC, 2023). Additionally, through my honorary contract and communication with the gatekeepers, R&D department, and IG team, it was determined that there was minimal risk in this regard. At times, there was information given to me about other members of staff during discussions with actors. I kept these insights confidential and did not record this information during observations or interviews.

Risks to myself were minimal as observations were conducted with other healthcare professionals present in a secure CLE setting, and I did not participate in any clinical activities in isolation. Although there was the potential to see distressing scenes in the CLE, this environment was not dissimilar to what I was used to in my professional capacity. I was therefore prepared for this and able to manage and ask for help and support when required.

Although participating actors are unlikely to directly benefit from this study, using mindlines to understand how knowledge is developed and shared in the CLE has wider benefits. A novel framework of clinical learning in UgDR education is useful for understanding how the theory-practice gap is negotiated by actors. This framework can also be used by educators and researchers to devise new strategies to share knowledge with students and clinical staff to understand how their actions, inactions, and social interactions impact the development of professional knowledge. This will not only benefit future UgDR students and CLE staff, but also service users and patients in the NHS. The research also has the potential to be transferable to other healthcare professions using CLEs across the UK.

Whilst ethical considerations focus on protecting actors and guiding researchers' conduct in the field, quality frameworks are important when designing research to ensure trustworthiness in the research findings. The two domains of ethics and quality are therefore closely connected as both shaped my methodological decisions and practice throughout the PhD.

3.6. Ensuring quality in ethnography

The discourse around quality in qualitative research creates challenges for researchers planning, undertaking and presenting their studies. Research knowledge is often judged through the positivist terms validity, reliability, and generalisability (Rolfe, 2006). However, Angrosino (2007) suggests that ethnographers should not strive for reliability through the potential replication of data, as a constructivist approach is used. Rather than appraising studies founded in different philosophical perspectives through positivist terms, there have been attempts to set new criteria which allow for the interpretation and flexibility needed for subjective inquiry.

3.6.1. Trustworthiness and validity

The concept of trustworthiness marked a progressive shift away from these positivist traditions of research quality. Introduced by Guba (1981), trustworthiness identifies the four criteria of, credibility, transferability, dependability, and confirmability, which align with the positivist concepts previously stated, to provide a framework of quality in qualitative research. *Credibility*, aligned with internal validity, is said to be enhanced through triangulation of different data, prolonged engagement with participants, and member checking (Ahmed, 2024; Guba, 1981; Lincoln and Guba, 1985; Mays and Pope, 2000). *Dependability*, aligned with reliability, can be achieved through audit trails and clear documentation (Ahmed, 2024; Guba, 1981). *Transferability*, used in place of generalisability, is enhanced by the provision of thick description, persuasive narratives, and purposive sampling (Ahmed, 2024; Angrosino, 2007; Guba, 1981). Finally, *confirmability*, linked to objectivity, can be boosted through triangulation, reflexivity, and member checking (Ahmed, 2024; Guba, 1981; Lincoln and Guba, 1985; Mays and Pope, 2000) and is said to be achieved when the other three concepts are realised (Nowell et al., 2017). These alternative criteria may offer more appropriate practices for qualitative researchers to achieve plausible and contextually relevant findings; however, they are still driven by positivist ideals.

The application of the trustworthiness criteria is debated as inconsistent with ethnographic methodology. As ethnography is an interpretive and social paradigm, the criteria which mirror positivist ideals can inhibit these methods and risk conflating incompatible philosophical standards (Hammersley, 1992). Similar and yet more flexible and subjective criteria can be seen in the field of psychology. Yardley (2000) provides a framework which encourages a more interpretive approach to quality, with heavy emphasis on context, reflexivity, and transparency. They frame the characteristics of good qualitative research as sensitivity to context,

commitment and rigour, transparency and coherence, and impact and importance. Although it may seem pedantic to go back and forth between terminology, there is a sense that Yardley's framework provides certain values for a qualitative researcher to emulate throughout a study. Conversely, the concepts of trustworthiness may inadvertently create a tokenistic approach to research quality.

Qualitative research by nature is subjective, creative, and original. Ethnographic research is even more so as the researcher generates data in the field, adding an additional element of perception and interpretation. It is suggested that ethnographers should align the way they observe and develop FNs with the aims and intended outcomes of the research (Emerson et al., 2011; Greener, 2014). In this vein, they are not determining the truth, rather giving potential perspectives on goings on in the field, although some state that the use of theory and the consistency of how theory is applied improves the quality of a study further (Bradbury-Jones et al., 2016). Ethnographers have further responsibility in being convincing in the presentation of their research, through authenticity, plausibility, and criticality (Golden-Biddle and Locke, 1993). This adds weight to the argument that it is down to the consumer of the research to identify the trustworthiness of the claims the researcher is making, which relies on a researcher being transparent in their processes (Rolfe, 2006).

With the number of moving pieces involved in qualitative research, and the infinite ways in which these can be operationalised, some have suggested that having flexibility in the approach taken would be prudent and truly consistent with the paradigm (Mays and Pope, 2000). It is, however, useful on a practical level to have certain processes and terminology to make efforts towards quality explicit. Although a more flexible and individualised approach to incorporating transparency and reflexivity is also important. I have endeavoured to be transparent about the choices I have made in both the planning and conduct of this research to demonstrate how I have tackled the key issues of plausibility in ethnography. In Table 3.3, I identify the key considerations for quality in ethnography as set out by Hammersley (1992), how these map to the concepts of trustworthiness and validity, and how I have tackled these considerations throughout the thesis (Lincoln and Guba, 1985; Yardley, 2000).

Table 3.3. Ethnographic quality and mapping to thesis

Issues of quality in ethnography (Hammersley, 1992)	**Trustworthiness** (Lincoln and Guba, 1985)	**Qual Validity** (Yardley, 2000)	**Suggestions** (Mays and Pope, 2000; Nowell et al., 2017; Ahmed, 2024)	**Examples**	**Thesis section**
Ensuring findings are plausible and make sense given the evidence	Credibility	Sensitivity to Context	Prolonged contact with actors	Fieldwork / Interviews	3.4.2 & 4.3.2
			Triangulation	Data throughout the findings	Ch 5 & 6
			Critical examination of one's own role	Vignette reflexive epilogues Reflexivity commentary	4.4.2 7.3
Ensuring conduct is consistent/systematic	Dependability	Commitment & Rigor	Audit trail/documentation	Research site file	Not incl
			Ethical approach	Ethical approvals	3.5
Ensuring findings are context driven and meaningful in that setting	Transferability	Impact & Importance	Thick descriptions	Field site/actor descriptions Cultural description	4.2.3 4.2.4
			Persuasive narratives	Vignettes	4.4.2
			Meaningful research questions informed by literature	Literature review Discussion	Ch 2. Ch 7.
Ensuring the researcher acknowledges their part and has represented the field appropriately	Confirmability	Transparency & Coherence	Reflexive journals/statements	Vignette reflexive epilogues Reflexivity commentary	4.4.2 7.3
			Presentation of data in relation to interpretations	Data analysis Findings	Ch 4. Ch 5. & 6.

			Consistency between epistemological and methodological choices	Philosophical and methodological discussions	3.3 & 3.4

3.6.2. Positionality and reflexivity

Reflexivity forms a core part of qualitative research and enhances quality through transparency, theoretical integrity, and plausibility. *Reflexivity*, as opposed to *reflection*, is a process of continuous and dynamic awareness of how values, beliefs, experiences, and methods impact research (Finlay and Gough, 2003). Maso (2003) argues that reflexivity is not only a tool to explore the researcher's subjectivity but also allows the development of a project that is inherently significant to the researcher. Reflexivity also has further purpose and meaning in this study as it is a process whereby a researcher can identify and externalise their tacit thinking in the bid for transparency (Charmaz, 2014). This is supported further by Enosh and Ben-Ari (2016), who contend that it is a process geared towards making hidden knowledge more evident. Reflexivity is therefore an integral part of my research and is designed not only to ensure transparency but also as a way to create and interpret my own knowledge of the field.

My personal and professional background and experiences are highlighted in Chapter 1 and shape my positionality in this study. As a qualified diagnostic radiographer with over 10 years of experience and a history of roles in clinical radiographer education, I inevitably hold preconceptions that have, no doubt, impacted all aspects of this research. My positionality has not only affected my interpretation of the data but has also been a driver for this doctoral project. I have witnessed first-hand the cultural attitudes towards UgDR students in practice, as well as a reluctance to embed new knowledge from a variety of sources. These experiences informed my sensitivity to the dynamics explored in this study.

Many authors have provided discussion of how to *do* reflexivity. In qualitative research, carried out through a constructivist lens, the researcher can be considered as the research instrument (Dodgson, 2019). Therefore, it was important for me to consider how my positionality was influencing my research conduct from identifying a research gap, through carrying out observations, to writing the last section of the thesis. I have considered these musings to be *in the moment* reflections, consisting of how my assumptions, experiences and emotions are affecting the research conduct, and how my presence may have influenced actors' behaviour (Finlay and Gough, 2003; Pillow, 2003). Additionally, consideration of how interpretations were made and pursued allows for enhanced credibility (Lichterman, 2017), which I developed through *looking back* on my data and research conduct. Finally, it is important to use reflexivity to *zoom out* from the "doing" of research and look at the wider impact of the self. Reflexivity is stated as an ongoing process where the researcher moves between being embedded within the phenomenon and stepping outside it (Berger, 2015; Enosh and Ben-Ari, 2016). Therefore, presenting my own role in creating the data and subsequent findings is important in identifying

analytical and epistemological consistency (Finlay and Gough, 2003; Pillow, 2003). By synthesising the debates and guidance around reflexivity, I developed a framework which facilitated being reflexive and demonstrating reflexivity throughout this thesis. This framework can be seen in Table 3.4.

Table 3.4. Reflexivity in practice mapping to the research process
(developed from: Finlay and Gough, 2003; Pillow, 2003; Berger, 2015; Lichterman, 2017; Dodgson, 2019)

	When during research	**Examples**
In the moment		
What assumptions are guiding my research?	Literature review	
What emotions/thoughts am I experiencing?	Data Collection	Field notes Research Journal
What meaning am I making from this?	Data Collection	Field notes Research Journal
How is my role as a researcher influencing the actions of actors?	Data Collection	Field notes Research Journal
Looking Back		
Have my initial interpretations changed from the original data?	Data Collection Data Analysis	Reading data Reading vignettes, Research Journal
Are there any alternative perspectives to consider? How might a different researcher/person interpret this?	Data Analysis / Write-up	Reading data Reading vignettes, reading wider literature
Zooming Out		
Is there transparency in how my own perceptions have shaped the research process?	Research Design Data Analysis Write Up	Developing methodology Writing and Editing / Thesis
Are my reflections critical, analytical and relevant?	Write Up	Writing and Editing / Thesis

Reflexivity has therefore been a sustained and iterative process to ensure transparency, credibility, and theoretical consistency. These reflexive prompts are used in the following Chapter to externalise my own tacit experiences and knowledge, developed from being embedded in the field. Subsequently, I have been able to critically engage with my assumptions, reactions, and interpretations, which enable readers to interrogate the research and attribute meaning to the findings.

3.7. Chapter summary

In this chapter, I outlined my philosophical stance, theoretical orientation, and methodological approach. With the foundations of critical constructivism and mindlines theory, ethnography has been justified as a suitable approach for the exploration of the research questions. I justify the data generation methods, sampling design, and the ethical and quality considerations to ensure a credible and trustworthy approach. Collectively, these choices were invaluable in identifying the tacit, situated, and relational nature of KS in the CLE. The following chapter translates these foundations and design into practice through my ethnographic fieldwork.

4. Chapter 4: Entering and interpreting the field

"The human species thinks in metaphors and learns through stories." - Mary Catherine Bateson

(Flickinger, 2021)

4.1. Chapter introduction

In this chapter, I build on the discussion in Chapter 3 by outlining how I applied the methodology and methods in the field. I begin with a thick description of the field and actors, establishing the organisational context in which the research was conducted. I detail the research schedule and how I generated the data through participant observations, FNs, and interviews. I discuss my data analysis process from initial coding to the resultant thematic interpretations. To capture the complexity and contextual nature of the data, four in-depth narrative vignettes were created. These are included in this chapter and depict real situations developed and dramatised from FN data. Interview data were incorporated into the analysis and used in an explanatory capacity for themes to be discussed in Chapters 5 and 6. I treated analysis as an ongoing and recursive activity which moved beyond coding and thematising data points, towards consistent immersion and reflexive interrogation of both the data and me, as the data generation instrument. This process has created a rich, situated account of how knowledge is created and shared in the CLE at Teaching Hospital.

4.2. Entering "Teaching Hospital"

4.2.1. Recruitment

Recruitment of Teaching Hospital and the actors within required careful relationship building with the gatekeeper for me to gather information and garner access. Due to the transient nature of the CLE with staff working different shift patterns and students coming and going in their placement blocks, different strategies were used for recruitment and providing research information. Students were contacted through their academic tutors with research information, PIS, and an invitation to an online research briefing. CLE staff were contacted via the gatekeepers, providing similar information and briefing invites. Online briefings were chosen to maximise attendance and accommodate different working patterns. However, attendance was limited, and therefore recordings of the briefings were sent by email via the personal tutors at the HEI and gatekeepers at Teaching Hospital, although it is unclear how many actors watched these. I also attended a staff meeting at the CLE before the research commenced to deliver a

briefing in person, which had higher attendance. In addition, posters were provided across the CLE and PIS were placed by gatekeepers for staff to peruse when working in clinical areas. Despite these efforts, many potential actors were unaware of the research when I arrived to commence my fieldwork. As such, information was shared on an individual and small-group basis when encountering new staff, as per the discussed consent conversations in section 3.5.2.

4.2.2. Organisation of Teaching Hospital and the CLE

Teaching Hospital is an acute general NHS hospital in an inner-city area in the Midlands region. The hospital forms part of a large teaching trust and provides a range of services for a diverse population. Imaging services at Teaching Hospital cover examinations such as general X-ray, CT, MRI, ultrasound, nuclear medicine, and interventional radiography. General X-ray procedures, which are the primary focus of student training and this research, are carried out in three different areas in the hospital. The general X-ray department, primarily for inpatients, the emergency department (ED) X-ray, located next to the ED for patients attending from accident and emergency, and the outpatient X-ray department, primarily for patients attending the hospital for their X-ray only. Each area has two general X-ray rooms with a central area for staff discussion and administration work. Traditionally, this area would have been used for viewing X-rays when they had to be processed, like photos in dark rooms, and latterly when images would be viewed on separate processing equipment. However, due to advancements in imaging technology, X-ray images now immediately appear on the computer screens in the X-ray rooms themselves and do not need to be viewed in this separate space. This communal area, therefore, has a legacy name of the “viewing area”. General X-ray and ED X-ray layouts are shown in Figure 4.1. and Figure 4.2, the outpatient X-ray department was similarly designed to ED X-ray.

Patients are generally referred to X-ray by clinicians in the hospital or their GP. These referrals are called X-ray ‘requests’. These are vetted by radiographers to determine if the request is appropriate and in line with radiation regulations (Department of Health and Social Care, 2017). Generally, the computer-based radiology information system (RIS) will be used to access these requests, particularly in the case of inpatients, ED patients, or patients referred from hospital-based outpatient clinics. Occasionally, a patient will attend with a paper-based request from their GP, which will be scanned onto the RIS for subsequent vetting. The RIS will be scrutinised to find out the clinical question to be answered, patient symptoms, and previous imaging procedures undergone by the patient. This is to ensure that the potential radiation dose needed

for the procedure is justified. In this way, an X-ray request is similar to a prescription for medication; however, the prescription is for a dose of radiation.

General X-rays can be requested for procedures all over the body, from the most common, chest X-rays, to more obscure ones, such as sacroiliac joints (see section 4.4.2.5). Reasons for imaging range from coughs, shortness of breath, pain, trauma, and mobility problems with various diagnoses, including cancer, infection, bone fractures, dislocations, and arthritic processes. Each X-ray procedure performed on different body parts has criteria for what constitutes a diagnostic image, and those performing X-rays need specialist knowledge of these techniques to ensure this is achieved. General X-ray, therefore, serves as a versatile catch-all tool for patients requiring health investigations. Consequently, students tend to spend the majority of their time in these areas to hone their radiographic technique for all different body parts and patient needs.

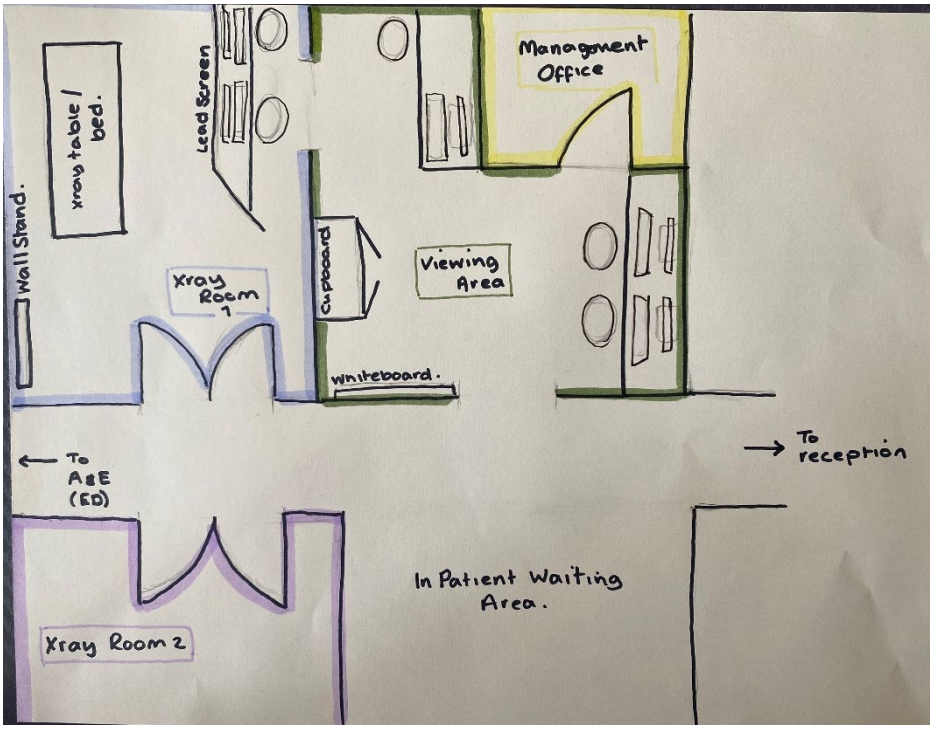

Figure 4.1. General X-ray department floor plan

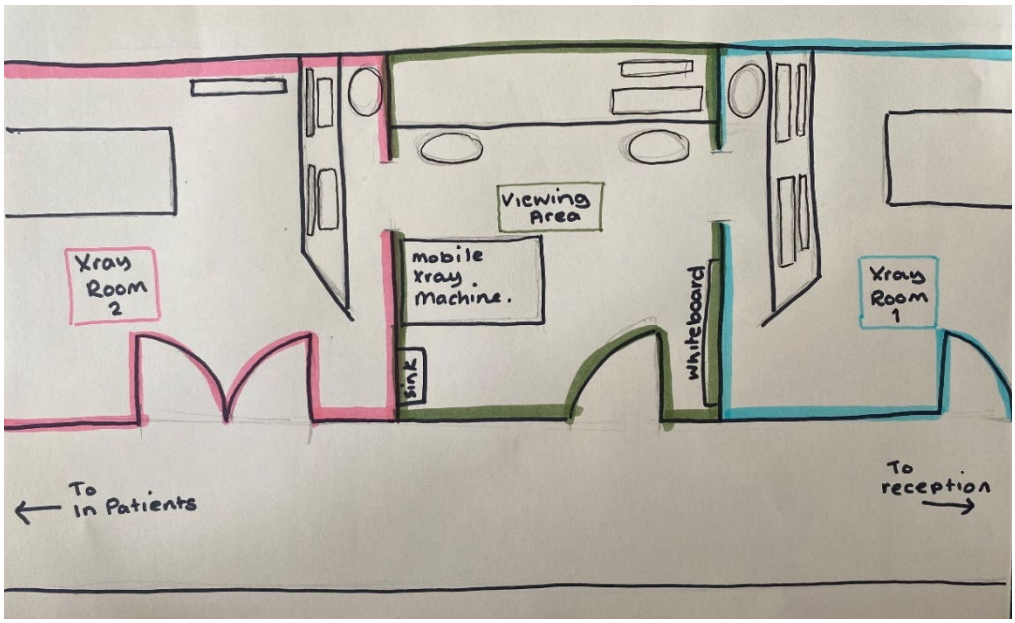

Figure 4.2. ED X-ray department floor plan

4.2.3. Actors and organisational roles

The UgDR CLE at Teaching Hospital incorporates a range of staff roles and responsibilities as previously discussed in the sampling sections. The organisational structure and reporting lines for these roles can be seen in Figure 4.3. Staff who carry out the majority of the patient-facing radiographic tasks are APs and radiographers. As students are focused on honing these patient-facing procedural skills, they spend their time in the CLE working alongside these groups of staff. As radiographers progress in their careers, they branch away from these general X-ray roles, either into other imaging modalities (outside the scope of this research) or into management, educational, or advanced clinical roles.

At Teaching Hospital, there were clinical lead radiographers who were seen sporadically throughout the day when they were needed to cover staff shortfalls or talk to individuals. Otherwise, they would carry out managerial or administrative duties in the management office. PEs were similarly seen intermittently working alongside radiographers or students. There were some senior radiographers who had supplementary responsibilities as part of the PE team, and these staff were more often seen working clinically. AdPrs and consultant radiographers, who are considered experts in general X-ray due to their roles in the diagnostic reporting of X-ray images, worked in offices in isolation, carrying out their reporting duties. I therefore observed these groups of staff the least, and when they were present, it was often in an advisory or social capacity rather than to carry out clinical tasks. Administration staff and auxiliary staff, including

imaging department assistants, although critical to effective service provision and patient care, had a limited impact on KS between radiographers and students and therefore are considered out of the scope of this research.

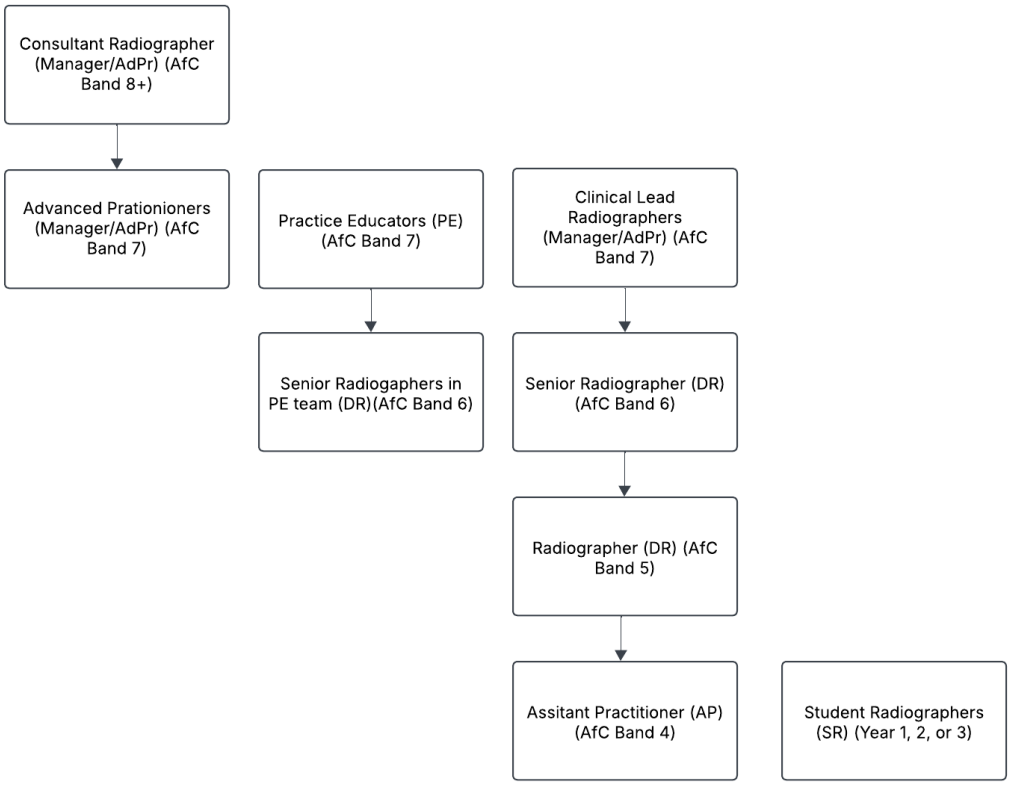

Figure 4.3. Teaching Hospital radiographer CLE organisational structure

Students would attend for their placements at Teaching Hospital in 3-6 week blocks, which were dictated by the sponsoring HEI. Therefore, there would be one year group placed at the CLE at any one time and observations were carried out across all year groups. This allowed for observation of similarities or differences in KS across these groups. Students would be given a rota for their placements, organised by one of the PEs. Shifts varied between 8 hours and 12 hours, and students would work across the 24-hour period, 7 days a week. Students would often be assigned to a specific radiographer and X-ray room where they would spend the majority of their time assisting with and carrying out imaging tasks. Students also referred to paper-based clinical portfolios, which differed depending on their year of study. These portfolios included their block placement rota, lists of clinical tasks or competencies, assessment forms, and feedback and reflective sections to be filled out by radiographers and themselves.

Over the course of my field work, I interacted with over 70 staff and students who were recruited as actors. Some of these individuals were considered key actors and have been included in vignettes and were asked to participate in interviews. Key actors were identified inductively

throughout the fieldwork and initial data analysis. Among CLE staff, key actors were those who appeared to wield significant influence within the setting and were often observed interacting with students. These individuals were either central to KS and decision making in daily practice, or positioned to be by the organisation, in the case of the PEs. Regarding students, key actor status was determined by the frequency of contact and visibility in the field, particularly when requesting their participation in interviews. In this sense, the designation of "key actor" reflects relational prominence and observed influence rather than through formal criteria. A breakdown of actors, their roles, and their involvement in subsequent vignettes (section 4.4.2) and interviews (IV) can be seen in Table 4.1. and 4.2.

Table 4.1. CLE staff actor list

Note: DR prefix denotes staff pseudonym; SR prefix denotes student pseudonym

Pseudonym	Role	Key Actor	Pseudonym	Role	Key Actor
DR1	Radiographer		DR28	Radiographer	
DR2	Radiographer	V3	DR29	PE	
DR3	Radiographer		DR30	AP	
DR4	PE	IV	DR31	Radiographer	
DR5	PE	IV	DR32	Radiographer	
DR6	Radiographer		DR33	Radiographer	
DR7	Radiographer	V4 / IV	DR34	Radiographer	
DR8	Radiographer		DR35	Manager / AdPR	V2
DR9	AP		DR36	Manager / AdPR	
DR10	Radiographer		DR37	Radiographer	
DR11	PE	V2	DR38	Radiographer	
DR12	Radiographer		DR39	Manager / AdPR	V3
DR13	Manager / AdPR	V1 / IV	DR40	Radiographer	
DR14	AP		DR41	Radiographer	
DR15	Radiographer		DR42	Radiographer	
DR16	Radiographer		DR43	Radiographer	
DR17	Radiographer		DR44	Radiographer	
DR18	Radiographer		DR45	Radiographer	
DR19	Radiographer		DR46	Radiographer	
DR20	Radiographer		DR47	Manager / AdPR	
DR21	AP	V2	DR48	Radiographer	
DR22	Radiographer	IV	DR49	Radiographer	
DR23	Radiographer	V4	DR50	Radiographer	
DR24	Manager / AdPR		DR51	Radiographer	
DR25	Manager / AdPR		DR52	AP	
DR26	PE		DR53	Radiographer	
DR27	Radiographer				

Table 4.2. Student actor list

Pseudonym	Study Year	Key Actor	Pseudonym	Study Year	Key Actor
SR1	2		SR10	3	
SR2	2		SR11	1	IV
SR3	2	V1 / IV	SR12	1	V4
SR4	3		SR13	1	
SR5	2	V2	SR14	1	
SR6	2	V2	SR15	3	
SR7	3		SR16	2	
SR8	3	V3	SR17	2	
SR9	3		SR18	2	

4.2.4. The cultural landscape of Teaching Hospital

Although the organisational structure outlined above provides clarity around the environment and roles apparent in the field, to provide further thick description, I will now depict the embedded culture of Teaching Hospital. This landscape influenced not only how actors interacted and shared knowledge but also how outsiders were, or were not, welcomed and how students perceived their participation.

Clinical practice was frequently organised around maintaining an efficient workflow and meeting throughput demands, with interactions among actors initiated by the imperative to complete X-ray examinations as efficiently as possible. This was underpinned by radiographers waiting in X-ray rooms and checking for patients to arrive, and seeking out help and further knowledge when something prevented them from being able to carry out their patients' X-rays. Conversations also frequently revolved around staffing levels, which would prevent X-ray rooms from being fully staffed and, therefore, resources from being used efficiently. Although there was no absence of welcome or goodwill towards students, the perception was that they were to fit in around this culture of workload efficiency, rather than interactions being pedagogically motivated. This provided a sense of opportunistic learning, which occurred during lulls in the primary workload or when they were organically embedded within the ongoing clinical task. As a result, intentional knowledge sharing was initiated to aid in getting the job done with limited thought to pedagogical explanation.

This culture was reinforced by the spatial organisation of the department, whereby radiographers and students would remain within their designated X-ray rooms rather than regularly circulating through communal areas. This was not always due to workload demands, as actors would often remain in these rooms, checking the computer waiting lists for patients to arrive. This is particularly amplified due to the technological advances of digital radiography, as

there is no longer a need for actors to move in and out of communal "viewing areas" to process their images. This shift has reduced opportunities for informal interactions and for the incidental overhearing of knowledge sharing taking place between other actors. Instead, these legacy areas now serve as an administrative space for more senior radiographers to work on the computer, answer the phone, and be available for queries when radiographers need advice, with students remaining in the X-ray rooms in these instances. Individual X-ray rooms, therefore, functioned as micro-environments in which learning occurred primarily through observation and imitation, rather than through sustained collective dialogue between actors. Although informal exchanges and advice were shared, there was limited visible opportunity for collective reflection across rooms or the development of a shared repertoire that extended beyond these isolated spaces.

Radiographers with advanced knowledge in terms of education and experience, particularly AdPR's, were often spatially separated from routine clinical work. These actors have extensive knowledge in both the practicalities of X-ray imaging and the theoretical and procedural knowledge needed in decision making. As they were physically isolated from the clinical areas and sequestered in reporting offices, their expertise was not visible to radiographers and students alike. Consequently, this knowledge was inaccessible unless explicitly sought out.

Similarly, the visibility of students was transient due to their rotational patterns. Students would attend the CLE for on average four weeks at a time, then return to carry out university-based learning for another four to six weeks on a rolling basis. Generally, students would be placed in one area, for example, general X-ray or ED X-ray (see figures 4.1 and 4.2) every week, and due to radiographer rotas, they could work with different staff every day during that week. Shift patterns for all actors varied between eight and twelve hours, across a 24-hour, 7-day-a-week service. This created an environment and relationships which were fleeting rather than stable. Working relationships between radiographers and students were often short-lived and bound by the clinical tasks they were carrying out together. While rapport was apparent in many cases, continuity of this rapport was not guaranteed. Additionally, the extent to which questioning and dialogue were encouraged varied between individuals and shifts, suggesting that the safety of participation was not a cultural norm.

This cultural landscape suggests that while radiographers worked collaboratively for the purpose of task efficiency, the broader CLE did not consistently operate as a sustained learning space in which outsiders, or students, were integrated into a stable collective community. Participation was structured around task completion and rota allocation, with variable

continuity of relationships. As explored in later chapters, these conditions shaped how knowledge was shared and accessed.

4.3. Data generation

4.3.1. Research schedule

Data generation was carried out over a period of four months in three phases. Observations were carried out 2-3 times per week, lasting 4-6 hours at a time. After discussion with the gatekeepers, it was decided that I could observe between the hours of 8 am and 8 pm, Monday to Friday. At these times, there would be managerial support if needed, and staff who were working outside of these hours wouldn't feel undue pressure due to observations at times when staffing levels were lower. Due to the vast amounts of FN data accumulated during observations, it is recommended that time is deliberately scheduled for data management immediately after observation periods (Angrosino, 2007; Coffey, 2018; Conroy, 2017). Observation periods, which were shorter than normal shift patterns, were therefore justified to spend time immediately afterwards to expand on FN jottings and develop my detailed descriptive and reflexive FNs. This structure allowed for observations across all actor groups and allowed adequate time for embedding myself within the field.

The research schedule was designed in three flexible and overlapping phases. It is important for ethnographers to carry out a period of *familiarisation* (Rea-Holloway and Hagelman, 2020), which took place in the first 4 weeks. At this point, I focused on meeting most of the CLE staff and students to ensure they knew about and understood my research and purpose. I focused on building rapport with the actors and developing preliminary descriptive FNs, which helped to identify areas for further exploration in the second phase. Subsequent observations were guided by this initial phase and carried out during the following 8 weeks. Towards the end of this phase, I began to recruit actors for semi-structured interviews, which formed my final phase of in-field data creation. Time was spent out of the field between phases to allow for data analysis and reflexive practice. Initially, data generation was expected to last over 6 months; however, due to delays in ethical approval, time pressures on this full-time mode of study, and a sense of adequate information power, discussed in section 3.4.3, the data generated were deemed adequate to address the research aim. In total, I spent 104 hours in the field carrying out participant observations. This phased approach is illustrated in Figure 4.4.

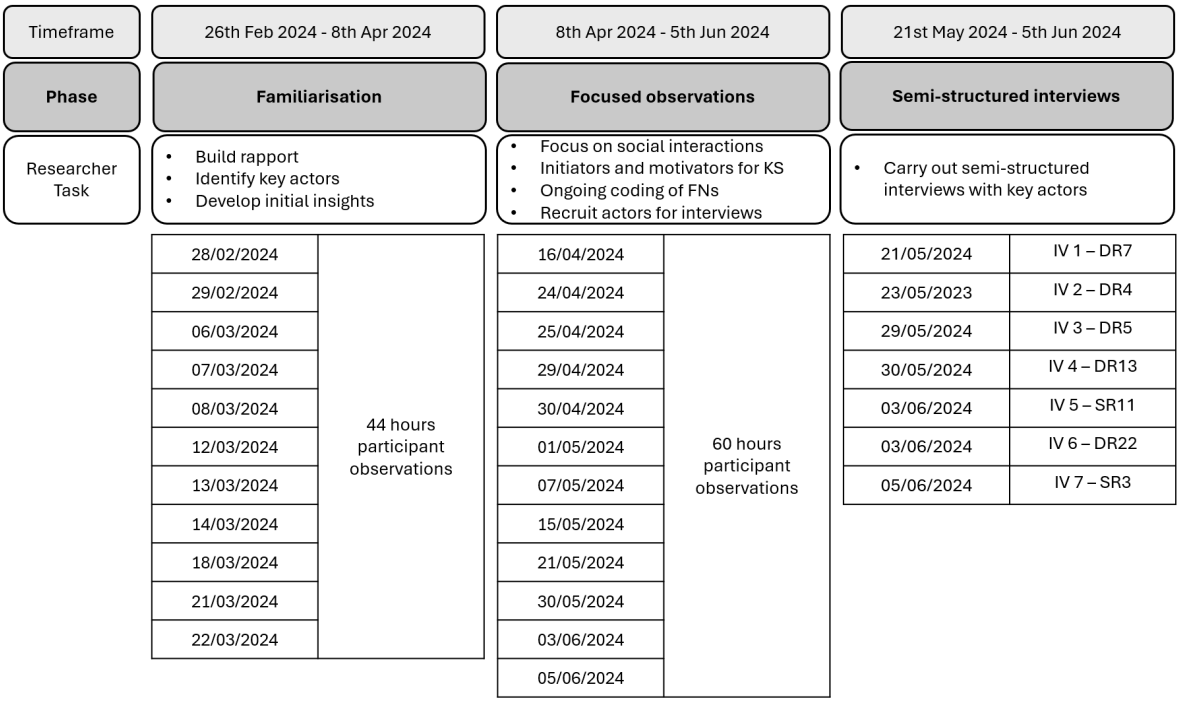

Figure 4.4. Research phases, observations, interviews and tasks

4.3.2. Application of data generation methods

4.3.2.1. Participant observation and field notes

My observer-as-participant position was managed and balanced prospectively in discussions with my supervisors and gatekeepers, and throughout data generation through reflexivity and actor discussions. To ensure I was seen as part of the team, I wore a clinical uniform similar to that of actors and wore a badge stating my role as a researcher. I was provided with an honorary contract and carried out a full trust induction, which included occupational health screening, organisational, and clinical training. This allowed me to participate in limited clinical activities under supervision, such as setting up and tidying away equipment, assisting with manual handling, and cleaning. I also participated in the daily schedule of the actors, joining them for break times, meetings, and when travelling between departments in the hospital. These activities supported my aim as an ethnographer to embed myself as part of the team whilst maintaining the ethical responsibility of transparency around my researcher role.

Initially, my jottings were guided by a rough field guide which aligned with my research objectives. Guidelines for ethnographic observation focus on space, actors, objects, acts, events, time, goals, and feelings (Spradley, 1980). These dimensions were used alongside other insights on observations to develop my own questions and principles, which were copied into my jottings notebook, which can be seen in Figure 4.5. I developed two types of FNs:

contemporaneous jottings, which were taken discretely in the field, and expanded descriptive and reflexive FNs written up digitally directly after observational periods.

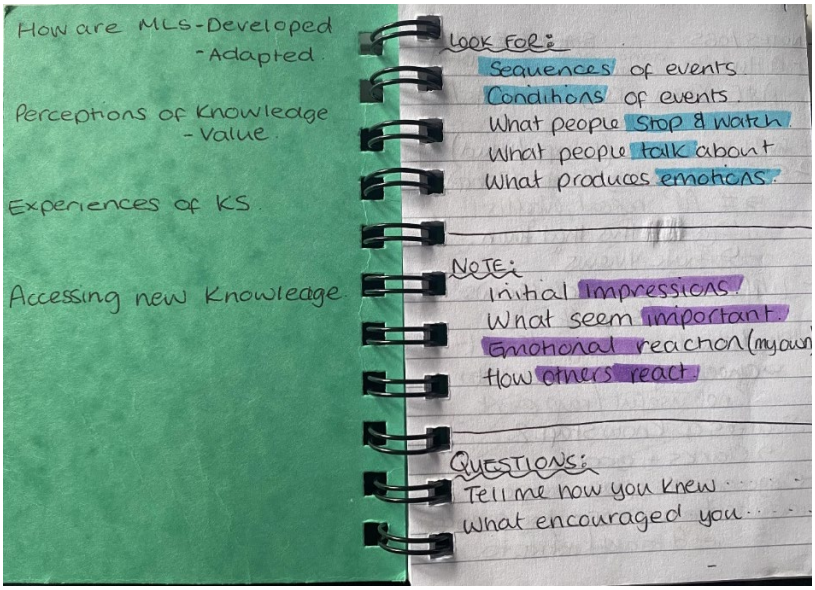

Figure 4.5. Field observation guide

4.3.2.2. Interviews

Interviews were conducted with key actors, whom I had worked with during my time in the field, in the final phase of field work, see Figure 4.4. At this point, I had developed a strong rapport with actors and an understanding of the field from my prolonged immersion in the field; this allowed for my interview questions to be grounded in my observational data rather than my own assumptions (Angrosino, 2007; Spradley, 1979). Theoretical sampling, carried out through judgement and opportunity, was used to ensure actors participating in interviews had meaningful insights (Gupta et al., 2024; Hammersley and Atkinson, 2007). I approached these actors during periods of observation to ask if they would be willing to participate in the interviews.

Throughout the fieldwork, I cultivated a good rapport with actors, which aided in the informal tone of the interview. To further support this comfort and openness, I was attentive to my manner, the pace of questioning, and actor cues (Hammersley and Atkinson, 2019). I developed the interview questions (Appendix 10 and 11) following Spradley's (1979) categories of grand tour, mini-tour, examples, and experiences. Grand tour questions were asked to ease actors into the interview, asking their perspectives on their roles and their everyday activities. This allowed me to develop a sense of whether my perceptions of day-to-day events were similar to those of actors. These then led to mini tour questions about certain intricacies, which were aligned more with social interactions and knowledge development or sharing. I offered actors examples of specific observations in order to elicit their perceptions and also asked them about

their experiences of education and educating in the CLE. The loose interview guides for students and staff were supplemented with additional probing questions when I wanted to glean more depth (Coffey, 2018).

As it was important for clinical work to remain undisturbed, it was agreed that the clinical lead radiographer would be made aware of the interviews to arrange a time for the actor and me to conduct the interview. This also encouraged actors to participate instead of having to sit for interviews in their own time. Interviews were carried out in either private offices, seminar rooms, on MS Teams, or an X-ray room, which was not in use. It proved difficult to recruit student actors for interviews as contact with them was intermittent due to their shifts, block rotas and time in other modalities. Therefore, formal interviews were carried out with more radiographers than students. However, this was compensated for, as during observations, students had more time for informal conversations with me than radiographers did due to their clinical workload. These informal conversations offered a rich insight into actor perspectives and tacit reasoning (Fetterman, 1998) and were recorded as part of my FNs. These more natural interactions, along with more formal interviews, allowed for triangulation of findings across the CLE community.

4.3.2.3. Reflexive Journal

Documenting my reflexivity in a journal formed the final aspect of data generation in this study. Reflexive practice supported and tracked the ways in which I co-constructed knowledge with actors (Emerson et al., 2011). Furthermore, it gave me an opportunity to explore my own evolving emotions, experiences, and positionality, demonstrating shifts from my outsider to insider position (Berger, 2015).

Given the critical constructivist approach in this study, the reflexive journal was a mechanism for questioning how the data was being shaped and generated by me as the research instrument. Beyond this, the journal was also used to develop and explore analytical insights. This became critical during data analysis as I often returned to the journal to determine why I had perceived a certain interaction that way, as my understanding changed throughout the time in the field. Practically, I wrote reflexively after every session, when thoughts about my time in the field would pop up unwarranted in my head and again during data analysis. My journal was kept digitised and separate from empirical data, guiding and framing further data generation to explore the ideas in the field (Lichterman, 2017). This practice, therefore, contributed directly to the trustworthiness of the study through transparency of interpretations and documentation of decisions (Lincoln and Guba, 1985; Yardley, 2000).

4.3.3. Data corpus

Data comprised of a combination of FNs and interview transcriptions (Table 4.3). Field notes form most of the data and illustrate situations, interactions, and informal discussions which were witnessed during participant observations. Within jottings and subsequently field notes, I recorded reflexive and analytical insights which were directly related to the descriptive notes from observations and interactions in the field. These differed from my reflexive journal, which contained broader reflections on the research process, my evolving positionality, and interpretations of the research questions as a whole. This distinction between field notes, both descriptive and reflexive, and my reflexive diary allowed me to separate my in the moment analytical thinking from more meta considerations and ponderings. The questions and insights which I documented in these notes formed the basis for further observations and focused my field work. This process is in line with the iterative and inductive nature of qualitative methods and ensures data generation is empirically grounded (Green and Thorogood, 2018; Hammersley and Atkinson, 2019). In addition to observations, I conducted seven semi-structured interviews, which lasted between 30 and 50 minutes and were digitally transcribed. Together with my reflexive journal, these data form a rich and contextually sensitive account of knowledge creation and sharing in the CLE.

Table 4.3. Data sources table

Data Category	**Description of data**
Field Notes (n = 23)	Digitised descriptive notes developed from in-field jottings. Depicting situations and interactions observed during field work. Observations were carried out over a period of 4-6 hours, equating to an average of 2000 words of FNs for each observation.
Interviews (n = 7)	CLE Staff = 5 Students = 2

4.4. Data analysis

4.4.1. Initial coding

Analysis was underpinned by the philosophical, theoretical and methodological perspectives and informed by reflexive, iterative, and interpretive engagement with the data. The complexity of ethnographic data, driven by the intricacy of the social world under scrutiny, creates a somewhat 'messy' process of data analysis (O'Reilly, 2009). In this study, my analysis began

with a process of immersion in the data after the initial familiarisation phase and then intermittently every few weeks throughout field work. I read through the data many times, both sequentially and randomly, to 'review, reexperience, and reexamine' the interactions witnessed in the field (Emerson et al., 2011). FNs and interviews were uploaded to the data management software NVIVO 12, where I began coding (QSR International, 2021). I subsequently developed inductive codes, which were generated with conscious thought to the research aim and questions, and influenced by my own embedded theoretical understanding of KS. This process is endorsed by Braun and Clarke (2021), who state that codes should incorporate some of the researcher's analytical take. These early codes were key to me making sense of the complex data, being able to discuss these insights with supervisors, and subsequently identifying concepts which needed further exploration. This internal and external discourse about the data was key in this study due to the idea that knowledge is both individually internalised and socially constructed. However, while the initial codes were helpful for making sense of the data, they were largely descriptive and lacked the contextual and interpretive depth needed to address the research questions. Through consistent engagement with the data, other ethnographic texts, and supervisory discussions, vignettes were developed to ensure that I could both analyse and present the data in context rather than in isolation.

4.4.2. Vignettes

4.4.2.1. Justification for vignettes

The art of creating narratives from events and happenings, by shifting data from elements to stories, is considered effective for articulating findings persuasively (Jarzabkowski et al., 2014; Polkinghorne, 1995). Vignettes are dramatised scenarios that provide sufficient detail for the reader to imagine and visualise the situation (Bloor and Wood, 2006). In shaping the data to create these stories, a process of "narrative smoothing" must take place (Polkinghorne, 1995).

To remain faithful to the observational data, I grounded my own vignettes in specific observed interactions. They are not fictional or combined accounts; rather, they are narratively constructed representations of particular moments in practice. Whilst the core sequence of events and actors remains authentic, contextual detail not central to the analytic focus was condensed to foreground the practices and sociocultural dynamics most pertinent to the research questions. For example, some interactions unfolded over extended periods of time and were embedded in concurrent tasks, actor movement through the space, and dialogue unrelated to the core event. These elements were not inconsequential; rather, they formed part of the atmosphere in which practice occurred and have been captured in the broader cultural

description of Teaching Hospital (Section 4.2.4). A specific example of narrative smoothing in action is in Vignette 3 (section 4.4.2.5), where overlapping, prolonged, and repetitive discussion among radiographers has been condensed to preserve clarity whilst maintaining the overall integrity of the observed scenario.

It could be argued that the smoothing of data required to create vignettes reduces the credibility of findings. However, as discussed in section 3.6, the aim in qualitative research is for the researcher's assertions to be trustworthy and meaningful, which is assessed by the reader through researcher transparency rather than objective scales and measurements (Hammersley, 1992; Jarzabkowski et al., 2014; Yardley, 2000). The use of vignettes, then, is justified and meaningful in this research, as they provide clarity on the key influences on the actors and the aspects most relevant to the research aim (van Maanen, 2011; Polkinghorne, 1995).

The literature often discusses the use of vignettes to elicit rich data from participants during the collection phase (Barter and Renold, 1999; Finch, 1987; Tremblay et al., 2022; Wilks, 2004). However, in this study, they are used both to support deeper data analysis, as discussed in Section 4.4.3, and to elicit understanding from readers through my storytelling. This allows for the stories to be both representations of observational experiences and mechanisms for meaning-making (Cortazzi, 2001).

I have been purposeful in positioning the vignettes at this point in the thesis to reflect the timeline for the analytical processes. After I had initially coded and had begun identifying recurring concepts, I began drafting the vignettes. The process of writing the vignettes, therefore, formed part of the analytic work itself. In reconstructing these observations narratively, I re-engaged with these moments, interrogating assumptions and re-examining interactional detail that was less visible in field notes. This allowed me to iteratively clarify and examine my working codes and themes based on initial inductive work.

Although the use of vignettes could be considered as highly subjective and entrenched with my own values, experiences, and world views, this is not necessarily a weakness. As discussed in Chapter 3, this in fact aligns with my philosophical and theoretical arguments and ensures I am staying faithful to the ethos of this work. However, qualitative researchers do have a responsibility to demonstrate efforts to ensure quality and trustworthiness, which is discussed in depth in Section 3.6. I have made use of tables throughout this thesis to support transparency in my data generation and analysis (Cloutier and Ravasi, 2021). Additionally, vignettes improve transferability, confirmability and sensitivity to context due to the thick description provided of the setting (Lincoln and Guba, 1985; Yardley, 2000). Furthermore, I

provide a reflexive epilogue after each vignette, which demonstrates how I perceived and interpreted these situations when in the moment, looking back, and zooming out, as discussed in Section 3.6.2.

4.4.2.2. Crafting the vignettes

Although examples of vignettes are seen in other ethnographic work, it is difficult to identify how to develop vignettes from scratch. To again align with the iterative and complex nature of ethnography and knowledge sharing itself, I drew upon the literature focused on ethnographic narratives and creative writing, rather than constraining myself to a fixed framework. There are different styles of ethnographic tales. On one end of the spectrum, *realist tales* focus on description and explanation of the goings on in a given setting; they lack the researcher's voice and push for more objective insights (van Maanen, 2011). Conversely, *impressionist tales* reconstruct the researcher's experience, insights and perspective in a purposeful way (van Maanen, 2011). To align the vignettes to the philosophical foundations of the research, I have aligned my vignettes to the impressionist style.

I began this process by looking at my initial codes to identify regular happenings and occurrences. I hoped these would demonstrate the ordinary moments embedded with knowledge sharing and the sociocultural dynamics apparent to me throughout fieldwork. I selected four instances which highlighted how different situations in the CLE would encourage different types of KS interactions. Although each vignette presents a bounded moment in practice, the dynamics portrayed were observed over several months, across multiple shifts, actors, and spaces.

My initial drafts were deeply embedded with my interpretations and analytical commentary and were not effective in describing the context on a micro level. To tackle this, I turned to creative writing literature to ensure I was developing descriptive accounts and that the reader would feel immersed in the story. The storytelling framework *'Freytag's pyramid',* which is widely used in film and literature, was therefore drawn upon to structure and draft the vignettes (Yang et al., 2022). This framework comprises the concepts of *exposition, rising action, climax, falling action*, and *resolution*, providing a dramatic arc through which to develop a compelling narrative (Freytag and MacEwan, 1900). This literary tool helped me to plot out the story, develop context, emphasise tensions, and depict the subtle dynamics apparent in the CLE. Alongside this, I delved deeper into the data to get a clearer picture of the key actors in each scenario and to unpick their motivations and behaviours. This process helped me develop the actors as characters in these stories, adding further meaning. Throughout my process of "narrative

smoothing", I did not alter events or insert fictional elements; instead, I organised details to highlight analytically significant features of practice. The vignettes were revisited during later analytic stages to ensure alignment with the final thematic concepts.

4.4.2.3. Vignette 1: The one with the markers…

Vignette actors:

Thirteen : DR13 - Manager/AdPr

Three : SR3 - 2nd year Student

Standing in the entrance to the L-shaped space of the inpatient X-ray department, colloquially known as the 'viewing area', I glance at the desk lining the wall to the right of me. Three members of staff sit facing the wall, a senior radiographer and an assistant are using the computers, one looks through a hospital database system, and the other sits silently with a phone to their ear. A porter sits next to them with their elbow propped on the desk, their head resting on their fist, looking towards them expectantly. I walk past them unacknowledged, towards the clunking sounds coming from the archway in the left-hand corner of the room. I take in the walls, which are covered in laminated posters, both fading and new, with various pieces of information from protocols for imaging nasogastric tubes to trust values and staff expectations. I notice the chaotic whiteboard on the wall to my left, detailing phone numbers and a list of staff names and their allocated lunchtime breaks.

As I move further towards the X-ray room, the stark contrast between the bright, unforgiving lights of the viewing area and the shadowy, cocoon-like atmosphere of the X-ray room becomes more apparent. The sharp clinking and electronic beeping sounds of the X-ray equipment start to drown out the bustle of patients and staff walking past the viewing area in the main corridor, and the clipped conversations of the staff sitting at the desk.

Rounding the corner of the archway, I see a student radiographer, Three, come into view. They are quietly perched on a stool behind the imposing windowed 'lead screen' that separates this cramped space, filled with a worktop with two computer screens, from the main X-ray room where a radiographer is busy with a patient. The dim lighting here, along with more posters stuck to the windows, makes parts of the X-ray room difficult to see, although the patient is illuminated by the light emanating from the boxy X-ray machine, which hangs down from tracks on the ceiling and dominates the room. The radiographer grips onto a handle on the front of the machine and, with a click, starts to move it over the patient's foot. I glance at Three, who is

observing quietly, their fingers hovering and twitching slightly over a yellow button by the side of one of the monitors.

The radiographer turns abruptly and strides across the room, slipping behind the screen beside us. Three straightens up on their stool and presses down on the button, the action accompanied by a few electronic beeps, and after a few seconds, the familiar monochrome appearance of an X-ray appears on the screen. The radiographer abruptly moves back into the X-ray room and talks to the patient whilst Three changes some of the settings on the X-ray, altering the orientation so the toes, which were on an angle towards the corner of the image, now face north, and adding a small letter 'L' to the side of the picture. They lean across the worktop and click away on the second computer screen, adding numbers into blank boxes on the patient record. The radiographer slips past me with a friendly smile, back out into the viewing area, and Three continues clicking away on the computer screen.

"How's it been this morning?" I enquire, feeling a sense of responsibility to encourage some interaction.

Three turns to me, eyes lighting up and says, "It's been steady," turning back towards the second computer screen on the left, they click onto a list of patients who have had examinations today, "lots of chests, but that's inpatients, isn't it?"

I give a hum of agreement and look towards the corner of the cluttered worktop where I see a dog-eared booklet which is folded open at a page which looks to be half-filled in with various numbers and notes. I nod towards it, "Have you got much left to do for your portfolio?"

Three's shoulders deflate slightly as they look over at it, "just spines really, but we don't get many of those here, more in A&E."

Leaning against the side of the archway, I hear someone approaching from behind me and turn to see Thirteen(DR), one of the band 7 radiographers. They display a cautious smile and give a quiet, "You alright?" as they glide past me into the X-ray room. I glance back into the viewing area, noticing that it is now empty and glimpse the clock. Midday. Everyone must have gone for their lunch.

Bringing my attention back to the X-ray room, Thirteen is standing, looking at the computer screen when they suddenly state, "There's a chest X-ray waiting. Will you get the patient in, please?" Three abruptly stands from the stool, appearing to understand that Thirteen is directing this instruction at them, despite Thirteen's attention remaining on the computer screen, "Hold on, what are you going to do first?"

Three glances at me nervously, then past Thirteen towards the computer and questions hopefully, “Check their clinical history?” Thirteen nods, moving to the side of the computer, allowing Three to begin looking through the patient’s record.

Three opens different windows, which show various pages of patient information. As they scroll through the information, they stop occasionally to read something in more depth. Thirteen starts to ask various questions: *“What does pneumothorax mean?” “Have you checked previous imaging?” “Is there anything else you need to check?”*

Three delivers uncertain responses, eyes darting around the screen looking for clues, realising some questions are there rhetorically to prompt them into action. Thirteen appears to notice the hesitance, adding with a tentative smile, “You need to check these things, you know, we get loads of radiation incidents of people not checking for previous or that the request is justified” Three obediently nods before Thirteen adds, “ok, you can get the room ready now.”

Three moves to the right in front of the other computer monitor, where the image of the foot appeared earlier, and the new patient’s name materialises on the screen. They then press a button on a remote control and point it into the middle of the X-ray room. Almost magically, the X-ray machine starts making clicking sounds and moves along the tracks on the ceiling over to the corner of the room. In a final flourish, it rotates sideways so the light, which was originally pointing downwards towards the floor, is now pointing at 90 degrees towards a rectangular panel large enough for someone’s torso to fit against.

Three walks out of the X-ray room doors, at which point Thirteen turns to me and advises, “You have to encourage them, you know, otherwise they don’t seem to check all the things they need to.”

I give an agreeable, “yeah, I’ve seen that a bit,” and we wait for Three to come back into the room with the patient.

The X-ray room door swings open, and Three holds it for the patient, a tall, slim, male who is wearing a grey sports top and running shorts, who bounces in after them. The patient doesn’t seem to notice Thirteen and me standing behind the lead screen and is only concerned with Three, who is taking her time to close the door and begin the procedure.

Three turns towards the patient and asks, “Can you tell me your date of birth and address, please?” As the patient responds, Three looks over to us for Thirteen to corroborate that the details match the ones on both of the computer monitors.

“Yep, go ahead”, Thirteen’s response spurs Three into action, walking across to the rectangular object in the corner of the room. The patient silently follows and stands in front of

Three calmly waiting for further instruction. A couple of moments pass with Three contemplatively looking at the patient.

"Shall I ask the patient to take their shirt off?" Three blurts out, as they look over towards us again.

Thirteen moves out from behind our isolated position of the lead screen and walks hastily over to the patient, looking at their torso as they go. "Yep, yes, this will show up" Thirteen goes to point to certain areas where there are logos on the patient's top. "Some patients have had to have C.T. scans because something has shown up on their chest X-rays before, and it turns out that it was an artefact on their t-shirt".

The patient, having avidly been listening to this conversation, has already removed his shirt and is ready to carry on with the X-ray as Three quietly starts to instruct him on the procedure, from their position at the side of the board.

"So, if you could stand here," Three points to a spot on the floor and presses her hand against the yellow surface of the board, "and put your chest on the detector".

The patient moves to face the wall and leans their bare chest against it. Three moves the same hand to their left shoulder blade. Three looks up at the patient's face and subtly shifts her other hand down the side of the detector as it shifts upwards so that the upper border sits below the patient's chin and the bottom corners are visible at the level of his waist.

Seemingly content with the position of the detector, Three moves away from the intimacy of the patient's personal space and walks over to the X-ray machine, which has been sitting undisturbed in the same spot it floated over to earlier. Three presses a button on the side of the boxy-looking contraption, which turns the light back on, immediately illuminating the patient's back, which is now facing towards the machine and to the rest of the room. The light is divided into quadrants with a subtle cross, intersecting at a point between the patient's shoulder blades. Three fiddles with a couple of knobs on the side of the machine, again, which widens and then narrows the size of the light. Three plays around with this for a few seconds and settles on a size that is slightly smaller than it was originally. They then look across to Thirteen, who has been intently watching on from their position just behind the X-ray machine.

Thirteen tilts their head and gently inquires, "Have you forgotten anything?"

Three looks back at the patient and suddenly starts feeling around in their tunic pockets for something. Looking at Thirteen, they warily reply, "Uhm…I haven't got any markers."

Thirteen nods, furrowing their brow, and walks abruptly out of the room, returning half a minute later with a couple of plastic squares about the size of a stamp in their hand. They hand them to Three, who inspects them and places the one with a little metal 'R' on it on the corner of

the detector above the patient's shoulder with some Blu-Tac. As Three does this, Thirteen starts to walk back towards where I am standing behind the screen, and Three, happy with the placement of the little 'R', begins the trip over to join us.

Just as Three arrives at the lead screen, Thirteen quietly remarks, "You need to bring your markers, you know you need to use them for every patient".

Three nods and wrings their hands slightly, scurrying past me towards the X-ray screen. Moving their hand towards the button by the side of the screen, they look over to the patient and, in a voice more assertive and assured than I have heard them use all day, call, "breathe in, and hold your breath!"

We all watch the patient expectantly and notice a subtle widening of his ribcage and rise of his shoulders. As the movement stops Three presses down on the button. The machine whirs and hums, then, almost as if sighing, lets out a few electronic beeps.

"Breathe out now." Three calls, as the image of a chest X-ray appears on the monitor.

As Thirteen appraises the image, they glance over to the patient, who is still tolerantly standing in the same position, "All done. You can get dressed and go back to the clinic now."

The patient spins around and starts putting his top back on, "Is there anything on it?" he asks inquisitively.

"The doctor needs to have a look, and they will let you know when you go back to clinic," Thirteen responds politely.

As the patient quietly lets themselves out of the room, Three and Thirteen turn their attention to the X-ray monitor. Thirteen glances at the left-hand computer screen, where there is a list showing if there are any patients waiting. Three taps around on the X-ray monitor, making similar changes to the X-ray as they did the foot X-ray earlier, cropping the sides of the image, adding the letters 'PA' and 'R' to the darker areas in the corners, above the shoulders, where there would have been air. Visible is the shape of the plastic and metal 'R' that was stuck to the detector before the X-ray.

As Three goes to position a digital 'R' over this Thirteen corrects them, "don't cover up your marker, we need to see that it was put on there prior to you processing the image. It's just good practice, you know and can be used for anything legal". Three quickly moves the mouse to place it to the side of the marker 'R' and starts typing in some numbers into the second computer screen to the left, where the patient records are still displayed.

"So, go through your 10-point checklist then," Thirteen encourages.

Three, looks at the screen and parts her lips slightly, taking a small breath before closing them, then holds up her hand and starts ticking things off her fingers. "So, patient I.D. is

correct…area of interest – skin borders, apices, and c-cardio…and costophrenic angles are on", Three sighs before she continues, "inspiration, I have…1, 2, 3…8, 9, just about 10 posterior ribs" indicating the small white arcs of bone that signify ribs on the X-ray. "No obscuring artefacts…" another finger gets ticked off.

As Three continues to tick off the rest of her fingers, Thirteen clicks away on the computer screen again as a new patient appears at the bottom of the list in green. Three, still focused on talking through the 10 points, trails off whilst stumbling through a comment about 'image contrast' being 'fine', and Thirteen turns their attention back to them for a moment, "good, ok, you can send it off".

Thirteen proceeds to double-click on the patient details in green, opening the patient details for perusal. Three's shoulders relax as they move their mouse over to the button which closes that X-ray, and the screen goes back to a list of other patients. They hesitantly glance over at Thirteen again, who directs, "You can go for your lunch now." Three picks up their water bottle from the worktop and turns to face me with a resigned smile, before Thirteen adds, "Just remember to bring your markers next time, and if you forget them, come and ask me. We have loads ordered."

As Three walks past me hastily, acknowledging Thirteen with a quiet, "Okay", I move further into the space behind the lead screen to query whether Thirteen would like me to stick around or go on a lunch break myself.

Thirteen interrupts my thought process, "You know, I don't know why people don't just use their markers. I have been trying to get everyone to use them more, but the radiographers don't, so the students don't feel they need to."

Internally, I ponder the times when I didn't use markers as a radiographer and why this is something that feels so difficult to instil and model in practice. "Yeah, it seems to be a really difficult thing to enforce," I affirm, noting how this now seems to be the overriding focus of the learning moment for Thirteen.

Box 4.1. Vignette 1 reflexive epilogue

In the moment:

This interaction happened early on in my field work, and it struck me mostly for the difference in approach Thirteen took with Three in comparison to the other DR/SR interactions I had seen. I had been struggling with separating my "hats" as a

radiographer, educator, and researcher, shown through this note in my research journal:

> *"Feel overwhelmed with the amount of information that I'm seeing and want to make sure that I'm focusing on the knowledge sharing rather than the technical ability of the actors. I have found it difficult today to prevent myself from intervening and giving my input on practice. This has been particularly difficult when I've noticed suboptimal imaging and teaching opportunities that are not being taken up"*
>
> *(Research Journal, 29/02/2024)*

This scenario, therefore, formed the turning point in my being able to observe interactions through a knowledge sharing lens over my instinctive radiographer one.

Looking back:
Up until this point, I had witnessed radiographers and students being passive in their knowledge sharing behaviours, with radiographers carrying out clinical tasks with students purely observing or carrying out computer-based tasks, as demonstrated at the beginning of this vignette. At the time, I found it difficult to see this as knowledge sharing; I was perceiving it as an absence of knowledge sharing, as opposed to more passive or tacit knowledge sharing practices.

Thirteen's approach in initiating engagement from Three made me almost sit up and listen, and seemed to have the same effect on Three. The educator in me was pleased to witness Thirteen make an effort to engage with Three in this way, which indicates that perhaps it wasn't the knowledge sharing which felt satisfying but purely the social interaction between the actors. Thirteen's comment to me about engaging students, indicating that they also see the benefit of this approach and that they do it intentionally.

In saying this, at the time I wondered how much my presence influenced Thirteen to engage in this way, as one of the more senior members of the team, perhaps they felt a responsibility to engage in these more explicit knowledge sharing behaviours with Three. However, as time went on, I also noticed that Thirteen would come into the clinical environment sporadically to engage with radiographers and encourage this type of interaction with students.

Initially, I saw this moment primarily as evidence of explicit knowledge sharing through questioning and how verbal knowledge sharing offers the opportunity to rationalise actions and decisions. This was demonstrated in preliminary coding of the data as "questioning to seek knowledge" and "rationalised knowledge sharing". I also feel that I almost glorified Thirteen's approach due to it being so different from other interactions that I had deemed in my educator position as unsatisfactory previously.

Zooming out:

Although I still recognise these explicit KS factors in the vignette, I also see how complex the interactions are between tacit *and* explicit ways of sharing and seeking knowledge. For example, the implicit message of importance Thirteen sends when they stop what they are doing to retrieve some markers for Three. Perhaps then I was initially placing more value on the explicit sharing of knowledge and trying to pinpoint these moments rather than appreciating the importance of every subtle and tacit moment of interaction. This is ironically aligned with the way I interpreted the literature around radiographer education in my literature review, and an argument for why this research was deemed important.

Despite my concerns around wearing my "radiographer/educator hat", I believe my insider position as a radiographer assisted me in observing the nuance of the types of knowledge being shared here. Without this insider knowledge, another researcher may have focused on the body language or power relations, which may be interesting on a sociological level; however, as technology and practical knowledge play such a crucial part in radiographer practice, it is useful for me to see how these different types of knowledge are shared.

4.4.2.4. Vignette 2: The one where a student stays on the sidelines...

Vignette actors:

Eleven : DR11 PE

Twenty-one : DR21 AP

Thirty-five : DR35 Manager/AdPr

Five : SR5 2nd year student

Six : SR6 2nd year student

I stand with my back against the long, cluttered worktop, looking into the small, boxy space of the ED X-ray viewing area. It feels claustrophobic in here at times, particularly when a large mobile X-ray machine, about the size of a shopping trolley, but solid, is parked about 4 feet in front of me in the middle of the room. The door beyond this, out to the main corridor, is kept open, which allows the bright lights of the hallway to filter through, highlighting the gloom of the space, as there are no windows here. Behind me lie a couple of tatty student booklets and various water bottles.

I've positioned myself in this spot near an X-ray room on my right, as the other end of the worktop near the second X-ray room has the computer sitting on it, which is primarily used and occupied by the senior radiographer coordinating the department for the day. I often find myself trying to find the least 'in the way' spot possible, whilst still being in the thick of the action to observe anything of interest. I noticed on my arrival that there were two student radiographers, 'Five' and 'Six', here today. As usual, when this is the case, they have split up to work in separate X-ray rooms. As I arrived, I saw Five sitting in the corner of the X-ray room to my right, tucked between the corner of the wall and the lead screen. Six is in much the same position in the other X-ray room to my left.

It's around 9:15 am and some staff who were here a few minutes ago have just been sent to carry out various roles, mostly to go and work in theatre for the day. A sense of peace has descended where the radiographers and students who are staying in the area for the day are waiting for patients to arrive, checking their emails, or looking at the online rota. A Tannoy system jolts me out of my contemplation, a shrill voice asking a porter to collect a patient from ED. I look across to my left and the archway leading to the X-ray room by the computer and see that a radiographer 'Eleven' and an assistant practitioner 'Twenty-One' are wheeling a patient who is lying on a trolley, through the heavy double doors on the far side of the room. I move across the viewing area to stand in the archway and observe from behind the lead screen. Six remains sitting on a stool, their eyeline into the X-ray room somewhat blocked by the X-ray monitor sitting on the worktop in front of them, although they move their head slightly so they can see what is happening.

Having pushed the trolley into the centre of the room, Eleven abruptly pushes their foot down on the brake lever by one of the wheels and walks around the lead screen to stand to my right in front of the PC monitor. Wordlessly, they click on the mouse and open up the patient's details. I notice Six looks across to the PC screen and then turns their attention back to the X-ray monitor, where they bring up the same patient's name on that screen.

Twenty-One, standing by the side of the patient on the trolley, inquires, “Hi Sir, could you confirm your name, address and date of birth please?”

As the patient starts listing off their details, Twenty-One looks over to Eleven, who nods their head, having correlated the details with the information on the computer screen. They then walk back around the lead screen into the X-ray room, glancing across at Six as they move.

Six shuffles quietly past me to follow Eleven past the screen and into the X-ray room. They stand at the foot end of the patient, which is closest to me and the lead screen, whilst Twenty-One starts to float the large X-ray machine, with a few clicks and clunks, over the top of the patient.

Eleven looks to Six and asks, “Can you do the detector?” As Six starts glancing around the room, Eleven adds, “It’s in the holder”.

Six immediately walks over to the wall on the right and slides the large square yellow board out of a slot in the wall, and walks over to the trolley. They bend down by the patient’s side and slide the detector underneath the mattress onto a ledge. They stand suddenly and then move back to the foot end of the patient. Eleven huffs out a sigh and squats down in the same position that Six just vacated on the other side of the patient. They slide their hands towards the ledge and appear to start repositioning where the board sits underneath the patient. At the same time, Twenty-One reaches above the patient towards where the X-ray machine is now hovering and presses a button, which switches a light on, illuminating the lower abdominal area of the patient.

“I am just going to feel for some bones Sir,” Twenty-one says as they start to feel the patient’s abdomen with one hand and moving the X-ray machine with the other so that the light correlates with where their hand is resting on the patient, the patient jolts at their touch and Twenty-One jokes, “hope you’re not ticklish!”, and the patient chuckles gently.

When Twenty-One seems content with where they have positioned the X-ray machine, Eleven does another subtle movement of the detector under the bed, having waited in the squat position. They then stand up with an “umph” and move towards where Six is still standing. It occurs to me that Eleven wants to check the position of the detector by looking underneath the trolley at the foot end of the patient, but Six remains standing at the end of the trolley until Eleven gets to them. At that point, Six hops out of the way with a quiet “oh, sorry.”

Six walks back around the lead screen at this point as Eleven bends down once more to check the ledge by the patient’s feet. As they stand, Eleven and Twenty-one start to walk behind

the screen. Eleven stands just in front of me and reaches over to their left, where they press a couple of buttons on the X-ray monitor in front of Six. Eleven leans back away, and Six, having hunkered back in their spot by the X-ray monitor, presses the yellow button, which takes the X-ray.

An image of a pelvis appears on the screen, the familiar wing-shaped appearance of the iliac bones taking up the top half of the image, with the twin femurs extending out from the hip joint. Within the femoral bones glares the stark white shape of bilateral titanium hip replacements, extending beyond the lower border of the image.

All four pairs of our eyes are on the image. Eleven looks to Six and asks, "What do you think I am going to do next?"

Six hesitates before softly saying, "Do another one to get the bottom of the prosthesis on."

"Yep", Eleven responds with a smile and a nod of their head.

Eleven and Twenty-one go back around to the patient and start repositioning for the second image. Six, this time staying put in the corner behind the X-ray monitor, looking attentively at the first image.

I glance behind me into the viewing area, where I start to listen in on a conversation between one of the reporting radiographers[4], 'Thirty-five' and a couple of the other radiographers.

"Yeah, so that's why I suggested the question about how to fix a lateral knee, it's that type of thing we want to make sure newly qualified rads know." Thirty-five announces.

I look back into the X-ray room when I hear the X-ray being taken and see that the image now shows the bottom of the hip replacement prostheses. Twenty-one walks back towards the patient, exclaiming "all done!", as they knock the brake lever with their foot and start to wheel the trolley towards the doors being held open by Eleven.

I turn back to the viewing area where Thirty-five is still in discussion with the other radiographers. Eleven and Twenty-one enter the room through the main door from the corridor and start to listen in on the conversation too.

[4] Reporting radiographer – AdPr who specialises in diagnosing pathology on X-ray imaging

"It's not that image evaluation isn't important, but it's priorities, isn't it?" Thirty-five continues, "In a band 5 interview, I'd rather know that we are hiring someone who knows what to do to make their image better than them being able to identify a pathology, that's not their primary role."

There are murmurs of assent between all of us, as I glance behind me to Six, who is still sitting in the corner of the X-ray room, chin resting on their hand, looking through some of the X-rays that have been taken today on the X-ray monitor. They seem oblivious or disinterested in the conversation going on a few feet from them and content to scroll through the X-rays.

Box 4.2. Vignette 2 reflexive epilogue

In the moment:

This vignette is reflective of many of the interactions I observed, in that the radiographer would often "hide" behind the X-ray screen and participate in small aspects of practice. Sometimes they were drawn to engage through explicit instructions, as is the case when Eleven asks Six to "do the detector". Other times, they appeared to anticipate the need for action themselves, like when they pressed the button to take the X-ray.

I often felt frustrated in situations like these. As a radiographer, I felt my expectations of the students' involvement in the task should be greater. This frustration often seemed to mirror the radiographer's own feelings due to signs of dissatisfaction, sighing or subtle glances. The situation where Six appeared to be standing in Eleven's way felt significant here and offered a different realisation. Through my own professional experience, *I* was aware of what Eleven was about to do, check the detector under the trolley, whereas *Six* appeared unaware of this and stayed in their way until the last moment. This hinted at misalignment between expectations and limitations between actors and the importance of explicit communication.

Looking back:

The idea that my knowledge and experience of radiography practice afforded me the ability to anticipate what was needed, which was something that students were lacking in, was consistently validated throughout my fieldwork. I initially empathised with radiographers in their frustration as I reflected on experiences as a radiographer when I felt irritated with students for not engaging in practice. However, being able to

witness these moments as an outsider, I gained a new perspective and appreciation of expectations around student practice.

In reading the vignette, it appears as though Eleven and Twenty-One perform the X-ray almost like a dance, moving silently around the patient with one person positioning the X-ray machine and the next positioning the detector. As radiographers often work together, they take on aspects of a task individually to get it done more efficiently. Having been a radiographer and also being in the position of a researcher and educator, I was able to see this through both perspectives. It struck me that a student, who is perhaps as yet unaware of all of these facets of practice, is sometimes unable to just "get on" with these things without obvious initiation from a radiographer. This gap in cultural and social understanding seemed increasingly significant as time went on.

Zooming out:
I see this vignette as indicative of how KS is restricted by the level of tacit understanding of how to act in a specific situation. Six's limited involvement may not have been due to a lack of willingness but a lack of understanding of social and cultural dynamics. These factors are often assumed, or assumed to be absorbed through presence, rather than explicitly communicated or taught. The students' hesitation, contrasted with the fluidity of interaction between radiographers, revealed how important this contextual awareness and social comfort is. Furthermore, I feel that if I had acted on the professional cues Six didn't pick up on, this would have put me at some sort of social advantage over them, garnering trust and rapport with the radiographers.

The CLE, therefore, appears to value and privilege those with more awareness of the unspoken codes of practice. Where those with this knowledge have better access to knowledge and KS moments. However, students are rarely given explicit instruction to acquire this, and various factors, such as the limited amount of time they spend in the CLE, are likely to play a part here.

4.4.2.5. Vignette 3: The one with the sacrum request...

Vignette actors:

Two: DR2 Radiographer

Thirty-nine: DR39 Manager/AdPr

Eight : SR8 3rd year student

I'm observing in the inpatient X-ray department again today. 'Two'(DR), who I have seen and spoken to quite a bit over the last 2 months, is acting as the coordinator, looking through some X-ray requests on the computer in the viewing area. It's the first time I have worked with 'Eight'(SR), who is in the usual spot in the corner of the X-ray room behind the computer and lead screen. I have been making small talk with Eight for a bit whilst we wait for some patients to be brought down for their X-rays from different wards. As our conversation drifts off, I move back into the viewing area, the clacking and clicking of a keyboard and mouse making me wonder what Two is up to. At that moment, Two looks around from their perch and notices me with relief in their eyes.

"Have you heard of doing a sacrum X-ray for sacroiliitis?" they ask me.

"Hmmm..." I hesitate for a moment, itching to find out the answer myself, but conscious of not wanting to get involved in clinical decision making. "What else is on the request? ...I'm not sure, to be honest. I wonder how that would be demonstrated on X-ray?" I inhibit my desire to seek out further information or ask more questions, wondering how Two might go about doing this themselves.

At that moment, 'Thirty-Nine'(DR) walks through the archway to the viewing area, and Two's eyes light up again, "Thirty-Nine! Do we do sacrums for sacroiliitis?"

Thirty-Nine moves across the viewing area to peer over Two's shoulder at the computer screen. They take the mouse and start to scroll through the patient details on the screen, "Yeah, we can do..."

Two searches the computer screen, following along with the information Thirty-Nine is looking at. "What would we be looking for on the X-ray then? Can they not diagnose it clinically?" Two queries.

"We would look at the joint spaces to see if there are any abnormalities. I suppose they could, but we could see if there are any other abnormalities in that area. Ideally, it would go for MRI, but depending on the patient's age and conditions, we can do an X-ray."

Thirty-Nine pulls away from the computer as a porter arrives through the archway, stating that they have brought a patient. The porter takes a seat at the computer by the side of Two as another member of staff walks into the viewing area and starts up a conversation with

them. Two looks across to them, giving a subtle nod of their head as they look back to Thirty-Nine.

"What views would you do then?" Two asks, as their fingers tap on the worktop.

Thirty-Nine twists their mouth in consideration, murmuring, "hmm...just the sacrum, I think". As they say this, they move back to the computer, opening the hospital intranet and the X-ray protocols. Whilst they scroll through the document, I look back towards the X-ray room where Eight is still sitting, flicking through their portfolio, seemingly oblivious or perhaps disinterested in this conversation.

"Yeah, so...sacrum views", Thirty-Nine closes the X-ray protocols and opens up a web browser, proceeding to Google sacrum views. "So, it says PA[5] angled down 15 degrees, but to be honest, just an AP[6] will be fine.

Two's eyebrows draw together as they question, "Why do they suggest PA then?"

"I suppose the divergent beam would be beneficial to visualise the joint spaces, but in this case, you'll be ok with the AP." Thirty-Nine confirms.

Thirty-Nine looks over to me and explains, "This is the issue with the protocols. They're so vague. Sometimes it says, *'in some instances such and such would be appropriate'*, but that doesn't help more junior staff make decisions, you know?" I nod and hum in agreement as they continue, "And then I've been in meetings where managers talk about how people just need to *'use their common sense'*! But what they don't seem to get is how *their* '*common sense'* is underpinned with more experience and knowledge than others."

I hear the clunking of the X-ray machine being moved in the X-ray room behind me, and look over my shoulder. Eight straightens and moves off into the darkness of the room as a healthcare assistant appears behind the lead screen and leans against the X-ray room archway.

I feel Thirty-Nine's presence behind me as they walk across to the X-ray room, peering around the healthcare worker to see what is happening in the room. They turn around with a sigh and announce, "Right, best get back to my hole then!"

Two pipes up, "yeah, thanks for that!"

"Anytime!" Thirty-Nine calls back as they walk out of the viewing area.

[5] PA – Posterior-anterior view, where the X-ray is taken from the back of the patient
[6] AP – Anterior-posterior view, where the X-ray is taken from the front of the patient

Box 4.3. Vignette 3 reflexive epilogue

In the moment:

As my field work progressed, I would incidentally end up seeing the same people again and again. Two was one of the radiographers I would see often, and they were friendly and welcoming, frequently asking about my research and radiography experience. I feel I had this rapport with many of the radiographers and students I encountered. Perhaps due to my curiosity and ability to focus on my research and develop this familiarity, rather than having the more pressing clinical priorities that radiographers appeared to have. Due to this, actors became increasingly likely to ask me clinical questions as their awareness of my experience grew. I found it difficult to balance my fear of being dismissive, my innate disposition to sharing knowledge, and my aim to remain more observer than participant.

In this instance, I felt I may have influenced the knowledge sharing interaction with Two and Thirty-Nine, wondering if I hadn't asked the question of what a sacrum X-ray would show, whether Two would have asked that same question to Thirty-Nine. However, I decided when these situations started to occur that I would aim for impartiality in the clinical decision making process, i.e. not giving actors the 'answers'. Not only to ensure that I could be as absent from the knowledge sharing process as possible, but also not to implicate myself in these decisions, as I was not in a radiographer role.

Coincidentally, when Thirty-Nine walked in as Two was having this dilemma, I felt a sense of relief, which I feel was mirrored in Two. This relief was not only due to my not feeling the need to be responsible for having an answer for Two's query, but also maybe a legacy as to how I would feel when I was a radiographer, and a more senior and knowledgeable radiographer was around to take the burden of needing to make these decisions alone.

Looking back:

Two appears here to want to understand Thirty-Nine's rationale for their decisions, and there is a sense of Thirty-Nine having to think about why they were saying what they were saying as they were being asked. Thirty-Nine's approach to seeking information from the patient details, X-ray protocols, and Google, and then combining it with their own expertise, for example, when talking about why a PA image would be better, is very much aligned with how I would have gone about making these decisions in the past.

As a radiographer, I was keenly aware of our reliance on protocols to supplement our knowledge in practice, and also mindful of how they often fell short in helping make decisions in borderline or unique cases. Thirty-Nine echoes this in their summary of protocol usage. Suggesting it was a *tool* to aid in decision making and to ensure that they were not going too far outside the boundary of practice, rather than something to tell them exactly what to do. It appeared that here, their clinical judgement was a greater influence in their decision than the organisational knowledge. Additionally, the conversation about common sense was of interest to me as I resonated with the issue of what one deems to be common sense to them might be something that has developed and become deeply ingrained in their practice over time. There is this sense that we forget how little we knew when we were students or less experienced, and identifying our enriched knowledge as "common sense" is actually doing a disservice to the profession. As if we deem those who cannot demonstrate this knowledge as being 'foolish' as opposed to a novice who needs to develop their knowledge.

As a manager/AdPr, radiographer, Thirty-Nine was not often present in the clinical area. Their statement of going "back to their hole" is in reference to them returning to their office, where they would carry on with their primary role. It is apparent in this vignette that they longed for these interactions, being keen to share their knowledge and make sense of clinical challenges with Two, but also when they peered into the X-ray room to see what was happening clinically. There is a sense of disappointment, as someone with so much valuable knowledge is absent from the clinical environment and, as a result, has less bearing on the knowledge development of more junior radiographers and students.

Eight's lack of engagement with the discussion reflected many instances during my observations when interesting professional discussions would happen between radiographers but go unwitnessed or unheard by students. Eight's position sitting in the X-ray room is a barrier, and suggests they perceive their purpose is just to take and observe X-rays, develop practical skills, over reasoning ones. In being absent from this interaction, I felt they had missed out not only on the rationale behind the sacrum X-ray, but also on how radiographers go about making these decisions in the first place, i.e. developing an understanding of what knowledge to seek and how to seek it.

Zooming out:

This vignette is indicative of how radiographers make clinical decisions, the knowledge they seek, from whom, and when. Some radiographers appear to be more highly valued as knowledge holders and legitimate decision makers due to their position and experience. The way they socially draw on protocol, experience, context, and patient information shows the complexity of decision making in practice. Yet students' physical and cognitive absence from these moments indicates that this professional reasoning goes unseen and remains a low priority for them.

4.4.2.6. Vignette 4: The one where they practice on each other...

Vignette actors:

Seven: DR7 Radiographer

Twenty-Three: DR23 Radiographer

Twelve: SR12 1st year student

I am standing just behind 'Twenty-Three' as they watch 'Twelve' carry out an ankle X-ray, from behind the lead screen in one of the ED X-ray rooms. It's been a busy shift with noticeably fewer staff around than usual. I notice the empty viewing area behind me and hear voices and the clunk of equipment coming from the other X-ray room opposite the archway I am standing in. Twelve has been moving the X-ray machine over the patient's foot for a few minutes now, after initially asking them to sit in the middle of the bed and swing their legs up so they are stretched straight out along the mattress. Twenty-Three lets out a sigh and abruptly moves into the X-ray room as Twelve looks across at them, subtly tilting their head and parting their mouth, about to say something.

Twenty-Three slots smoothly into the position Twelve was standing in by the side of the bed, their head level with the X-ray machine hanging above the patient's lower leg. "Could you shuffle your bum up the bed, please?" they ask the patient.

As the patient moves themselves up the bed, their ankle moves underneath the light emanating from the X-ray machine, and Twenty-Three starts to subtly move their ankle, rotating it inwards slightly and pushing their toes upwards towards the ceiling. They fiddle with the knobs on the side of the X-ray machine and quickly turn around, bumping into Twelve, who was hovering to watch them position the patient. "Oops, sorry!" They both call to each other, laughing slightly and then walking back towards me.

Twenty-Three presses the button on the X-ray monitor, taking the X-ray and then shouting across to the patient, “All done, you can go back to A&E now.”

Twelve turns around and gives me a tentative smile as they walk past me into the viewing area, where ‘Seven’(DR) has appeared and is now sitting at the computer. I follow them and lean against the worktop, saying hello to Seven, and then turn back to Twelve, who is facing the wall and flicking through their student booklet, which is resting on the worktop next to me.

“How’s it all going?” I casually ask twelve.

They continue looking down at their portfolio, flicking back and forward between pages, “mmm, yeah, ok, I suppose,” they shrug.

“Are things starting to click? Anything you feel is particularly tricky?” I encourage, noticing that the X-ray rooms are empty and that the radiographers in them are sitting at the computers with no patients waiting to be seen.

“Hmm, yeah, well, chests are pretty straightforward now, I suppose,” They say as they look up from their book and turn around to face me and Seven, who has started listening to the conversation, “I’ve done loads of them. But extremities are a bit tricky. Like, I did a wrist the other day, and I just couldn’t get it lateral, and I couldn’t figure out how to fix it.”

“Ah ok, yeah that can be difficult,” I say, trying to recall how I would explain how to X-ray a lateral wrist, feeling like I was trying to drag some long-lost piece of information up out of a pit of quicksand in my mind.

“You just need to feel for the styloid processes at the back of the wrist,” Seven pipes up, holding out their left wrist in a side on position in front of them, proceeding to use their fingers on their right hand to poke the bones on the back of their wrist where it meets the hand, but getting into some difficulty trying to do it on themselves. “Here, give me your wrist,” they instruct Twelve. Seven starts to feel the back of Twelve’s wrist, guiding them to do the same back to them.

Twelve continues tilting Seven’s wrist side to side whilst feeling the bones through the skin. They pull their eyebrows together and counter, “Ok, yeah…but how do you know how to fix it when you’ve done one and it’s not lateral?”

“Mmm, you just have to know whether the radius needs to be back or forwards…hang on, I can’t explain,” Seven turns back to the computer and starts looking through the patient list and clicks away on the mouse, eventually bringing up an X-ray of a wrist. They point to the

thicker bone that sits below the small pebbly bones of the hand, “see, the radius is rotated a bit backwards, towards the…mmm, dorsal side, so you would need to rotate it a bit inwards.” As they speak, they hold their wrist, demonstrating what they mean by rolling their wrist in and out.

As Seven explains this, Twelve holds their own wrist in front of them, mimicking the position and movement that Seven is demonstrating, “ah, yeah, ok”.

“You just get used to picturing it, and once you’ve done it so many times, you just get it,” Seven adds, closing the picture of the wrist X-ray, and opens the patient list back up. We all notice that there are some patients waiting, and Seven gets up to go into one of the X-ray rooms with Twelve following behind.

Box 4.4. Vignette 4 reflexive epilogue

In the moment:

My feelings around knowledge sharing in the CLE often oscillated between frustration, when witnessing knowledge sharing encounters which I deemed unsatisfactory as an educator, and enlightenment, when I would see ways of sharing knowledge that were distinctive to me as a radiographer.

In this vignette, the first interaction between Twenty-Three and Twelve slots into the former category, as Twenty-Three demonstrates impatience with Twelve as they carry out the ankle X-ray. The way Twenty-Three takes over the X-ray procedure rather than talking Twelve through it was something I saw regularly and felt deeply disappointed by. Twelve’s apparent despondence in leaving the room after this interaction prompted me to initiate some conversation. I am aware that my engagement with Twelve in this way then prompted the subsequent discussion around how to perform lateral wrist X-rays. Despite being an initiator of knowledge sharing in this moment, I then consciously deferred to Seven, who proceeded to share their knowledge through physical demonstration.

This was a process I instantly recognised as a radiographer, our jobs are tactile, needing to feel for bony landmarks on patients often and therefore using our own bodies as a way to facilitate knowledge sharing is notable, although not surprising. Equally, when Seven brings up the image of the wrist X-ray as a visual prompt, this demonstrates the importance of imagery in the profession. Both the physical demonstration and visual prompt served as an aid for Seven to explain their knowledge

and offer advice. Furthermore, during this interaction, I noticed that Twelve became more engaged with Seven as they realised they were prepared to engage in knowledge sharing; they began to ask questions, which prolonged the interaction.

Looking back:

Instinctively, before conducting this research, I understood the value of facing challenges and making mistakes in learning, and this has become even more evident throughout this process. Therefore, I hoped that Twelve would have been guided through that challenge more explicitly. However, this was a busy day, and therefore perhaps a more empathetic perspective is to acknowledge the pressure, both internally and externally, that Twenty-Three was under to be efficient. Perhaps then there is tension in the priorities of a radiographer and my own priorities as an educator and researcher. Nevertheless, I still believe there is a need for radiographers and students to work through these challenging situations together, rather than getting the job done more efficiently.

Twelve and Seven's interaction demonstrates a more interactive and discursive approach to KS. I noticed on the occasions where radiographers appeared invested in knowledge sharing, that students would almost take the lead from them and begin to converse back and forth. However, this was almost always initiated by radiographers rather than students, indicating a power dynamic or hierarchy. Perhaps students themselves have bought into the cultural sense that efficiency and getting the job done are the priority, over their own learning.

Seven's comment about getting used to "picturing it" spoke to the tacit knowledge developed through years of experience and practice. Perhaps they had reached their limit of how much they could verbally explain this hidden knowledge and therefore deferred to "picturing it". This was akin to other instances where I would hear radiographers say, "once you qualify, you'll get it" or "you just have to do loads of them, and then you can judge it." These statements are then potentially a way for radiographers to subconsciously evade the challenge of articulating the deep-rooted practical knowledge they have. Or perhaps they truly believe that experience and repetition alone are the ultimate route to developing knowledge.

Zooming out:

In this story, the tensions between clinical and learning priorities and the different approaches to sharing knowledge are apparent. In the first interaction, the

radiographer took control of the situation with little verbal communication, leaving the student to passively observe. However, the second interaction demonstrates a more active and relational approach to KS led by the radiographer. The student's response in the second interaction demonstrates curiosity and questioning, which suggests that student passivity is likely to be a learned response to the social cues of radiographers.

Furthermore, difficulties in articulating professional and practical knowledge lead to it being dismissed as experiential knowledge. Deeply embedded tacit knowledge is not necessarily withheld but better demonstrated physically or through visual cues. As a lot of radiography practice is physical and visual, it is understandable why those aspects of knowledge are difficult to articulate.

4.4.3. Thematic analysis

Following the construction of these vignettes, I engaged in further reflexive thematic analysis (TA) to synthesise insights and create themes to enhance transferability of the findings (Braun and Clarke, 2021a). This phase involved a deliberate shift from the narrative, situated analysis embedded within the vignettes, to a more abstracted thematic approach to address the research aim and questions.

As stated, NVivo was initially used to analyse FNs and systematically manage and update codes. This was supported by printed FN data, which I read, highlighted, and annotated. The vignettes, which were developed from this initial coding, allowed me to engage with and identify the more relational and contextual influences which shape knowledge sharing in the CLE. Condensing the vast and diverse dataset was a substantial and daunting task. The FNs, vignettes, and interview transcripts produced hundreds of overlapping codes, which were difficult to combine into clear themes. Analysis was therefore a process of grappling with the complexity and richness of the data, rather than just one of condensing or summarising it. As I wrote, edited and reread the vignettes, I used NVivo to develop what I termed interpretive codes, which captured and maintained the context of the knowledge sharing interactions. These interpretive codes are not definitive truths, but rather reflexively constructed interpretations grounded in my positionality, field experiences, and theoretical foundations.

From these interpretive codes, I returned to the field and interview data, noticing patterns and links between my initial coding and the interpretive ones. This demonstrates alignment with the emphasis on reflexive TA as an active and interpretive approach rather than a simple categorisation of data (Braun and Clarke, 2021a). As I tried to make sense of the data set as a

whole, I wanted to visualise the codes more tangibly. To do this, I used notes and printed codes, arranging them physically on the floor to further categorise, trace links, and identify relationships (Figure 4.6).

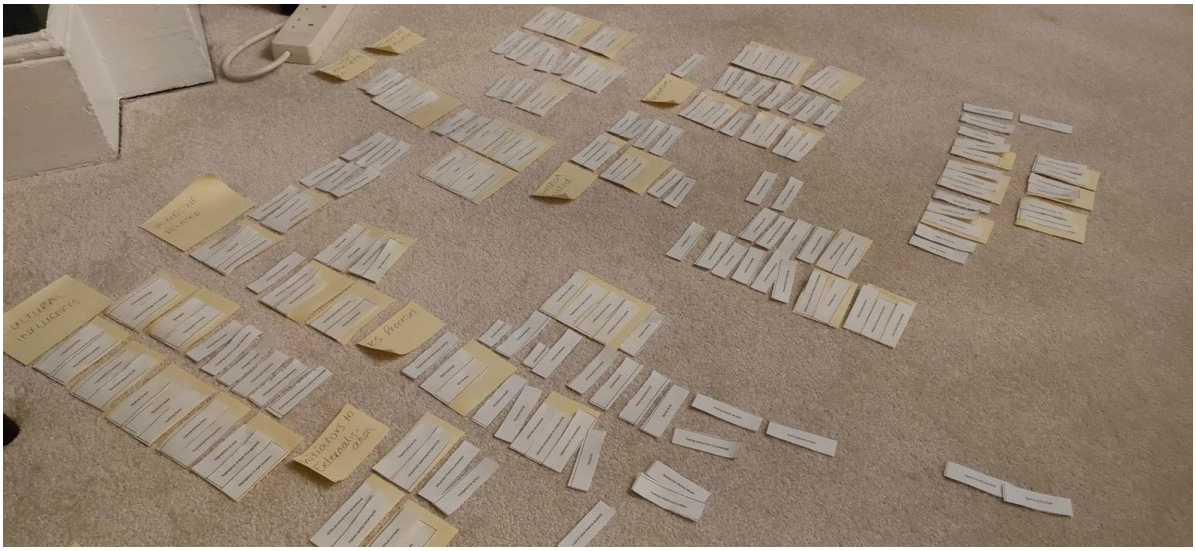

Figure 4.6. Physical demonstration of coding

Although initial coding was inductive and subsequent interpretive coding was still inductively informed by the data, I began to deductively draw on my theoretical framework, specifically mindlines, to develop broader analytical statements and core concepts. These were informed through consistent engagement with the data through reading, rereading, discussion with supervisors, and reframing codes and my thoughts over many months. These codes, analytical statements, and core concepts were ultimately what guided the theme and subtheme development, which represent patterns of shared meaning across the dataset.

Through this process, themes, subthemes, and core concepts were reviewed, refined, and renamed. The relationships between them can be seen in the following chapters in Table 5.1. and 6.1. This process allowed me to construct themes which not only captured specific and practical aspects of the data but also reflected the complexity and interdependency of the knowledge sharing practices and sociocultural conditions apparent in the CLE. The two themes are presented in the following chapters and are structured to highlight the ways in which knowledge is sought, shared, and shaped in the CLE, with consideration of the sociocultural and power dynamics which impact these processes. Together they provide an original and nuanced understanding which will inform further discussion of how mindlines are negotiated in clinical UgDR education.

4.5. Chapter summary

In this chapter, I have detailed my experience in the field and my engagement with the data. I began by providing a transparent account of the context and data generation, followed by my approach to analysis. By immersing myself in the field and the data, I crafted rich narrative vignettes which depict the social, relational, and situational nature of KS in the CLE. I accompany my vignettes with reflexive epilogues, which provide insight into my interpretation of the events to promote trustworthiness in my approach. The vignettes proved critical as part of the wider corpus of data in my thematic analysis. The prolonged and iterative engagement with the data allowed for the development of broader interpretative and analytical codes, which eventually culminated in the development of the themes and subthemes depicted in the following two chapters.

5. Chapter 5: Theme 1 - Knowledge seeking and sharing practices

"The important thing is not to stop questioning. Curiosity has its own reason for existence" – Albert Einstein

(Miller, 1955)

5.1. Chapter introduction

This chapter presents the findings from the wider thematic analysis of all data generated through this ethnographic study of knowledge sharing in UgDR clinical education. The vignettes from Chapter 4 are revisited as analytic entry points, grounding the discussion within these specific moments of observed practice. However, the themes, subthemes, and core concepts developed across Chapters 5 and 6 derive from patterns identified across the full dataset. Field notes and interview excerpts are therefore drawn upon to evidence how the practices and conditions were recurrent features of the CLE rather than isolated occurrences. The following two chapters are structured around two overarching themes. Across both themes, the findings indicate the deeply relational and hierarchical nature of knowledge sharing in the CLE. Knowledge is rarely shared or structured around formal pedagogical processes. Instead, it is embedded in action, observation, informal interactions, and cultural norms. Implicit hierarchies of knowledge types and knowledge holders significantly influence who has access to knowledge and who can participate in KS/S practices.

This chapter focuses on the first theme, *Knowledge seeking and sharing (KS/S) practices*. This theme examines how actors perform KS/S both verbally and non-verbally in the CLE and the apparent motivators for these processes. Four subthemes were identified relating to verbal and non-verbal seeking, and verbal and non-verbal sharing, with two key concepts for each subtheme.

5.1.1. Overview of knowledge seeking and sharing practices

During the observational phases of my research, it became clear that knowledge *sharing* processes were intrinsically linked and influenced by the knowledge *seeking* processes of the actors. Specifically, sharing rarely happened between students and radiographers without some form of seeking interaction, and vice versa. This section will examine the verbal and non-verbal processes used for KS/S, supplemented by the apparent motivations which guide these interactions. Brief consideration is given as to how the concepts discussed in this theme are further shaped by the second theme and will be expanded upon in Chapter 6.

Key to this discussion are the motivation concepts, which are used to explain the context for KS/S practices. *Initiating* occurs when actors are prompting interaction or encouraging action. *Assessing* refers to actors evaluating the knowledge of another to highlight the extent of, or gaps in, knowledge. *Modifying* happens when knowledge needs to be corrected or adjusted to improve the actor's practice. *Supplementing* is similar to modification but is distinct as it involves applying additional layers of knowledge through explanation. Finally, *validating* provides confirmation that the knowledge is correct or appropriate, reinforcing the actor's knowledge or actions. These motivations are not mutually exclusive and are often layered within a single interaction or KS/S process. However, not all KS/S behaviours aligned clearly with the identified motivation concepts. In particular, the KS/S practice of modelling, which is identified in section 5.5.2, appeared driven by more implicit, personal, and less detectable motivators. This may suggest that some practices stem from internalised norms or habitual practice rather than deliberate KS/S motivations. The following sections first present and analyse each subtheme in detail before drawing these ideas together in Table 5.1 at the end of this chapter.

5.2. Verbal knowledge seeking

5.2.1. Questioning

Questioning operates as a seeking practice motivated by initiating, assessing, validating, supplementing, and modifying knowledge. While it enables knowledge sharing between actors, it simultaneously reinforces existing epistemic hierarchies, positioning radiographers as primary knowledge holders and students as knowledge consumers.

When carried out by radiographers, questioning often served to both initiate student engagement and helped in assessment of knowledge. In Vignette 1, the radiographer began with an open question, "Will you get the patient in, please?", which initiated action from the student. This initial open question was then followed up with more assessing questioning, "What are you going to do first?", which encouraged the student to carry out an action, thus allowing the radiographer to assess their understanding and knowledge in relation to this. Subsequent questioning from the radiographer initiated a knowledge sharing dialogue, where they could assess and gauge how much support the student needed in this interaction.

In some cases, if the knowledge shared by a student aligned with the expectations of the radiographer, they would withhold correction, which in turn tacitly validated the knowledge the student demonstrated. Comparatively, if apparent gaps in knowledge were highlighted through the student's response, their knowledge was supplemented or modified. Again, in Vignette 1 the

radiographer appeared to be largely content with the student's answers and therefore their absence of modification or supplementation allowed for this knowledge validation.

This pattern was seen across the data. Data showed that questioning *from* radiographers *to* students was often motivated by the need to initiate and assess, with consideration as to how student knowledge can be then modified, supplemented, or validated.

> *"I'll go into clinical areas and students are hanging back a little bit from the radiographers, so I'll speak to the student about what they're doing, what they're seeing on the screen. Ask them if the X-ray's normal. Ask them if they know what the exposure index is, and you know, what they should do or suggest things the radiographer could be doing differently. Lots of different things. I will always talk to people about what's going on."*
>
> *(DR4 - Interview 2, 23/05/2024)*

> *DR4 and SR5 are doing an ankle X-ray. DR4 starts talking through the image and asks what SR5 thinks about it. They say they think there is a spur and that there could be a fracture, pointing to a bit of bone which appears disconnected from the main bone. DR4 states that it isn't a fracture, as the bone would be jagged; this is a degenerative process, as it is more rounded.*
>
> *(FN, 14/03/2024)*

> *SR7 was carrying out a lumbar spine X-ray, and DR39 was talking to SR8 about the resultant images. DR39 asked SR8 which side they would position the patient on for the lateral view. SR8 answered, but I couldn't hear it. DR39 started talking about the curvature of the spine whilst pointing to the image, suggesting that they needed to consider how the divergent X-ray beam would penetrate the joint spaces.*
>
> *(FN, 16/04/2024)*

In these cases, initial questioning to initiate and assess led to the radiographer modifying and supplementing the student's knowledge. When the radiographer stated why the ankle was not fractured, they shared their rationale as to why they had come to that conclusion, which modified the student's initial belief that the bone was broken. Additionally, when the radiographer was asking the student how to position for a lumbar spine X-ray, they supplemented the student's knowledge by stating the technical aspects that should be considered when carrying out this procedure.

Whilst questioning was seen to be an effective process in KS/S, the value of it differed depending on the context and communication style. At times, questions could be quite vague and open to interpretation.

> *Despite being on multiple portable X-rays around the hospital with SR5, it was not until DR15 came to take over from DR1 that SR5 stated the need for them to do an assessment and asked if DR15 was an assessor. DR15 just asked, "Are you happy doing portables?" and SR5 said yes.*
>
> *(FN, 14/03/2024)*

The use of more open-ended questions like this could be considered beneficial when trying to initiate knowledge sharing conversations, but when assessing students' knowledge level in order to modify or supplement it, it is difficult to know what being "happy" means in terms of the level of knowledge they have about carrying out this procedure. This suggests that the efficacy of knowledge seeking through questioning is restricted by the way in which questions are asked by the radiographer.

The way in which radiographers question to assess suggests that they see themselves as the knowledge holder, and students as the knowledge consumer. This is demonstrated when radiographers were asked about interactions with students.

> *"There are things that sometimes, before I even go ahead and like, try and ask them, I need to make sure I know it myself…you need to know your stuff before you assess students."*
>
> *(DR22 - Interview 6, 03/06/2024)*

This perhaps offers an explanation for why some radiographers were seen to be less inclined to ask students questions, due to a concern around not having the knowledge to validate, supplement or modify.

Where radiographers question students to initiate or assess, students lean into the dynamic by questioning to validate, modify, or supplement their own practice. In Vignette 1, the student demonstrates this when they answer the radiographer's question with "check their clinical history?", which was met with a validating nod from the radiographer. Furthermore, the student questions the radiographer about asking the patient to take their shirt off. This again indicates that they understand the need to remove artefacts from the image, but need reassurance before they do so.

Despite this interaction, it was rare to see students asking radiographers questions and their knowledge seeking was often done non-verbally through implicit signals, which is explored in Section 5.3.2. This lack of questioning from students was a surprising finding for me, and further exploration of this during field work and interviews suggests that questions from students are not often welcomed by radiographers.

> *Have been talking to SR6 about their experiences in other modalities and other departments. They stated that when they have asked radiographers questions, they have been told that they are a student, and they don't need to know those things.*
>
> *(FN, 22/03/2024)*

Students were aware of the responsibility to ask questions to develop their knowledge and understanding of practice. However, they were acutely aware of timing and context when doing so.

> *"You very much have to ask. Otherwise, they just reckon you can do it, so yeah, it's more on the student to ask, than like the radiographer babysitting you through it."*
>
> *(SR11 – Interview 5, 03/06/2024)*

> *"I guess in like, the less busy hospital, the staff are more available, like open for questions. But then that doesn't mean that in this hospital they're not open. Yeah, it's just like you have to find the right time to ask."*
>
> *(SR3 – Interview 7, 05/06/2024)*

This suggests that students who are more conscious of radiographer demands and have a desire not to be a burden may avoid asking questions and, as a result, may be disadvantaged in terms of knowledge development. This dynamic is further instilled by radiographers who feel more motivated to engage in KS/S with those students who do ask questions.

> *"Some of them lack the confidence to, but you kind of just like try to get them involved and do it. But people who actually like come up to you and ask, like it just motivates me to just want to tell them, if they ask me a question, I'll just answer it."*
>
> *(DR22 – Interview 6, 03/06/2024)*

In some cases, however, radiographers had an awareness that students may lack the confidence to initiate these interactions. One radiographer reflected on how they didn't like to

ask questions when they were a student, and the impact that having a good relationship with the radiographer had on them. This reflection then led them to discuss their responsibility in tackling this barrier.

> *"Certainly, as a first year, you have that kind of fear of approaching people. Now, looking back, I know that radiographers are used to filling out books all the time. But when you're a student, you don't like to ask people, you think they're busy, they've got patients…But you know, he was the sort of person who would relate to you as a person and, like, make friends with you."*
>
> *(DR4 – Interview 2, 23/05/2024)*

> *"I think that they don't tend to volunteer the information unless you ask for it… but if you ask them a couple of questions, it gets them going."*
>
> *(DR4 – Interview 2, 23/05/2024)*

Moments where students did ask questions were often preceded by the radiographer appearing to be eager to develop a rapport or share their knowledge first.

> *DR39 appeared and took some students into the X-ray room and started talking to them about the technical aspects of the X-ray table, and the students stated that they were unaware that there was a 'head end' and a 'foot end' to the table. During this, students were asking DR39 questions to supplement their knowledge, such as "how do we know it is the head end?"*
>
> *(FN, 16/04/2024)*

Similarly, in Vignette 4, the radiographer interrupted my and the student's conversation to impart their knowledge when we were discussing how to carry out a wrist X-ray. Their willingness to share allowed the student to feel comfortable enough to ask additional questions for their understanding and to supplement and modify their knowledge. These data suggest the need for relational and situational safety for students to ask questions to validate, supplement, and modify their knowledge.

This radiographer-student questioning dynamic differed from radiographer-radiographer questioning, as with the latter, it was used as a mechanism for decision making and problem-solving rather than assessment. Radiographers showed a willingness to ask and be asked questions by other radiographers; *these* questions tended to result in a discussion and shared

understanding. This was seen most when a radiographer had a decision to make or needed assistance carrying out a clinical task.

> *I witnessed DR6 asking DR13 about the justification for a chest X-ray due to a previous one being done the day before on the patient. DR13 stated that yes, it was justified due to there being a new onset of symptoms and that it may be an indication of sepsis.*
>
> *(FN, 06/03/2024)*

When asked in interviews about how they would go about making a difficult clinical decision, radiographers always stated that they would ask someone else at some point during their decision making process.

> *"I have a look at it, and if I don't think it's OK or I've checked on [RIS] and I don't, like, see what I need to see, then I'd probably get someone else. Like it doesn't, it doesn't matter who it is. One of my colleagues can look at it, maybe they see something that I'm missing. And if they agree with me, then I'd probably talk to the band 6 that's in charge leading that day."*
>
> *(DR7 – Interview 1, 21/05/2024)*

> *"If it's like a specific view that I'm not aware of or I can't do it, then I would like to see if another senior knows around me. If not 'cause I just don't wanna go out of the department, really. If not, then with reporting radiographers, ask them maybe for help."*
>
> *(DR22 - Interview 6, 03/06/2024)*

This type of interaction is depicted in Vignette 3, where the radiographer asked another radiographer about the sacrum X-ray request. These interactions tended to be a dynamic back-and-forth discussion resulting in a joint sensemaking of the situation. This ultimately led to radiographers validating, supplementing, and modifying their knowledge, similarly to when students asked questions. However, it was clear from the data that radiographers did not consider students to be key players in seeking knowledge for their own development.

Throughout my observations, I identified this lack of knowledge seeking from radiographers to students and asked them about this in interviews. I was met with pauses and responses which indicated that radiographers saw little practical value in the knowledge that students hold.

> *KP: Do you feel like you can learn anything from students at all?*
>
> *[Pause] "No."*

KP: Do you feel like they offer anything new to you at all?

"If they offer it, then like, yeah, but it doesn't happen."

(DR13 - Interview 4, 30/05/2024)

"I don't feel I do, no. I mean, certainly not clinically."

(DR5 - Interview 3, 29/05/2024)

"Obviously, interpersonally, you know, you learn things from everyone you meet. Different characters and things like that. Everyone's got different life experiences, yeah, but the way they deal with this situation is different. And yeah, I mean, they, they could be like different ideas of ways to do things. Partly informed by the university, but they also work with every radiographer in the department and across different hospitals, so they might say, "Oh, I was working with somebody last week and they told me this way of doing it," and you know, they can pass on that information that we don't necessarily get from each other."

(DR4 Interview 2, 23/05/2024)

Even when suggesting that students may hold more holistic knowledge, the hypothetical language used by DR4 suggests that these types of interactions were not commonplace in the CLE. This suggests an element of hierarchy in which students are at the bottom in terms of knowledge value.

Questioning, or its absence, played a central role in KS/S. When radiographers questioned students, it was often to initiate action or to assess knowledge, leading to validation, supplementation, or modification of knowledge. Rather than questioning to initiate or assess, students would use questions to directly validate, supplement, or modify, placing themselves as the developmental actor in this dynamic.

The effectiveness of questioning depended on communication style, timing, and perceived relational safety. There was often a hesitancy for both students and radiographers to question, perhaps arising from situational factors, but also personal influences such as a lack of confidence in knowledge. Despite this, the data discussed here shows the significance of questioning in highlighting gaps and limitations in knowledge for all actors.

5.2.2. Instructing

Radiographers often foster student engagement and KS through the process of *instructing*. This typically aligns with the motivation to initiate action and can subsequently lead to validating, supplementing and modifying. Direct instruction can provide clarity in tasks and an entry point for action for students who are often peripheral to clinical activity. It also has the potential to support knowledge development when questioning is absent. Although instructing appears outwardly as a sharing practice, across this data, it functions as a form of enacted knowledge seeking by radiographers. By directing students to perform a task, radiographers are able to observe performance and implicitly assess competence, thereby determining whether validation, supplementation, or modification of knowledge was required.

Regularly, radiographers were seen to give students instruction when they appeared unsure or disengaged. In Vignette 2, the radiographer asks the student, "Can you do the detector? It's in the holder" The student immediately understands what is needed in this instance and demonstrates this by carrying out the task. This direct instruction provides the student with a purpose, which enables them to get involved and potentially develop an awareness of the steps to take during this imaging procedure. Through this enactment (see Section 5.5.1), the radiographer is able to observe how the student approaches the task, implicitly assessing their confidence and understanding before deciding whether further explanation or instruction is required. However, in this interaction, there is no further guidance given beyond the initial instruction, and the student quickly reverted to their original passive position. This indicates that whilst direct instruction can facilitate engagement and competence assessment, sustained participation in clinical tasks may require more persistent interaction.

Students consistently appeared keen to carry out instructional tasks assigned by radiographers, which may reflect a desire to have purpose within the CLE.

> *"Yeah, I feel like that would be helpful because most of the time I'm just standing there thinking, what can I do, and I'm trying to wrap my brain, and everyone else is already doing something. So, I'm feeling like maybe I should just stand there and just clean afterwards or something, I don't know. Yeah."*
>
> *(SR11 - Interview 5, 03/06/2024)*

These moments highlighted missed opportunities to share where theory or reasoning was used in practice. When direct instruction was given with minimal explanation, students were missing steps in the decision making process.

> *"I feel like maybe if the radiographer talked you through their justification cause most of the time, they just read [the X-ray request], they check if it's justified, then they tell you to do the X-ray without really explaining why.*
>
> *(SR11 - Interview 5, 03/06/2024)*

Direct instruction is therefore a helpful adjunct to verbal knowledge seeking, not only as a means to assess a student's ability to engage in a particular task but also to develop a sense of role and belonging. However, delivering brief instructions in a superficial manner leads to intermittent engagement and does not develop a broader understanding of how theoretical knowledge aligns with practice.

Instructing, therefore, proves to be a bridge between knowledge seeking and knowledge sharing. It proves useful in initiating action, which enables radiographers to assess performance and determine whether validation, supplementation, or modification is required. Yet, in practice, this remains at the level of directive task allocation rather than evolving to initiate shared reasoning.

5.2.3. Summary: Verbal knowledge seeking

Through verbal knowledge seeking, radiographers are able to initiate, assess, and validate student knowledge. Questioning is a crucial process to do this and is also used by radiographers to seek knowledge from other staff. There is a hierarchical approach to knowledge seeking here in that radiographers do not seek knowledge from students, and they mostly assess knowledge to direct their own knowledge sharing.

Questioning and instructing are focused on direct practice-based knowledge, and despite open questions being seen to aid in wider knowledge sharing of student priorities and understanding, this was limited and rarely initiated by radiographers. Students are often hesitant to ask questions and are never seen to give direct instructions to radiographers. These factors suggest a hierarchy in KS/S, and questioning is often reserved for when students feel that the radiographer is already showing willingness to engage.

5.3. Non-verbal knowledge seeking

5.3.1. Observing

Much of the knowledge seeking in the CLE is carried out through observation. *Observing is* a seeking practice used by students to validate and supplement their knowledge. It provides a low-risk means of accessing tacit knowledge and navigating hierarchical boundaries, yet it often limits deeper understanding and sensemaking when unaccompanied by dialogue. For

radiographers, observation functions as a mechanism of supervision and evaluation, reinforcing their role as epistemic authorities. Because these processes are non-verbal, it is difficult to ascertain motivations and identify the knowledge being sought or acquired. Whilst observation appeared passive, it may represent a more acceptable form of knowledge seeking for students who do not want to disrupt workflow or hierarchy. Observation is a commonly referenced method of KS/S when discussed with actors.

> *"So, if there's a student around it's mostly getting them involved so maybe taking them around, so they know get an idea or are able to observe what we do."*
>
> *(DR7 – Interview 1, 21/05/2024)*

Students frequently observed radiographers from a distance, often behind lead screens, whilst carrying out computer-based duties. In Vignette 1, the student quietly perched on a stool behind the lead screen whilst a radiographer carried out an X-ray procedure. They appeared to be ready to assist the radiographer by being poised to press the X-ray exposure button when the radiographer was ready, without any verbal interaction or prior confirmation of this role. This observational positioning appeared habitual throughout my observations, particularly in busy periods. Additionally, students often paid more attention to the computer-based tasks than to the clinical skills the radiographers were using.

> *Observed multiple X-rays where SR6 stood processing on RIS whilst DR7 and DR30 did the X-rays – most of which were adaptive technique. They were not watching the positioning; they were just focused on processing and only looked at the outcome of the X-rays rather than the process of doing them.*
>
> *(FN, 21/03/2024)*

> *When the department got quite busy again, students kept just carrying out admin tasks rather than X-raying.*
>
> *(FN, 25/04/2024)*

The data suggested that students are keen to avoid being a burden in these busy periods, and when there are complex procedures being carried out which they feel are out of their scope.

> *"It's usually with difficult patients. I know that's not a "very good" radiographer of me, but the difficult patient is... I guess kind of daunting, and I feel like I'll be more of a burden than a help. So, I'd rather stand back and watch. Or just try to be as useful behind the screen as I can.*

(SR11 – Interview 5, 03/06/2024)

> *"So, I do try to like learn, but then sometimes, I think I'm like pushing myself, like pushing all the information on myself. I don't know if I'm going to remember everything. But I do like to watch and observe and try and learn [that way]."*

(SR3 - Interview 7, 05/06/2024)

However, this passive observation is perceived to be ineffective for students' knowledge development.

> *"Watching it and doing it are two different things. I reckon. I'm more of a I guess I'm a practical learner, I guess so once I get to stuck into it, it sticks more into my head, whereas observing, I do gather some stuff, but it's not…It's not the same as doing it. For me, anyway."*

(SR11 – Interview 5, 03/06/2024)

Observation was not always carried out behind the lead screen; at times, students positioned themselves closer to the action. In Vignette 2, the radiographer gave the student a look which I interpreted to mean that they expected the student to come and observe them or assist them away from the lead screen. This interaction eventually led to the student becoming more involved in the clinical task, and further questioning and direct instruction methods being used. This was not always the case, as I often witnessed students silently paying attention to radiographers' actions in these positions with no further verbal interaction.

> *Observed DR34 come back from portables; they were processing and checking images on PACS. SR6 was watching them do this in a passive way; no verbal communication was demonstrated.*

(FN, 21/03/2024)

> *SR11 often stood behind the screen observing examinations, however I did see them move into the room to directly observe on occasion.*

(FN, 29/04/2024)

When students observed radiographers with limited verbal interaction, it appeared as a passive process until the radiographer initiated verbal interaction; it was rare to witness students verbally seeking knowledge as a result of observing radiographers. This need for active encouragement of students was acknowledged by DR4 in their interview.

> *"I think there's always a way to involve learners in whatever you're doing. And I guess you could argue that perhaps observing how you deal with that situation is teaching. But more hands on, I don't know...there's always things that need doing, you know, getting people changed, bringing people in. I don't know. Encouraging them to get more involved in what they're doing."*
>
> *(DR4 - Interview 2, 23/05/2024)*

Conversely, when radiographers observed students, it appeared they did so to assess the student in order to validate, modify, or supplement their practice. When the radiographer observed the student's hesitation in performing an ankle X-ray in Vignette 4, they stepped in to modify their practice. This is reflected in much of the observational data.

> *SR12 started doing an elbow examination. DR46 went and directly supervised and modified their technique by helping position the tube and adapting to the position of what SR12 had done. Stating and pointing, "move the tube this way."*
>
> *(FN, 29/04/2024)*

> *SR12 is carrying out a foot X-ray, and DR3 and DR52 are watching from behind the screen. SR12 started positioning the oblique view the wrong way, and DR3 went to modify their technique.*
>
> *(FN, 01/05/2024)*

Even in Vignette 1, which is illustrative of verbal knowledge seeking, the radiographer also used non-verbal observation to seek and assess the student's knowledge. As they watched the student interact with the patient, they were able to pick up on their level of knowledge, which ultimately directed and impacted the knowledge shared by the radiographer. This is particularly demonstrated when they observed the positioning of the patient and identified that the student had not used any X-ray markers[7].

Observing students to assess them is also a more active assessment-motivated process instilled by HEIs.

[7] X-ray markers – small plastic or metal squares with the letters 'R' and 'L' placed by the patient's body part to indicate which side of the body is being X-rayed

> *"I know that at [the HEI] they want to see certain examinations performed, whereas at other institutions we work with, they want you to watch a student over a morning and everything that happens, you watch them, and you assess them over that time frame."*
>
> *(DR4 - Interview 2, 23/05/2024)*

Therefore, when radiographers observed students, they were seeking knowledge to assess the student rather than seeking to supplement or modify their own knowledge. The data discussed in Section 5.2.1 about radiographers learning from students again reinforces this one-sided dynamic.

Knowledge seeking through observation is hindered by its ambiguity, both in intent and outcome. It relies on the position of the observer, situational factors, and their ability to "catch" valuable knowledge. Without the addition of verbal KS/S practices, it is unclear what knowledge has in fact been sought, caught, and embedded. The tendency for students to observe with no verbal interaction limits this practice and suggests missed opportunities for clarification and deeper understanding. Conversely, radiographers' observation appears more purposeful and linked to the knowledge students are sharing through action, and their apparent position as knowledge holders in these moments suggests a hierarchy for KS/S in the CLE.

5.3.2. Signalling

Inextricably linked to observation is the non-verbal method of implicit signalling. *Signalling* is a non-verbal seeking practice motivated by initiating action, validating performance, and prompting modification. For students, implicit signals provide a low-risk way to request assistance or confirmation without overtly challenging the hierarchy. However, when these signals result in radiographers taking over tasks, opportunities for explanation and shared reasoning are reduced.

Students often use implicit signals to request help or validation from radiographers. In Vignette 1, the student does this multiple times, and most obviously when they look to the radiographer after positioning the patient and the X-ray machine for the chest X-ray. The student looks across to where the radiographer is standing, and they immediately move over to the student. This interaction suggests that the student is seeking to confirm if they think they have positioned the patient effectively and wants the radiographer to validate or modify their practice. This dynamic of students seeking validation or modification from radiographers was commonly observed in the field.

> *Watched SR3 start performing a finger X-ray, they appeared unsure when identifying the patient and when they asked the patient to remove their sling, they mumbled something, and SR3 gave DR15 a concerned look, at which point DR15 took over the patient communication. Eventually, SR3 took over the imaging of the patient again with the help of DR15.*
>
> *(FN, 07/03/2024)*

These implicit signals were often met with limited verbal communication from both the student and radiographer, and regularly resulted in the radiographer 'taking over' the examination or task and the students being left to observe the radiographer perform the action. In one interview, DR7 explained the different levels of supervision, or observation of students, they consider, hinting at the subtle cues they pay attention to.

> *"Yeah, I mean, there are different levels, there's one where you're standing next to the student and the student is collimating, and you just touch the collimation again and like you move the collimation, but it's in exactly the same place. Which kind of throws the student off a bit, they're probably thinking like I've done something wrong. And there's one where, like, you're there, but you're behind the screen, like you know you can check from behind the screen, the collimation and stuff. And then, like having a go, and I just say we'll see where it is, and then after [they take the X-ray], correcting them if there is something, or even before [they take the X-ray] if you need to correct them. Telling them [what to do], rather than like taking over."*
>
> *(DR7 – Interview 1, 21/05/2024)*

There is no indication in this explanation that students verbally seek knowledge from the radiographer; it is therefore likely to be implied by the radiographer that they need to intervene or share their own knowledge to support the student.

Implicit signalling was not limited to student-radiographer interactions. When radiographers worked together, they often performed tasks in synchronisation, demonstrating an intuitive awareness of one another's actions. In Vignette 2, both radiographers fell seamlessly into a specific role; one positioned the X-ray detector, and one positioned the X-ray machine and talked to the patient. This dynamic suggests that radiographers are keenly aware of the actions of others and seek out where they can be useful in carrying out clinical tasks. It may also model non-verbal behaviours to students, making them believe that verbal knowledge seeking is less safe or acceptable.

Whilst implicit signalling appears efficient in knowledge seeking, it also demonstrates that some aspects of knowledge become routine and tacitly embedded in practice. This could lead to a lack of understanding for outsiders, namely students, who are still formulating their knowledge. Additionally, the frequent result of radiographers taking control of the situation when they identify these signals leaves students with limited opportunities for sensemaking of what has gone wrong.

5.3.3. Summary: Non-verbal knowledge seeking

Non-verbal knowledge seeking in the CLE is primarily enacted through observation and implicit signalling. These processes often serve as subtle and socially acceptable alternatives to verbal knowledge seeking. Students frequently observe radiographers from behind lead screens or intermittently whilst carrying out administrative tasks. This passive observation rarely encourages verbal interaction and is limited in purpose. The effectiveness of observation relies heavily on hierarchy, workload and students' desire not to burden staff. Radiographers, however, use observation more intentionally to assess student competence or knowledge level, which is instilled through academic requirements. These instances are followed up with validation, supplementation and modification of student knowledge, although often radiographers take control with limited explanation of why. Radiographers additionally model non-verbal behaviours when acting out their clinical tasks with each other. Despite observation providing the opportunity for actors to witness practice they are not yet comfortable with, there are clear limitations to the reliance on these non-verbal processes, considering the benefits of verbal knowledge seeking processes discussed previously.

5.4. Verbal knowledge sharing

5.4.1. Responding

Verbal responses and advice-giving are the most immediate and observable processes of knowledge sharing used between actors. *Responding* acts as a reactive sharing practice typically used to validate, supplement, or modify. It offers immediate, experience-based knowledge but often lacked overt theoretical grounding, sustaining practical hierarchies and limiting students' epistemic access to deeper reasoning.

Often when radiographers sought knowledge through questioning students on specific elements of clinical practice, for example, carrying out an X-ray, students verbally responded. This explicit knowledge could then be validated, modified, or supplemented accordingly. In Vignette 2, the radiographer asks, "What do you think I am going to do next?", to which the student responds, "Do another one…" The radiographer then verbally *validates* the student's

response and moves on to their task. In another instance, the radiographer modified the students' knowledge once they delivered their response.

> *DR19 asked where the centring points for a lumbar spine would be. They then corrected SR3 when they said it was the iliac crests.*
>
> *(FN, 08/03/2024)*

On the rare occasion that radiographers asked more open questions, students responded and shared their knowledge around educational requirements and competencies.

> *DR19 and SR3 had a conversation initiated by DR19, introducing themselves and asking what SR3's aims for the day were. This started a conversation around spine X-rays, where DR18 also got involved and said that there should be a patient for this later on.*
>
> *(FN, 08/03/2024)*

> *DR2 asked SR8, "How's it going?" SR8 responded that it was ok, but they needed to do spines, and they struggled to do these. DR2 said that they can just position as if they were doing a chest and then bring the collimators in.*
>
> *(FN, 16/04/2024)*

Students responding in this way allowed them to share their needs, priorities, and struggles, which subsequently initiated more knowledge sharing from the radiographer in the form of advice-giving.

Advice-giving was inherently responsive to knowledge seeking practices in practical situations. Radiographers were seen to attempt modification and supplementation of students' knowledge in the form of advice or tips. Radiographers often did this when they perceived there was a lack of knowledge, which required them to impart their wisdom.

In Vignette 4, the students' acknowledgement of their knowledge gap in carrying out wrist X-rays prompted the radiographer to share advice and supplement their practice by suggesting that they feel for specific bones in the wrist. In other instances, radiographers gave students tips designed to supplement student knowledge to make tasks more efficient and effective.

> *Observed DR29 helping SR5, DR4 and another student with a chest X-ray on a severely kyphotic patient. DR29 asked another student to get something to put under the knees and said that it helped to stabilise the pelvis.*
>
> *(FN, 14/03/2024)*

> *DR2 advised SR8 that they could position for a spine as if they were doing a chest, and then bring the collimators in.*
>
> *(FN, 16/04/2024)*

These tips are mostly based on experience and are distant from exact theoretical knowledge. In this last data extract, the radiographer is giving the student a shortcut to positioning the patient, as they do not comment on explicit theoretical knowledge such as centring points or anatomy. This indicates a separation of clinical practice and theory, and that radiographers have developed what they consider more efficient ways of practising and articulating this knowledge than remembering the theoretical positioning information, which is taught to students in HEIs.

This type of advice-giving was witnessed regularly, and it became apparent that the lack of awareness of theoretical knowledge became counterproductive.

> *Observed various lateral knee X-rays being performed today. I have noticed there is a lack of understanding of how to improve lateral knee X-rays. DR21 did one and repeated it; they had turned it the correct way, but it still appeared under-rotated. They asked DR2 about repeating it again, and DR2 stated, "Yeah, just roll it out a bit more". SR6 was observing with me, and I asked them if they had a good way of remembering how to do this, and they went to find an index card that had a tip on it that someone had given them.*
>
> *(FN, 22/03/2024)*

In this instance, when the radiographer asked for advice, they were given the direct instruction but not the schematic for how to do it in future. This suggested that they may have difficulty verbalising the theoretical knowledge which underpins this advice. When students witness practice which is misaligned with what they have learned academically, they have to go through a process of negotiating which knowledge to embed.

> *"Yeah, it might have been taught but only touched over briefly. Like "you could also do this view, but not many people do it", and then they just scoot over it. Then, you find out in placement that's the better way to do it. So, it's like "oh well, which one do I use?" They just say it's a preference thing, so I guess it's just working my way around it."*
>
> *(SR11 – Interview 5, 03/06/2024)*

This suggests that when met with disparities in practice and theory, students are given more practical or experiential rationales, rather than theoretical ones.

Whilst responses and advice-giving are effective for practical knowledge sharing or for filling a knowledge gap, they remain focused on clinical shortcuts or know-how rather than on *know-why*. This limits how much students can develop a deeper understanding of practice and, subsequently, their evidence-based decision making. Again, a hierarchy of knowledge holders is apparent; students would never be seen to give advice to radiographers, and they would only use verbal responses when asked a question. The briefness and task-focused nature of these exchanges means that reasoning is frequently implied rather than made explicit, shaping student learning through exposure to enacted practice rather than through critical explanation. Furthermore, the asymmetry in who responds and who advises consolidates the epistemic hierarchy, positioning radiographers as authoritative validators of knowledge and students as recipients.

5.4.2. Reflecting

Reflecting is a sharing practice motivated by the aim of supplementing or modifying. It allows radiographers to articulate their rationale for decisions through storytelling, metaphor, or decision making, rendering tacit experiential knowledge temporarily explicit. This is often used in a bid to articulate experiential knowledge and add context or credibility to assertions. Advice-giving and responding are often supplemented by these reflective processes, which involve greater depth using analogy or past experience to make it easier to externalise reasoning.

Storytelling was key in allowing radiographers to explain their decisions and understanding of practice through their experiences or past mistakes. Often, this was done as a warning when supplementing or modifying practice, as seen in Vignette 1 when the radiographer discussed the need for the student to remove the patient's t-shirt. They told the student about patients requiring unnecessary further imaging due to clothing obscuring anatomy, which allowed them to share their rationale for their decision. This type of storytelling was also used to modify student knowledge.

> *SR12 did an X-ray and placed their marker so that it obscured some soft tissue. DR16 stated that they shouldn't worry about putting a marker on if they thought it would cover up any anatomy and told them about a situation where they did this and were "told off" for it, obscuring something important on the image.*
>
> *(FN, 29/04/2024)*

Stories were often used as cautionary tales, demonstrating that actors often modified their practice when informed of their own or others' mistakes. DR7 discussed with me how they know they are doing a good job through the absence of negative feedback.

> *"I think it's like not being emailed by reporting rads saying this is how you need to improve."*
>
> *KP: "Where have you developed this understanding of receiving emails from?"*
>
> *"My colleagues. Maybe talking about, oh, you've got emailed about, for example, a chest X-ray or just a portable CXR or something and just some advice or saying that can you please see like [a practice educator] to just improve your technique."*
>
> *(DR7 – Interview 1, 21/05/2024)*

This demonstrated that radiographers sharing stories about their practice being modified developed a collective understanding of what is right or acceptable in the CLE. These situations demonstrated how the process of storytelling enabled actors to verbally share their reasoning for their actions. Furthermore, they illustrated that instances of knowledge modification were perceived as "being told off" or getting into trouble, and that this deeply influenced their own, and consequently others', future practice.

In addition to storytelling as a process of rationalisation, it was occasionally used to initiate discussion and highlight important concepts.

> *DR39 shared a story about doing an X-ray and seeing some horizontal dark lines on either side of the image. They asked DR2, SR7, SR8, and DR21 to guess what could have caused it. We kept guessing, and no one could get it right. They eventually told us it was due to the grid being upside down. This led to more of an explanation of how grids work.*
>
> *(FN 16/04/2024)*

This interaction took place during some downtime where there were no patients waiting for X-rays, and significantly, DR39 is a Manager/AdPr who did not regularly work in the clinical area. These environmental factors were key to knowledge sharing in the CLE and will be discussed in the next chapter. Pertinent to this section is the way the story was introduced as a conversation starter by the radiographer, but enabled a wider discussion, which inspired explicit theoretical knowledge to be shared.

Similarly, when interviewed, all actors used storytelling at some point to further explain their answers to questions.

> *"I mean, I can remember sitting with an AdPr one day and then going back to the department and telling them, actually, we were doing it wrong the whole time, we are looking for the wrong thing. Like, I don't know what it was. It was a joint space, I think in the ankle. And like everyone's always looking for the mortice joint. And everyone was looking for it to be clear, and I think the reporting radiographers were more like they're more interested in it being flexed or something. And then I went back around, and I was like teaching everyone."*
>
> *(DR7 – Interview 1, 21/05/2024)*

Storytelling was clearly beneficial in articulating reasoning and enhancing the credibility of personal claims. However, there was still a reliance on experience, and in particular negative experiences, rather than explicit theoretical knowledge.

Metaphors were similarly used by radiographers to simplify complex ideas or reframe their thinking to make it more understandable. This was seen when I witnessed one radiographer liken learning the ropes in radiography to learning to drive a car.

> *SR6 kept talking about how they don't feel ready to qualify and that things feel overwhelming, especially when they needed to adapt their technique. DR21 kept explaining the process of learning, like driving. "You learn to pass your test, then once qualified, you learn how to really drive."*
>
> *(FN, 22/03/2024)*

At times, metaphors were used to describe how to position patients and how to present the X-ray images once they were taken. For example, when two radiographers were debating which way to orient an axial shoulder X-ray.

> *There was a lot of moving into the physical position with arms out to see how it should look when the patient is positioned. And then DR18 suggested that they were "always told" it looks like a "thumbs up", in relation to [a part of the shoulder anatomy].*
>
> *(FN, 08/03/2024)*

In both instances, metaphors gave the knowledge sharer a way to articulate the message they were trying to relay clearly.

In contrast to these more retrospective reflective processes, thinking-aloud occurred in real-time and was used sporadically by radiographers when carrying out clinical tasks.

> *DR19 directly supervised SR3 whilst performing a spine X-ray. They were in the room close to each other, carrying out this task. When SR3 started to struggle, DR19 took over but started to verbalise exactly what they were doing, also giving reasons as to why they were doing it. I also noticed this with other exams, such as an ankle and foot.*
>
> *(FN, 08/03/2024)*

As I had not witnessed thinking-aloud in other radiographer-student interactions, I asked DR19 and SR3 about the motivations and feelings around this.

> *DR19 appeared shocked that I asked why they did this, almost as if they thought why* wouldn't *they do it. SR3 stated that they had not experienced other rads doing this, but that they found it helpful.*
>
> *(FN, 08/03/2024)*

Thinking-aloud, although not a common practice, appeared to be prompted by implicit signalling of a knowledge gap in the student, as witnessed by DR19. However, rather than step in and complete the X-ray in isolation, as had happened in other instances, they shared their reasoning and explained why they were doing things a certain way, helping the student make sense of the situation.

The reflective processes were most commonly carried out by radiographers and impacted by situational factors and workload pressures.

> *"I think it's just like generally we start talking about what we've like done. Sharing our stories. Because a patient comes in and we'll be like oh I remember last time I had a patient like this, and shall we have a go, this is how we did it last time. And just like showing each other."*
>
> *(DR7 – Interview 1, 21/05/2024)*

> *"I think that one of the big barriers for a lot of people is the workload. When less experienced, perhaps, radiographers have got a lot of patients waiting outside...they'll focus on the immediate."*
>
> *(DR4 - Interview 2, 23/05/2024)*

Although students were keen to share stories with me in discussions and interviews, they often lacked the confidence and agency to do so with radiographers.

> *"I think it is how comfortable I am with the radiographer. So, like, if I'm in a lot of conversation with the radiographer, then I can talk about it. But if I'm just like, doing the X-ray, watching them do the X-ray, then no."*
>
> *(SR3 - Interview 7, 05/06/2024)*

> *"Well, I don't really feel too confident about that because I feel like they should know more than me, so I'm in no position to tell them. And then sometimes when I do think something, I find out that I was actually right. And then I should actually just have more confidence in myself."*
>
> *(SR11 – Interview 5, 03/06/2024)*

Verbal reflective processes such as storytelling, metaphor and thinking-aloud enable actors to externalise experiential knowledge in ways which clarify rationale. These approaches can effectively supplement or modify knowledge through offering clearer explanations and conceptual models to look back on. However, these practices are particularly contingent upon various sociocultural conditions (see Chapter 6) and are not consistently embedded in routine workflows. Consequently, while reflecting has the potential to support deeper conceptual understanding and critical sensemaking, its sporadic and radiographer-led nature reinforces perceptions of who holds valuable knowledge within the CLE.

5.4.3. Summary: Verbal knowledge sharing

Verbal knowledge sharing in the CLE occurred through processes which can be considered as responsive or reflective. Responsive processes were immediately observable as knowledge sharing, as they offered practical solutions to clinical situations and helped others to perform tasks. However, they tended to rely on actors' know-how based on experience, giving little indication as to where the knowledge originated from. This limits how much this knowledge can be interrogated and questioned further by the knowledge receiver. More reflective processes, such as storytelling, metaphor and thinking aloud, provide a means to do this, as there is further clarity and credibility offered as to the knowledge provided. However, there was still an absence of explicit theoretical knowledge shared in these interactions. Again, the data demonstrates a hierarchy where students are placed as knowledge consumers and radiographers shape the flow and framing of professional knowledge, which in turn inhibits students from developing their own rationale for their practice.

5.5. Non-verbal knowledge sharing

5.5.1. Enacting

Knowledge is often communicated in the CLE through physical demonstration or the performance of tasks. This, e*nacting* practice is motivated by validation, supplementation, or modification. It enables embodied knowledge sharing, especially for hard-to-articulate skills, but assumes observers can extract meaning independently, sustaining a culture of 'showing not explaining'.

Actors seemed to revert to enacting when knowledge related to the core radiography task of patient positioning. This is illustrated throughout the data, and in Vignette 4, when the radiographer used their own and the student's body to help explain the process of positioning for a wrist X-ray, thus supplementing the student's knowledge. The radiographer physically felt for specific bones in the wrist and moved the wrist backwards and forwards whilst thinking-aloud. This process not only appeared to allow the radiographer to more effectively express their knowledge but also initiated more social interaction and KS/S practices, such as questioning.

This process of physical demonstration was a common observation, seen across actors and situations, allowing radiographers to articulate knowledge which was deeply rooted in their practice. In another instance, I was speaking to a different radiographer about wrist positioning, and they demonstrated the same tendencies.

> *I was talking to DR21 about trying to explain how to do a lateral wrist X-ray to DR6 on a different day, and how I found it hard to verbalise this information. DR21 started showing me different ways they had been taught in the past by physically demonstrating these techniques.*
>
> *(FN, 16/04/2024)*

These demonstrations were not limited to radiographer-student interactions and were also seen when radiographers required assistance from other radiographers in carrying out positioning tasks.

> *Observed a humerus X-ray carried out by DR3, SR12 was observing behind the screen. When DR3 was carrying out the second view, DR52, who had been doing computer-based tasks, suggested that DR3 did things a different way and went around the screen to show them how to move the patient into the right position.*

(FN, 01/05/2024)

Physical demonstration was also used in actor-patient communication. Both radiographers and students would show patients the position they wanted them to get into by acting this out; this was often done with little verbal communication.

> *I noticed that during examinations, patients are positioned by being physically shown what they want them to do. I.e., with chest X-rays, actors show patients how to stand in front of the board and push their elbows forward with limited verbal communication.*

(FN, 13/03/2024)

This enactment of knowledge is often referred to by actors as "showing" and was perceived as a valuable tool for knowledge sharing in interviews.

> *"So, a lot of the newly qualified radiographers were quite quickly moving into band 6 roles, and there was nobody really around to kind of show people the right way of doing things. So, the idea was that we would work alongside people, and we could provide that experience."*

(DR4 - Interview 2, 23/05/2024)

> *"If I need help, then I'll be like, 'Is that right?', and then they come and show me."*

(SR3 - Interview 7, 05/06/2024)

Physical demonstration was not only one of the most instinctive processes of knowledge sharing in the CLE but also prompted further KS/S such as questioning and reflecting. The use of these methods suggested that valuable knowledge is deeply internalised and therefore more easily shown than stated.

Although demonstration is a direct process for modification and supplementation, it is often preceded by a student first performing a task. Students acknowledge that initially trying to perform an X-ray allows them to indirectly share their level of knowledge, so the radiographer is able to assess this.

> *"Oh, yeah that's another thing, when I'm working with someone, I wouldn't say a long time, let's say I do a couple of X-rays with them. Then they'd see what I am like with the patient and see my skill level."*

(SR3 - Interview 7, 05/06/2024)

Consequently, knowledge gaps are shared and identified, which in turn encourage the radiographer to share their knowledge to supplement the students' knowledge via enacting and reflecting.

> *SR carried out an ankle X-ray, demonstrating knowledge of positioning and which views to do, but the radiographer came in and helped to achieve this more efficiently by moving the whole patient into a different position and moving the X-ray machine slightly.*
>
> *(FN, 07/05/2024)*

> *SR4 started doing a forearm X-ray, and the patient was in a cast, so they were struggling to position for the X-ray views. DR32 went over showing and explaining that you can do it a certain way, which deviates from the way they were taught.*
>
> *(FN, 18/03/2024)*

However, enacting was not always used in combination with verbal knowledge sharing. At times, radiographers would simply perform tasks for other actors when there was a perceived gap in knowledge.

> *DR27 stated that they could never get their head around how to do lateral shoulder views and asked DR28 to help them. "Can I get help?", DR28 went ahead and completed the exam themselves as opposed to talking through what they were doing.*
>
> *(FN 13/03/2024)*

This was mirrored across all actors, particularly when students appeared to be struggling with carrying out their tasks. As previously discussed, radiographers would often opt to take control of the situation by carrying out the task themselves with limited verbal explanation of their process. Whilst this ensured that the task would be completed, it proved to be a missed opportunity for understanding or sensemaking. This demonstrated an assumption that the learner will passively absorb knowledge through non-verbal knowledge seeking methods such as observation.

Enacting, therefore, played an important role in the KS/S of deeply embodied and physical knowledge, which is at the core of radiographic practice. However, there is an assumption in the reliance on these methods that the observer can appropriately interpret, interrogate and internalise the knowledge they see in use. Enactment paired with reflection is interpreted as a more effective process of knowledge sharing; however, this is only performed by perceived knowledge holders, with knowledge consumers conforming to their role.

5.5.2. Modelling

The final concept in non-verbal knowledge sharing is the implicit process of *modelling*, where actors convey their knowledge through action and inaction. Modelling reinforces shared values and priorities in the CLE but often unconsciously privileges certain forms of knowledge, reproducing unspoken hierarchies about what 'counts' in professional practice. Validation frequently occurs through inaction, while supplementation or modification occurs selectively, signalling which aspects of practice warrant correction and which do not.

The modelling of both individual and collective priorities was frequently shared through what an actor chose to act on. In Vignette 1, the radiographer noticed the student's failure to use X-ray markers. They swiftly exited the room to go and get some, subsequently reinforcing the message that this aspect of practice is a priority. To an outsider, the urgency and priority given to this by the radiographer appeared to outweigh any interaction, or lack of, with the patient. They communicated with the student within the patient's earshot, potentially causing confusion or concern, as the patient may not have understood the issue. This interaction subtly modelled that certain professional procedures were non-negotiable and should be rectified before the X-ray goes ahead.

Further to this, during a discussion between radiographers about a clinical task, additional implicit priorities were shared.

> *I was standing, listening to DR16 and DR49 having a conversation about how to document something related to a portable X-ray, and DR13 interrupted to say that there were patients waiting. This conversation then ceased, and a resolution was not found.*
>
> *(FN 29/04/2024)*

This showed that despite the radiographers talking about a work-related issue, the immediate workload and efficiency were deemed of higher priority than professional knowledge sharing and sensemaking between radiographers.

Through modelling, actors could pick up on the types of knowledge which appeared valuable in practice. This is demonstrated through my interview with a student when I asked if they believed academic learning was applicable to practice.

> *"I think it does help anatomy wise or positioning wise, but as a student, I think the [knowledge of how to interpret images and write reports] and things like that, maybe it might come like afterwards in the job."*

KP: So, you mean like looking for pathology and things like that and being able to articulate those things?

"Yeah."

KP: Do you see radiographers use that knowledge? Do they use it within their role?

"Let's say, they took a chest X-ray and they're looking for the NG tube ... then they'd have to know or if anything's like affecting it or where it is ... I think we should still obviously learn the pathology part of it, but it's the way of writing the report."

KP: So, being able to articulate it in a medical sense?

"Yeah."

(SR3 - Interview 7, 05/06/2024)

The student here stated that they do not witness radiographers using medical terminology in a written or verbal format to describe and explain pathology during their imaging tasks. This implicitly suggested that this type of knowledge was not seen as valuable in the CLE.

Radiographers also tended to validate knowledge through their inaction. When radiographers chose not to intervene during a task being carried out by a student, they subtly indicated that they approved of the student's actions. In Vignette 1, the moments where the radiographer does not intervene as the student is positioning the patient suggested that they believed their technique to be correct. This was also shown when the markers were the area of practice which was highlighted as ineffective, implicitly validating the other aspects of practice which were not corrected.

Radiographer actors, particularly those who were part of the clinical education team, recognised the influence of others' behaviours in supplementing and modifying their own practice, and also consciously recognised the influence they may have on others.

"He was always really good with patients and really good with staff. Very sort of open and cheerful and approachable. When I was like a second year, I decided I'm gonna be like him...I had a really good role model."

(DR5 - Interview 3, 29/05/2024)

"I always hope that part of what I do is I try to show people what I do. So, when I go and speak to the work experience student, I do it while the other radiographers are around.

> *Role modelling…as a leader it's important to, you know, be the model that you want other people to follow."*
>
> *(DR4 - Interview 2, 23/05/2024)*

Modelling is a compelling, often unconscious form of non-verbal knowledge sharing. It conveys values, priorities, and expectations through actors' action and inaction. This process was not used as an intentional knowledge sharing strategy, but rather as a mechanism for reinforcing professional norms. This was evidenced through actions such as correcting elements of practice, abandoning professional discussions in preference to efficiency, and validation through a lack of intervention in some situations. Particularly key is the way in which certain types of knowledge are modelled as more valuable than others, a factor which sustains the knowledge hierarchy and the apparent disparity between theory and practice.

5.5.3. Summary: Non-verbal knowledge sharing

The processes of enacting and modelling represent two distinct aspects of non-verbal knowledge sharing in the CLE. Enacting involves the physical performance or demonstration of tasks and was used as a bridge to share difficult to articulate practical knowledge. This practice offers effective and intuitive ways to validate, supplement and modify knowledge, and often triggers valuable verbal KS/S. However, when performed without reflecting or questioning, it reinforces the assumption that knowledge should be sought through observing, which limits understanding and sensemaking. By contrast, modelling often unintentionally shares knowledge around values, priorities, and expectations through action or inaction. This shapes understandings of what knowledge matters and what practices are desirable. Cultural norms such as prioritising efficiency over collaborative discussion can be counterproductive to effective KS/S and highlight the need to recognise the impact of modelling.

5.6. Chapter summary

KS/S in the CLE is a dynamic, relational process which is motivated by initiating, assessing, validating, supplementing, and modifying, where both verbal and non-verbal communication concepts are employed. Across the subthemes, a distinction emerged between knowledge seeking and knowledge sharing practices, though these were deeply interdependent in practice. Verbal knowledge seeking, questioning and instructing are used by radiographers to assess students' knowledge, reinforcing power dynamics and hierarchical tendencies. Limitations in questioning due to a lack of relational safety negatively impact KS/S moments and ultimately the knowledge development of all actors in the CLE. Non-verbal knowledge seeking is perceived as more socially acceptable than verbal engagement and is conducted through observation and

signalling. However, these methods used in isolation are limited in their capacity to encourage understanding, prompt sensemaking, and highlight knowledge gaps. Verbal knowledge sharing occurs through responding and reflecting practices, which allow actors to more effectively share their understanding and rationale. Despite this, these explanations were often firmly based in experiences and mistakes rather than attributed to explicit theoretical knowledge, which is an indicator of why a theory-practice gap pervades. Finally, non-verbal knowledge sharing is seen through enacting and modelling, which again appear to be more intuitive processes of knowledge sharing than the verbal methods.

Collectively, these practices illustrate that knowledge mobilisation in the CLE is rarely neutral. Instead, it is structured by relational status, workload pressures, spatial arrangements, and implicit cultural values about what knowledge 'counts'. Without integration of verbal and non-verbal methods, knowledge sharing becomes guided by assumptions and chance rather than being intentional and multi-directional. Furthermore, there is a risk that practice will become stagnant if these processes are not improved and enhanced due to knowledge gaps remaining hidden.

Figure 5.1 and Table 5.1 synthesise these findings to illustrate the core KS/S practices against the dominant motivations and analytical implications. Together, they demonstrate how knowledge seeking and sharing operate not as isolated events but as interconnected processes that both construct and reproduce professional knowledge in the CLE.

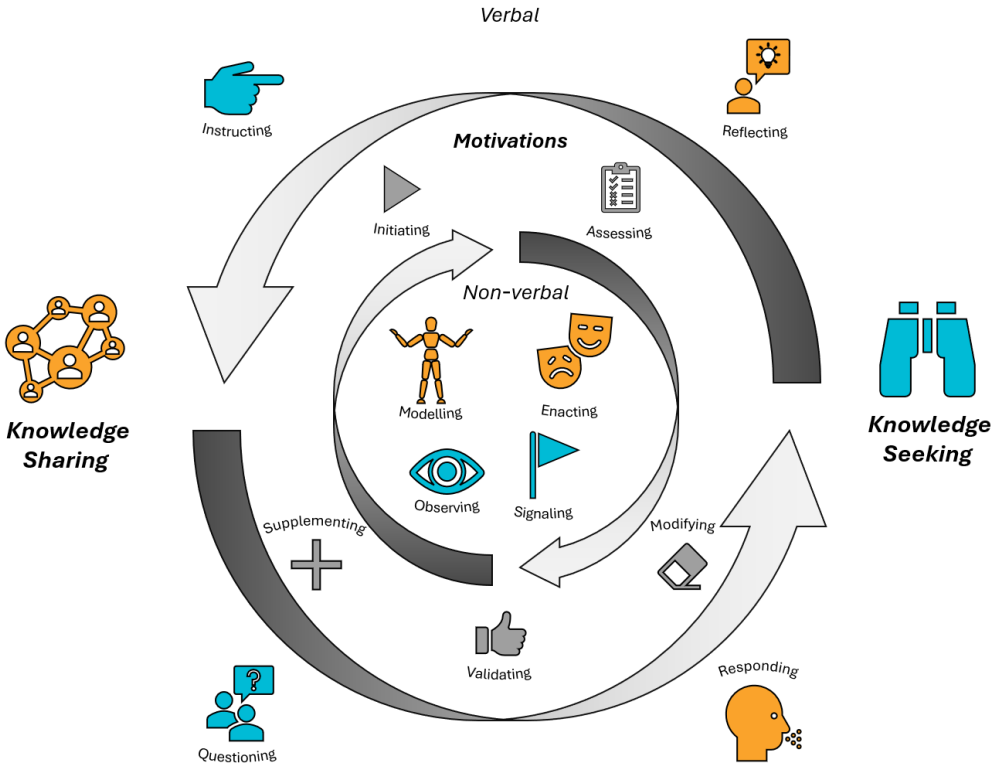

Figure 5.1. KS/S practices and motivations

Table 5.1. KS/S practices thematic mapping

Subtheme	**Knowledge Seeking**		**Knowledge Sharing**	
	Verbal	**Non-verbal**	**Verbal**	**Non-verbal**
Core Concept	***Questioning***	***Observing***	***Responding***	***Enacting***
Analytical statement	*Questioning is a seeking practice motivated by initiating, assessing, and validating. It enables knowledge sharing but currently reinforces hierarchical roles, positioning radiographers as primary knowledge holders.*	*Observing is a seeking practice through which students unobtrusively validate and supplement their knowledge. However, without dialogue, it may limit deeper understanding. Radiographers use observation to assess student competence, reinforcing epistemic hierarchy.*	*Responding is a sharing practice typically used to validate, supplement, or modify. It offers immediate, experience-based knowledge but often lacks theoretical grounding, sustaining practical hierarchies and limiting students' epistemic access to deeper reasoning.*	*Enacting is a sharing practice motivated by validating, supplementing, or modifying. It enables embodied knowledge sharing, especially for hard-to-articulate skills, but assumes observers can extract meaning independently, sustaining an implicit culture of 'showing not explaining'.*
Example codes	questioning, determining knowledge level, validation of own knowledge	observing, fear of doing the wrong thing, student initiative, missed opportunities	clarification of understanding, staff modification, verbal externalisation	imaging task, autonomous practice, physically demonstrating, positioning knowledge
Core Concept	***Instructing***	***Signalling***	***Reflecting***	***Modelling***
Analytical statement	*Instructing is a seeking practice motivated by initiating and assessing. It enables student engagement; however, it frequently inhibits further articulation of reasoning, limiting deeper understanding and reinforcing hierarchical power dynamics.*	*Signalling is a seeking practice motivated by initiating, validating, and modifying. It enables discreet requests for support in busy environments, but often results in radiographers taking over tasks, thereby limiting student agency and reinforcing radiographer control over practice.*	*Reflecting is a sharing practice motivated by supplementing or modifying. It enables deeper articulation of rationale, but is predominantly used by radiographers in informal contexts, reinforcing asymmetrical expectations of who holds valuable knowledge.*	*Modelling is a sharing practice expressed through action or inaction, driven by implicit motivations. It reinforces shared values and priorities in the CLE but often unconsciously privileges certain forms of knowledge, reproducing unspoken hierarchies about what 'counts' in professional practice.*
Example codes	staff verbally instructing, staff initiating, educational task, staff modification	body language, tacit knowledge, assumed knowledge	making mistakes, reasoned knowledge, metaphor, storytelling, problem solving, decision making, thinking aloud	role modelling, good practice, poor practice
Critical Threads	**Motivations:** Initiating, Assessing, Validating, Supplementing, Modifying **Power & Hierarchy**			

6. Chapter 6: Theme 2 – Sociocultural conditions

"A [person] possessing that knowledge without that faculty of exposition might as well have no idea at all on the matter." – Thucydides.

(Thucydides, trans. Crawley, 1910)

6.1. Chapter introduction

In this chapter, I explore the second theme, *Sociocultural conditions,* which identifies the conditions which shape how KS/S practices are used by actors across the CLE. Four subthemes were identified relating to personal, social, organisational, and professional factors, with three key concepts for each subtheme. The subthemes collectively constitute and reflect the culture of the CLE, and along with the key concepts are depicted and summarised in Table 6.1 at the end of this chapter. Again, I draw on extensive fieldwork and interview data to examine how these concepts influence how knowledge is sought and shared in this context. As is the nature of this topic, the findings are not isolated but intersect in ways that reinforce power and hierarchical structures, privilege knowledge types, and maintain the status of students as peripheral in the CLE.

6.2. Personal factors

6.2.1. Agency

The condition of *agency* is shaped by personal traits and internalised roles, which impact actors' willingness or capacity to participate in KS/S. Students with reduced agency participate less in certain clinical and social activities, further reinforcing the epistemic hierarchy. In comparison, actors with greater agency are more able to initiate and participate in KS/S. Confidence, autonomy, and initiative all play a role in actors ability to navigate the CLE, their opportunities for KS/S, and the amount of agency they have.

Agency varied among actors, being enhanced when they felt more confident and diminished when they hesitated to be involved. Observations highlighted how confidence played a part in how much agency the actor had for KS/S. This first instance was initiated by a particularly outgoing and personable student.

> *SR4 was hoping to get a spine assessment done and therefore went to the out-patient department as ED has patients which mostly require adapted technique, and they*

> *needed a "straight forward" patient for a spine X-ray. SR4 asked DR32 if they could run through the process of a spine X-ray with them. DR32 said, "Yes, but first you have to tell me what you know about spines". SR4 stated positioning and collimation knowledge, DR32 corrected them on some points and gave a tip about making sure there was light at 'the back'.*
>
> *(FN, 18/03/2024)*

In this instance, SR4's agency manifested through their initiative and forthcoming nature and subsequently gave them the confidence to ask the radiographer to play out a potential interaction to learn from. This engaged the radiographer in a knowledge sharing interaction where they began by seeking the students' knowledge to guide them in supplementing and modifying SR4's knowledge.

Conversely, I had a conversation with a student who appeared very self-conscious and appeared to avoid engaging in clinical tasks or knowledge sharing interactions.

> *Discussion with a student about feeling self-conscious about their English, and that they often get words mixed up, which can make them uncomfortable talking to people. Also discussed the fact that at home, they wait for their parents to ask them to do something before doing it.*
>
> *(FN, 21/03/2024)*

This student demonstrates limited agency due to various personal traits and their cultural upbringing, which subsequently impacts their ability to initiate valuable KS/S. This lack of agency led to passivity, which ultimately reinforced the hierarchical flow of knowledge indicated in Theme 1.

Some radiographers suggested that they challenge this lack of agency by proactively seeking knowledge from students.

> *"Certainly, the further through the course they get, I really like talking to them about their research proposals and dissertations because by that point they're really interested in something and they go away and they read so much about it that, you know, they're an expert in that particular area…I think that they don't tend to volunteer the information unless you ask for it."*
>
> *(DR4 - Interview 2, 23/05/2024)*

Whilst this attitude may be shaped by professional role, with DR4 being part of the practice educator team. Differences between actors' practice in similar roles suggested that these dispositions were not purely role-based but related to personal traits. Therefore, where students lacked agency, KS/S remained reliant on the radiographer to lead. However, although rarely witnessed, when radiographers exercised agency in seeking knowledge from students, this subtly balanced the hierarchy.

6.2.2. Experience

The level of e*xperience* actors have legitimises their perceived knowledge. Experience is seen to be developed through exposure, autonomy, and making mistakes. These factors require sustained participation in the CLE, which, in turn, positions radiographers as more legitimate than students and potentially devalues students' contributions.

As discussed in Chapter 5, radiographers' knowledge is often rooted in experience and tends to be used and articulated when prompted through a similar situation or relevant questioning. Several radiographers commented on the significance of being "left to it" and making mistakes in their knowledge development.

> *"I wasn't terribly anxious [when I qualified]. I understood you know, the gravity and the potential for calamity of what could happen. I would say that I made a lot of my mistakes in an era of lone working and plain film days. In, like, in the night, you know, you could do a terrible picture, but I knew it was terrible. I didn't have to show it to anyone. That's, you know, that's not something people get to do anymore. Everything sort of gets double-checked and scrutinised. I'm not sure that's a bad thing. I think no, that's a good thing."*
>
> *KP: Do you feel like students are able to make the same mistakes now?*
>
> *"[long pause] No."*
>
> *(DR5 - Interview 3, 29/05/2024)*
>
> *"When I actually qualified, that's when I actually was more confident in everything I was doing and was learning new things like learning my own technique, because then that's when you can like do what you want."*
>
> *(DR7 – Interview 1, 21/05/2024)*

Freedom to make mistakes and decisions appeared to increase confidence and autonomy, and as a result, agency in KS/S. It may be that making a mistake or having to make a particularly

tricky decision encouraged more active embedding of that knowledge and subsequently guided future practice.

Experiences provided radiographers with frameworks for practice, which they articulated through the reflecting practices discussed previously. However, this articulated knowledge appeared to have limited theoretical underpinning. This was amplified when asking actors about their influences in developing knowledge.

> *"I think when I started working at what was [hospital]. There's one radiographer that sticks in my mind. When I was training and just how he was with patients and how sort of sympathetic he was with patients. Mm hmm. And, you know, you could tell sometimes he wasn't personally in a good mood. Yeah. And he had quite a complicated personal life. But he was always really good with patients."*
>
> *(DR5 - Interview 3, 29/05/2024)*

> *"I remember like we used to work with reporters more when like 1 reporter did [a morning session reporting and an afternoon working in the CLE]...We spent more time with the reporters. Yeah. Like when they were more clinical. Yeah. And I think that really helped."*
>
> *(DR13 - Interview 4, 30/05/2024)*

Although this may suggest to the outsider that practice was atheoretical, it may point to the deeply embedded nature of theory, which is so rooted in radiographers' knowledge that it is almost impossible to extricate it and recognise it as such. Instead, radiographers often used their experiences with people and their stories to rationalise knowledge through more socially acceptable means.

6.2.3. Purpose

Purpose operates as a condition which directs actors' priorities and participation. Radiographers focus on clinical efficiency, while academic requirements direct students to KS/S. This concept includes how actors understand their roles and what they perceive as their primary task or responsibility. Misalignment in purpose constrains KS/S practices and reproduces unequal roles, reinforcing a unidirectional flow of knowledge.

I often observed students who remained peripheral in the CLE, at times appearing disoriented, passive, or even bored. Insiders often had dedicated roles, as seen in Vignette 2, where many radiographers were sent to theatre at the beginning of the day, whilst others were X-raying

patients or looking at emails. This suggested a sense of usefulness, which students, who were unable to work autonomously and were not employees of the organisation, were unlikely to feel. The data demonstrated that students often felt like a burden in the CLE, and this related lack of purpose was further reinforced through informal discussions with students.

> *Went to resus with DR16 and SR12. SR12 seemed quite unsure of what to do and was just observing DR16. I asked them if they were ok, and they stated that they felt uncomfortable in that environment as it was noisy and a lot going on.*
>
> *(FN, 29/04/2024)*

> *SR12 helped to bring a patient on a bed in for a chest X-ray, they stood watching by the trolley but the radiographers continued carrying out the procedure without giving any instruction or direction.*
>
> *(FN, 01/05/2024)*

Without guidance or being given a purpose, it may feel quite difficult for students to engage and feel useful in the CLE. However, it became apparent that the academic responsibilities to complete their portfolios were a driver for students, over radiographer requests or patient requirements. A common question posed by radiographers was "Have you got anything you need to get done for your book?", which was met with various responses and often provided reason to act or not act.

> *Watched SR8 observe a child having their leg X-rayed. They were behind the screen observing, and I asked if they were confident with X-raying children, and they said "yeah," they had got it all signed off in their book, but needed help when kids were screaming.*
>
> *(FN, 24/04/2024)*

This demonstrated that portfolios, although necessary to direct student learning, became inhibitory in developing wider knowledge and allowed students to 'opt-out' of clinical tasks when they had completed that section of their book. This highlights the differing priorities that radiographers and students demonstrated, which also impacted the possibility for further knowledge development and sharing.

The use of portfolios, which tended to be focused on specific procedures, formal reflections, and assessments, as a driver for purpose impacted their engagement with KS/S in the CLE. In Vignette 3 when the radiographers are discussing the sacrum request, the student maintains their place in the X-ray room and does not move to listen in and develop an understanding of

this knowledge. Perhaps the student was unaware of the conversation or had a lack of interest, although it may be likely that they deemed it unnecessary for them to pay attention to.

Radiographers' purpose was more firmly rooted in clinical efficiency and task completion, which also impacted on KS/S. Even when KS/S occurred between actors, it was often punctuated with glances at computer screens to remain aware of the clinical workload. This is demonstrated in Vignette 1, where the radiographer checked the patient list before proceeding with more KS/S with the student.

Radiographers often demonstrated a tendency to prioritise their clinical purpose over their teaching or knowledge sharing. This was introduced in Chapter 5, where actors were seen to take over from others who were demonstrating difficulty in carrying out a task rather than using it as a knowledge sharing opportunity. In Vignette 4, the radiographer appeared frustrated with the student taking a while to position the patient for their ankle X-ray and proceeded to carry out the X-ray with limited verbal KS/S. Students further fed into this dynamic of prioritising efficiency by carrying out the administration aligned with patient-facing tasks. Throughout the data, students were seen to be taking a back seat and focusing their attention on the computer, which allows radiographers to quickly perform the X-rays and move on to the next task. This was even more apparent on busier days.

> *Very busy today, students are still doing mostly admin tasks. Students get involved and demonstrate knowledge in subtle ways, such as changing exposure factors, checking clinical history, etc.*
>
> *(FN, 25/04/2024)*

This was identified by one actor in their interview, who suggested an alternative approach.

> *There's some value in being able to process, yes, but there's no value in spending 7 hours a day. When I work with students, I have the opposite approach. I'm the one who, maybe I'm lazy, but I am the one who sits behind the screen and they're the ones who bring the patient in and do all those things.*
>
> *(DR4 - Interview 2, 23/05/2024)*

However, this actor's purpose may be defined by their role within the clinical education team and therefore is not subject to the same pressures that general radiographer staff would be in terms of efficiency and workload.

6.2.4. Summary: Personal factors

Personal factors in the form of agency, experience, and purpose are key influences on the development of knowledge and how it is sought and shared in the CLE. Although these core concepts may seem to signal individual or psychological characteristics, I have interpreted them here to influence and be influenced by the sociocultural conditions of the CLE. In this respect, an actor's agency to participate in KS/S, the experiences they are exposed to, and their sense of purpose, all influence their capacity to participate in, and contribute to, collective KS/S practices.

Students who demonstrate agency through confidence and initiative are more likely to engage and be involved in KS/S, whilst others will remain passive and limited to non-verbal KS/S practices. Radiographers who display high levels of agency in seeking knowledge from students could challenge hierarchical norms in knowledge sharing, although this is uncommon. Experience gained through autonomous practice and making mistakes also appears to enhance actors' perceived value and status, is discussed in the following sections. Students who are limited in opportunity for decision making and error-making are therefore further constrained in their participation in KS/S. Finally, purpose is shaped by structural roles and expectations and plays a significant role due to the misalignment between radiographers and students. Students are driven by their academic responsibilities through their portfolios, whilst radiographers are driven by clinical efficiency. This not only encourages students to disengage from wider opportunities for KS/S but also discourages radiographers from actively pursuing KS/S when they feel it will take more time. These concepts limit reciprocal KS/S in the CLE and reinforce the knowledge holder/consumer roles previously discussed.

6.3. Social factors

6.3.1. Rapport

The social condition of *rapport* is highly influential in actors' social comfort and willingness to engage in KS/S. The data demonstrates that when radiographers build relational connections with students, it enhances other conditions, such as agency and experience. In the absence of rapport, students default to nonverbal, passive roles, limiting multi-directional KS and reinforcing hierarchical roles.

In the section on knowledge seeking (Section 5.2), I discussed that students were more likely to seek knowledge verbally if radiographers demonstrated a willingness to share knowledge first. Open questions about how students were 'getting on' encouraged students to share their needs and often developed into broader knowledge sharing conversations. Although clearly valuable, I

found that these social interactions, to build rapport, were limited between radiographers and students.

When radiographers took steps to build rapport, such as making introductions or asking them their aims, it tended to open space for further KS/S.

> *DR19 and SR3 had a conversation initiated by DR19, introducing themselves and asking what SR3's aims for the day were. This started a conversation around spine X-rays, where DR18 also got involved and said that there was a patient booked for this later on in the day.*
>
> *(FN, 08/03/2024)*

Some radiographers appeared more aware of this dynamic than others, and it was particularly important for senior radiographers who were coordinating clinical activities to model this.

> *There was much more conversation and camaraderie today. There was more physical movement around the space, too. The coordinator kept coming over to the X-ray room, and the other radiographers went over to the coordinator's computer too. There were ` often teasing comments and jokes, or banter, which SR3 also got included in. Radiographers were also more proactive in telling S3 to do X-rays.*
>
> *(FN, 08/03/2024)*

DR22 was particularly sensitive to building rapport with 'outsiders' through ensuring they felt part of the team, as discussed in their interview.

> *"Sometimes I don't know who's coming in and who's not. So, when they pop up, I'm like, oh, OK, "what's your name? What year are you in?"... I don't know what year they are in, and sometimes they don't really update their little tags on uniforms... So, they're part of the team, so you [put their name on the board with the other radiographers]."*
>
> *(DR22 - Interview 6, 03/06/2024)*

However, when there was a particularly quiet or stoic coordinator, radiographers tended to keep themselves to themselves and talk in small groups in the X-ray rooms. This was especially noticeable in the first few days of my fieldwork when I was yet to develop rapport with actors.

> *It can be a bit daunting entering this area, as it feels that people are either busy or having private conversations in segregated areas. It is difficult to know whether to try to engage in conversation or wait for someone to engage me in conversation.*

(RN, 29/02/2024)

Feeling comfortable through effective rapport building was clearly important to students and impacted their agency.

> *"I think it is how comfortable I am with the radiographer. So, like, if I'm in a lot of conversation with the radiographer, then I can talk about that."*
>
> *(SR3 – Interview 7, 05/06/2024)*

> *"I think it's like getting them involved in conversation. I think if the students are comfortable with you and they're involved in the conversation... then I think they talk to you. But the ones that are maybe a bit new and they're more reserved, they might not."*
>
> *(DR4 - Interview 2, 23/05/2024)*

Although most radiographers appeared to prioritise workload and interactions with other radiographers over rapport building with students, a discussion with one radiographer demonstrated a conscious effort to involve a student, which proved critical in their professional relationship.

> *DR14 talked about how they communicate with students and that some are difficult to talk to. They said that there was one student who they found particularly difficult to talk to, so one day they consciously thought they would make an effort with them. So, when they were X-raying a patient with dementia, DR14 put some music on and talked to the patient, asking them to have a dance with them, and the student joined in. After this, DR14 felt that the relationship between them and the student was more comfortable.*
>
> *(FN, 07/03/2024)*

Previous data demonstrated that when radiographers work together, they appear to anticipate the needs of the other radiographer and synchronise their tasks to be more efficient. This demonstrated an element of comfort and trust with the other person that was not apparent between students and radiographers. These examples suggest that student hesitancy and lack of agency may stem from their social comfort and position within a social hierarchy in the CLE.

As radiographers have more apparent power, it may be easier for them to engage students than the reverse, and if this doesn't happen, it leaves students positioned as outsiders. Without a strong rapport, students are likely to fall back on the passive and non-verbal methods of KS/S, and maintain their positions as knowledge consumers, which hinders capacity for effective and multi-directional knowledge sharing.

6.3.2. Status

Actors' roles, along with their social and epistemic standing, are reflected through symbolic *status*. This relates to how actors are perceived and how they perceive themselves in relation to others, particularly regarding the knowledge they hold and its value. Actors also assume implicit roles that factor into their status, such as leading, following, and observing. These factors shape power dynamics and the knowledge hierarchy, as illustrated by expectations and assumptions about acceptable practice.

Radiographers would often tell me that they expected students to take initiative in carrying out tasks, or that students nowadays do not have as much initiative as they "used to." However, there was little evidence to show that these expectations were explicitly communicated.

> *Talking to DR32 about how they feel students act now in comparison to how they did [2 years ago]. Stated that they felt students weren't very helpful or didn't use initiative. I.e., not holding doors when the radiographer is pushing equipment in the theatre. I asked if they thought* they *did this as a student, and they said yes, at least if they were asked once, they would then make sure they did it the next time. They said that with some students, they wouldn't be able to trust that something would be done when they ask.*
>
> *(FN, 18/03/2024)*

Meanwhile, students struggled to understand what was expected of them and even when they did know they felt uncomfortable following through on these expectations.

> *"They say, appoint yourself a radiographer every day. But sometimes they get so caught up in it all and you're just like, what about me? But you understand it cause like it's, you know it's hectic and there's gotta be some understanding [from the radiographers] there I reckon."*
>
> *(SR11 – Interview 5, 03/06/2024)*

Students would reinforce and internalise their lower status within the power structures, often withdrawing to the safety of the computer and the lead screen. Furthermore, the absence of challenge to this dynamic allowed it to be accepted and further enforced, which was demonstrated one day when a work experience student was present.

> *I noticed a person sitting by the side of the computer in the viewing area. They had a name badge on but I couldn't see what it said. Radiographers kept walking past, but no*

> *one really paid them any attention or introduced themselves. Later, I found out this person was a work experience student.*
>
> *(FN, 25/04/2024)*

Being positioned outside the social structures of the CLE can, at times, render those deemed to be 'outsiders' invisible. Physical space also has an impact on this dynamic and is discussed in the next section. However, relational expectations and assumptions often shape actors' perceptions in this regard and subsequently impact engagement with KS/S.

6.3.3. Conformity

Conformity emerges from social pressure to align with dominant norms. Students mimic radiographer practices, even when these practices contradict academic teaching. This is often done without questioning the underlying rationale. This inhibits critical reflection and restricts autonomous decision making, which, as discussed previously, is key in supporting *experience* development. Ultimately, conformity reinforces existing ways of working rather than encouraging modification of knowledge and adaptation, thereby constraining professional growth.

Due to the previously discussed power dynamics, actors were seen to align themselves with the norms and expectations of those perceived to hold more power, which demonstrated conformity. This was most visible when students mirrored the practice and preferences of radiographers, at times without a clear understanding of the underlying rationale. While conformity acted as a social function of 'fitting in', it inhibited questioning, challenging of practice, and the development of autonomy. This is depicted clearly by SR11 in their interview.

> *"Different radiographers have different standards. So, it's more like trying to understand them and what they like, I guess. For example, I did a skyline knee [X-ray view], and I placed the board on the floor rather than on the chair. Some radiographers like it, some don't... so then you've got to change it each time. I've got to ask, "Do you want it on the chair? Do you want it on the floor?" And they say, "do it on the chair," but then I prefer the floor because the board's expensive [and might fall off the chair]."*
>
> *(SR11 – Interview 5, 03/06/2024)*

This demonstrated how students internalised the idea that alignment with radiographer preference took precedence over articulating or defending their own reasoning. These subtle acts of conformity reflected the broader knowledge hierarchy in the CLE.

Further data illustrated how students adapted to the routines and priorities of radiographers whilst in the CLE.

> *Observed multiple X-rays where SR6 stood processing on RIS whilst DR7 and DR30 did the X-rays – most of which were adaptive technique. They were not watching the radiographers positioning the patients, they were just focused on administration tasks and only looked at the outcome of the X-rays rather than interaction with the patient."*
>
> *(FN, 21/03/2024)*

Students were not only conforming to these practical habits, but also to a culture which prioritised efficiency and non-verbal communication over dialogue and social interaction.

As previously discussed, the deference to non-verbal KS/S methods bred a sense of uncertainty around the use of practices such as questioning and reflecting, particularly when students experienced negativity towards questioning.

> *Talking to SR6 about their experiences in other modalities and other departments stating that when they have asked questions in the past, they have been told that "they are a student, and they don't need to know these things."*
>
> *(FN, 22/03/2024)*

The discussion in section 5.5.2 shows how modelling functioned as a practice which shares valued ways of working. Conformity is distinct from modelling and reflects the uncritical performance or reproduction of these demonstrated norms and values. It is reinforced through hierarchical structures and could result in restricted development of knowledge and autonomy in students, as well as stagnation in practice due to a lack of multidirectional knowledge sharing. Without those lower in the hierarchy being given space or permission to challenge norms, they will continue to conform to the status quo, which privileges procedural knowledge over reflective and collaborative growth.

6.3.4. Summary: Social factors

Knowledge sharing in the CLE is deeply relational, and therefore, social factors are significant in how this is shaped. The presence or absence of rapport determines whether actors feel socially safe to engage in KS/S practices and how much agency students must proactively seek knowledge in the CLE. When rapport is weak, students can resort to passivity and non-verbal KS/S, which reinforces them as peripheral and subordinate in the knowledge hierarchy. This status is also sustained by implicit expectations and assumptions amongst actors. These are

rarely verbalised and often misaligned between students and radiographers. When students assume their lower status, they again withdraw from active participation and defer to the more superior knowledge holder. These factors foster conformity, where knowledge and norms are adopted and go unchallenged, which occurs even when academic and theoretical teaching is contradictory. These factors, if accepted, lead to stagnation in practice rather than continuing growth and knowledge development.

6.4. Organisational factors

6.4.1. Structure

KS/S is shaped and facilitated through organisational and academic *structures,* which supplement the inherently contextual, social, and hierarchical process of decision making. While digital systems and policies are valued, they are often used selectively and negotiated through social interactions. Although radiographers focus their use of organisational tools on completing clinical tasks, students are rarely seen to engage with them and appear disengaged when they are used. Students focus on their own structural tools, such as portfolios and assessments, which guide and inhibit their engagement with practice.

Both digital systems and policies and protocols are seen as valuable knowledge sources and used in clinical decision making and sense-making. In Vignette 1, the radiographer observed the student reviewing the computer system before performing the patient's X-ray. The student demonstrated an awareness of what to look for, but was subtly questioned, which initiated a knowledge sharing moment. The radiographer asked, “Have you checked previous imaging?” and “Is there anything else you need to check?” They supplemented this with a cautionary tale, “You need to check these things, you know, we get loads of radiation incidents…”

A similar pattern occurred in Vignette 3, where both radiographers engage in conversation around the protocol for a sacrum request. They consulted the organisational policies to seek knowledge around the technical aspects of the task and then negotiated which views were appropriate through the use of more experiential knowledge and reflection. However, in this instance, the student is disengaged from the KS/S occurring between the radiographers and remains focused on their portfolio in the X-ray room.

Although digital systems and formal documents are clearly valuable in the CLE, they often need to be used selectively and combined with more nuanced personal knowledge.

> *Witnessed DR6 asking DR13 about the justification for a chest X-ray due to the patient having one done the day before. DR13 looked at the computer system and stated that yes, it*

was justified due to there being a new onset of symptoms and that it may be an indication of sepsis.

(FN, 06/03/2024)

DR19 queried a chest X-ray request where the patient had a CT scan request on the system. They asked DR18, who told them to check the X-ray request protocol section on the computer system, which stated that the chest X-ray needed to be done before the CT scan.

(FN, 08/03/2024)

In all these cases, the system was a supplementary knowledge source to the deeply social and cognitive decision making process. Actors deferred to colleagues with the appropriate level of knowledge, often in a similar or more senior position to them, to validate or interpret what the systematic knowledge meant in context.

"I'd probably talk to the band 6 that's leading that day. Just to make sure, like they're on the same page as me... And if they're like, yeah, it doesn't make sense or something, then you talk to the referrer first and get them to agree."

(DR7 – Interview 1, 21/05/2024)

"If it's like a specific view that I'm not unaware of or I can't do it then. I would see if another senior knows."

(DR22 - Interview 6, 03/06/2024)

This type of knowledge then served as one aspect or link in a more complex chain of relational reasoning. In some cases, however, explicit knowledge in the form of protocols was used as both the starting point for reasoning and as a method for gaining a deeper understanding.

I witnessed DR22 referring to physical protocols multiple times to find out what X-ray views should be used. Protocols were available on a flip chart in the viewing area. Also noticed that they were asking other radiographers when the information was not in the protocol, i.e. when they said the clinical indications on the request were a bit obscure.

(FN, 12/03/2024)

"If it was during the day, I'd speak to the [AdPr's], if I needed some advice. But I don't know. I prefer to go and look at the information myself. For me asking someone is a bit of a shortcut. They tell you the answer to the question but I wanna know, a bit more, why? What is the reasoning behind it? Maybe that's because as somebody who does training,

> *I've got to prepare myself to answer questions from other people. But I prefer to find out that little bit more about the situation, rather than just get a "you do it like this" or "we do it like that"."*
>
> *(DR4 - Interview 2, 23/05/2024)*

This illustrated the approach to using structural knowledge was flexible and dependent on context, along with personal and social factors like agency and status. More complex cases revealed how escalation through the institutional hierarchy played a key part in difficult decision making.

> *Big discussion and activity around a request for an NJ tube placement X-ray... DR17 and DR15 looked at the system to try and find any documents relating to NJ/NG tube placement... I asked what they would usually do when they were unsure. DR15 stated that it usually gets escalated up the hierarchy band 6/band 7/AdPrs, unless it is out of hours, where the radiology registrar would be consulted. Finally, DR13 was consulted, who looked at the system for the patient history, where there were discrepancies in whether it was an NG or NJ tube. DR13 stated that it was an NJ tube, and the patient should have an abdomen X-ray.*
>
> *(FN, 07/03/2024)*

Structure here revolved not only around the digital tools and policies and protocols, but also the hierarchical landscape, which must be navigated to develop their clinical reasoning. This was also influenced by who was present and what expertise those people had, which is discussed in subsequent sections.

For students, structure was mostly linked to the academic functions of their portfolio documents and assessments. These tools provided clear direction, which guided their objectives, but often dominated their priorities and focus to the detriment of more holistic learning opportunities.

> *"I've always focused on that [portfolio] and assessment. So other knowledge of [research] I'm not really too focused on... obviously I didn't prioritise my time, not well, so I didn't really have time for [other professional knowledge]."*
>
> *(SR11 – Interview 5, 03/06/2024)*

In SR11's case, these academic structures became both motivator and constraint. They provided purpose, but limited engagement with broader, less measurable, but potentially valuable, forms of knowledge.

6.4.2. Stability

KS/S is further shaped by the *stability* or transience of the CLE, which can undermine consistency in the social interactions required for effective KS/S. This instability is particularly evident in the transient nature of students' participation, unpredictability of workflow, and variation in radiographer presence, which all impact students' ability to gain experience and build rapport. Clinical practice is by nature dynamic and ever-changing, but stability is not just reliant on who is present, but also on how consistent the norms, expectations, and relational dynamics are within the CLE. When students lack continuity, they may struggle to develop their agency, experience, and purpose, leading them to resort to passivity and the consumption of knowledge rather than its sharing.

During my fieldwork, I was acutely aware of how transient students were within the CLE. When discussing their time on placements, students would often comment on the fact that they had been at university the previous week or were going to a different hospital the next week. Their regular rotations through different areas, including imaging modalities such as CT, MRI, and ultrasound, limited continuity in building relationships with radiographers.

> *I went on a portable with DR1 and SR5. SR5 started to tell me about their learning experiences saying that they felt that a lot of things were tick box exercises, that they felt the constant moving between hospitals and departments was a barrier to learning and that they felt each day/week was just a rush to get things signed off… they felt the apprentice students were at a greater advantage being a full-time member of the team in one department and that other staff built rapport with them and supported them more than the degree students.*
>
> *(FN, 14/03/2024)*

The implication of transience for this student was not only logistical inconvenience but a sense of epistemic injustice and social disadvantage, particularly in comparison to other types of students. Furthermore, radiographers noted the impact of being able to monitor student knowledge and progress effectively.

> *"It's just really nice to hear from them because obviously sometimes you just don't know how far they've gone through their book and how much they've got left."*
>
> *(DR22 – Interview 6, 03/06/2024)*

Radiographers would often not be aware or seem concerned with student absence or inconsistent attendance, even when their rota was visible in the department. On a few occasions, I attended expecting students to be in an area to be told they hadn't turned up that day.

> *"Went in to carry out some fieldwork today, despite checking the rota to see if students were in, they hadn't turned up, so I went to the library to do some work instead."*
>
> *(RN, 10/04/2024)*

> *"Same happened again today! I thought about just observing radiographers to see what it was like when students were not there, but the radiographers who were there seemed a little avoidant and very busy, so I left to go to the library again."*
>
> *(RN, 11/04/2024)*

The clinical education team were tasked with keeping track of and arranging student activity and engagement through rotas. However, capacity was clearly an issue and ensuring that students got the exposure needed to complete their portfolios and assessment was a clear priority for DR5.

> *"We've got one student in the 2nd year, they don't attend, but they attended like one day in the last place in the block. Nothing in the previous placement block. And I'm saying [to the HEI]... can I get [another SR] into this area?"*
>
> *(DR5 – Interview 3, 29/05/2024)*

Students, in this sense, are clearly not perceived as critical members of the team who would be missed if they were not to attend. The instability in their attendance, be it planned or not, disrupted their capacity to develop the key conditions discussed in previous sections, such as agency, status, and rapport.

This discontinuity was also seen in Vignette 1, where the radiographer was covering the lunch of the more consistently present radiographers, suggesting that they had had little prior interaction with the student. The hesitancy and uncertainty of the student in this situation may reflect the instability of the working relationships and the emotional strain of adapting to new people and environments on a regular basis. At times, I also felt this pressure, which is documented in my reflexive notes.

> *Realising how much of an impact moving around departments might have on students. At this point, I feel I have developed a rapport with radiographers fairly quickly, as I am in*

> *the same hospital and seeing the same staff, even for only 4 hours a day. This could also be due to my experience and own knowledge. Am I able to resonate with the staff more than students? It is also draining to have to introduce myself to staff, but now mainly students, every time I see new people. Students must have to do this over and over again. Is this devaluing for them?*
>
> *(RN, 22/03/2024)*

Again, SR11's statement about having to adapt to each radiographer's practice emphasised how the instability in working relationships lead to an over-reliance on conformity rather than the development of a stable professional identity.

> *"Different radiographers have different standards. So, it's more like trying to understand them and what they like... I have to ask, do you want it on the chair? Do you want it on the floor?"*
>
> *(SR11 – Interview 5, 03/06/2024)*

This illustrated how frequent interpersonal changes may therefore result in students developing practice which is uncritical, reactive, and compliance driven.

6.4.3. Access

Access to knowledge in the CLE is not guaranteed by mere presence and is shaped by spatial, social and organisational factors. Students often remain physically and cognitively on the periphery of decision making and problem-solving. Whilst senior radiographers sometimes change these dynamics, such shifts rarely lead to prolonged and meaningful inclusion and are constrained by the personal and social factors detailed in previous sections. Informal KS/S often emerges by happenstance when there are rare clinical cases or visual cues, yet the participation and effectiveness of KS/S depend on who is present, their role, and their willingness to engage.

The physical layout and spatial arrangements of the X-ray areas (seen in floorplans, Figure 4.1 and 4.2) were seen to shape the extent to which students were included in KS/S. During my time in the field, students would often assume a position behind the lead screens in the X-ray rooms, while senior radiographers who would coordinate clinical activity worked at the computers in the viewing areas. This created a physical and symbolic separation between these groups.

Spatial dynamics occasionally shifted, however this was rare and instigated through the intentional movement of the senior radiographers rather than students. However, even when this happened, students clearly remained on the periphery of KS/S.

> *There was much more conversation and camaraderie happening today. There was more movement around the space in this area. The senior radiographer kept coming over to the X-ray room, and the other radiographers went over to the coordinating area too. SR3 maintained the position in the X-ray room, however, and rarely moved from this area.*
>
> *(FN, 08/03/2024)*

In Vignette 3, this dynamic was again demonstrated when the radiographers were participating in KS/S, and the student remained in their position in the X-ray room.

These patterns were further reinforced by the institutional hierarchy and perceived roles of radiographers. When more senior radiographers, particularly Managers/AdPrs, or PEs, worked alongside students, other radiographers tended to leave them to it and move off to perform other tasks. This prevented radiographers from developing their own knowledge based on the senior staff's interactions with the students. Not only were they sharing useful clinical knowledge with the radiographer, but also knowledge on how to interact and share knowledge, which radiographers and subsequently patients could have benefited from. Access to knowledge was further determined by convenience and happenstance: who was available, which cases arrived, and whether staff initiated KS/S.

Although there is an element of structure in the form of students' portfolios, due to the nature of radiography work, there was no way of knowing exactly what each day would bring. This was demonstrated in all the vignettes, most specifically in Vignette 3, when the sacrum X-ray led to a dilemma about what decision to make. This was clearly a procedure that did not happen often and therefore required extensive KS/S between radiographers to 'work it out'. As stated previously, radiographers often looked for other radiographers to help them make sense and make decisions. However, this practice was also clearly led by convenience, as the radiographer initially asked me for advice until the other radiographer entered the viewing area.

For students, many situations they witnessed or came across were unique, which may have helped them to develop a broad understanding of professional practice. However, without the need to make the decision, it is arguable how much knowledge they would internalise in these cases. Again, this relied on the radiographers who were having to make difficult decisions to share this process.

Another factor which impacted KS/S and occurred through happenstance was visual cues. Often, actors, having seen an X-ray image, would initiate KS/S in reaction to what they had seen.

> *I witnessed some conversation with DR4 and other radiographers about the imaging of a femur. They were having a discussion about ways to carry out these images and we're using phrases such as "yes that's how I do it."*
>
> *(FN 29/02/2024)*

> *DR4 asked SR6 what they thought about a spine X-ray, if they thought there was any abnormality. There were some degenerative changes which SR6 pointed out and DR4 corroborated but also explained how they thought there was an abnormality with the shape of one of the vertebrae, explaining that the others were square, but this one didn't have the same shape.*
>
> *(FN 21/03/2024)*

The radiographer profession is inherently visual. Arguably, the primary purpose of radiographers is to create images of patients' bodies to diagnose pathology and aid their care. Therefore, perhaps it is not surprising that visual cues played a large part in KS/S in the CLE. However, the way in which this was approached relied on all the other factors discussed here, personal, social and organisational, and therefore lacked consistency and structure. Significantly, both instances were initiated by DR4, who is part of the PE team, and on interrogation of the data, was not often introduced by more junior radiographers.

This is important, particularly as students work most often with junior radiographers who, as they begin their careers, work in these general X-ray imaging areas. This issue was broached in an interview with DR13.

> *"The [senior radiographers] should be in the rooms. But I still don't understand why some just sit at the computer... Some do, some don't."*
>
> *(DR13 - Interview 4, 30/05/2024)*

Organisational requirements for more senior radiographers to do more specialised tasks like image reporting for the AdPrs, or administration tasks for the Managers and PEs, left them spending less time in the clinical areas and around students, which limits the opportunity for access to their knowledge.

Due to the workload in the CLE being so unpredictable, at times, there were lulls in the day when there weren't any patients to see. This allowed informal discussions to take place, which

were at times purely social. This aided in rapport building, but also often involved professional storytelling.

> *There was a lull in workload and a discussion started when I asked DR19 where they trained. Conversation ensued around how different HEIs have different ways of assessing competencies. Here they have an amount of 'numbers' they do and then an assessment where they record if the student passed or failed. Talked about how it is good to record things that need to be improved on for next time.*
>
> *(FN, 08/03/2024)*

Although these conversations were often productive in terms of KS/S, students remained distant from them, as seen in this FN.

> *During some downtime a conversation was initiated by DR35 and around 3-4 other radiographers – SR6 walked off quickly and sat in the X-ray room for a while whilst we talked for around 20 minutes. We talked about interview processes and how DR35 thought that image evaluation in band 5 interviews was misplaced, and it should be more about clinical skills and problem-solving, such as how to fix a rotated knee X-ray.*
>
> *(FN 21/03/2024)*

Despite the finding that pauses in clinical workload allowed for informal discussion time, students appeared to remain distanced from these conversations, which suggested that they do not feel invested in the social dynamic. These data demonstrated a recurring pattern, that even when opportunities for KS/S arise, students remain on the periphery, likely due to the personal and social factors previously discussed.

Organisational feedback mechanisms can be considered as both a barrier and a facilitator to accessing knowledge. Although many of the KS/S practices discussed in the previous theme could be considered as forms of informal social feedback, actors did not consider them as such. Feedback was conceptualised as a formal, top-down, organisational mechanism, rather than an embedded relational practice. There was also an underlying assumption that feedback was only triggered by errors in practice, which further shaped how it was given, received, or perhaps avoided.

Interviews were key in highlighting the perception that feedback was often negative and synonymous with appraisals or communication with management.

> *"I get feedback from my managers… [I have] one-to-ones. I've got one today.*

(DR13 - Interview 4, 30/05/2024)

> *"I get feedback from my manager. Generally speaking, I think if you're not doing the right thing, you are more likely to find out. But the expectation is that you do the right thing, and if you don't do the right thing, someone will tell you about it."*

(DR4 - Interview 2, 23/05/2024)

The idea that you are more likely to receive feedback reactively when you have done something 'wrong' was highlighted by others.

> *"It's OK here, but like I just feel like sometimes. If something goes wrong, they're really quick to say to you, like really quick. No hesitation. But if things are going well. Sometimes it's not as quick as that and I think you need to hear the positive things to make you do better."*

(DR22 - Interview 6, 03/06/2024)

> *In a discussion with a radiographer, the main thing that they talked about was the heavy reliance on protocols and that everything had to be done under the protocols. I asked how they learned these, they said that [when starting at Teaching Hospital] they would often do something wrong or make a mistake and then they would get email feedback stating that it was not the way it should be done, and then in the email they would be referred to the protocols.*

(FN, 30/04/2024)

Some radiographers had the sense that they had never received feedback.

> *"There isn't any to be honest. Never actually got any feedback."*

(DR7 – Interview 1, 21/05/2024)

This radiographer had previously stated that they had not received any emails to modify their practice, and that they had only heard this from their colleagues. Their assertion that they had never had any feedback could perhaps then be conflated with the idea that feedback was generally explicit and negative in the form of written communication.

This idea of feedback from radiographers was opposed to a sentiment from a more senior member of staff who was part of the practice education team.

> *"When we work alongside people clinically, we will give them feedback. And that will be based on whatever they've done. So that will be undoubtedly positive things as well as any*

things they need to work on. And sometimes we sort of document the feedback we are giving people."

(DR4 - Interview 2, 23/05/2024)

These misalignments between radiographers' ideas of what feedback is, how it is received, and what it should include undoubtedly impacted how they shared feedback with students. I discussed this with various students in the field.

I had a conversation with SR1 and SR2 about the end of week reflections that they get radiographers to complete. I asked if they found these useful. They said that they don't really, they just check and see if the radiographer has said anything negative, which doesn't tend to happen. Although they stated that they would be unlikely to give the radiographer their portfolio if they thought that they might say something negative. I asked about feedback and practice, and they said they know they're doing OK because radiographers will periodically say that they're doing a good job.

(FN, 28/02/2024)

This discussion highlighted the element of avoidance of feedback due to fear of receiving criticism and suggested that, despite the explicit need for written feedback in their portfolios, students did recognise the informal, flexible moments of validation they receive in practice as feedback also. This narrow framing of feedback as correction rather than a dialogic and relational process is damaging to KS/S as it promotes fear and anxiety amongst both students and radiographers. There is a clear misalignment of these perceptions between the clinical and educational teams, which suggests inconsistencies in delivery and expectations.

"So, there's a requirement for feedback. From the radiographers who the students are working with and a requirement for reflection. Which I think is important…I think the bar's quite low in terms of quality of feedback. I remember one I read the other week that just said '[students name] is a lovely girl'."

(DR5 - Interview 3, 29/05/2024)

Speaking to S3 about the portfolio. Asked about how they feel about getting the feedback sections filled in and they said it feels like they are a burden to radiographers.

(FN, 30/05/2024)

Feedback, whilst arguably embedded in many of these processes, was largely considered a process triggered by mistakes. This framing discouraged a relational and active approach to

seeking feedback; instead, it contributed to a culture of avoidance and apprehension amongst all actors. Alongside this, the attitudes and experiences around giving and receiving feedback prevented appropriate and useful access to knowledge and participation in KS/S.

6.4.4. Summary: Organisational factors

Organisational structures, stability, and access to knowledge are key in the way in which knowledge is shared, sought and embedded by actors. While structures such as digital systems, protocols, and portfolios are designed to guide KS/S, they at times inhibit learning and are often used selectively and interpreted through social and hierarchical interactions. Instability in the CLE, seen through fluctuating presence, limited relational continuity, and inconsistent student engagement, undermines sustained KS/S practices and consequently knowledge development. These factors are also likely to impact the development of the previously discussed personal and social conditions. Access to knowledge is similarly inconsistent and compounded by students' tendency to remain peripheral to KS/S practices. Knowledge access is rarely equitable or reliable; it is contingent upon departmental layout, who is present, and restricted perspectives of feedback. As a result, organisational structures often reinforce passivity and restrict the capacity for contribution and internalisation of knowledge for those with less power.

6.5. Professional factors

6.5.1. Domains

In this study, the condition of *domains* refers to the different types of knowledge recognised and valued in the CLE. These domains are not discrete or bounded categories but overlapping forms of knowledge which are enacted and valued by actors and the profession as a whole. The use and visibility of different *domains* of knowledge in the CLE vary, with practical, experiential, and procedural knowledge being the most visible and spoken, whilst theoretical and soft skill domains remain assumed and unspoken.

Practical knowledge focused on task completion is by far the most visible and frequently acknowledged domain between radiographers and students. This domain is largely demonstrated through the conduct of X-raying patients and is often adapted depending on the patient’s condition, which leads to challenges in positioning patients for their X-rays. It is shared and sought through non-verbal practices, which leaves other domains of knowledge, which are implicitly used, hidden from the observer.

> *Observed SR3 starting a foot X-ray and struggling when the pt could not cooperate fully. DR7 helped by adapting the positioning with pillows and pads and changing the patient's position. They did this silently without any verbal reasoning as to their practice.*
>
> *(FN, 08/03/2024)*

Here, the students' practical knowledge was insufficient to carry out the X-ray based on the patient's condition. The radiographer demonstrated the use of adapted practical knowledge but did not share the reasoning behind the adaptation. In other cases, there were attempts to identify other domains of knowledge in DR/SR interactions.

> *SR4 started doing a forearm X-ray. The patient was in a cast, so they were struggling to position the wrist and elbow laterally [on its side] for the 'textbook' view. DR32 went over and explained that you can position the wrist ap [flat] and elbow laterally [on its side] when the patient is in a cast. DR32 then allowed SR4 to complete the positioning with subtle instructions from behind the screen.*
>
> *(FN, 18/04/2024)*

Here, the students' practical knowledge was verbally supplemented by the radiographer, but they still provided limited reasoning in relation to other domains, such as theoretical or patient care. Occasionally, theoretical knowledge did emerge, often encouraged and facilitated through specific questioning and more experienced radiographers.

> *DR39 asked SR8 which side they would position the patient on for the lateral view. SR8 answered, and DR39 started talking about the curvature of the spine whilst pointing to the image. DR39 talked about how the divergence of the X-ray beam would better penetrate the joint spaces, allowing for better visualisation on the X-ray.*
>
> *(FN, 16/04/2024)*

> *Observing a calcaneum X-ray, SR12 also observing. DR3 is X-raying and asks DR52 how much they should angle the X-ray tube for an axial calcaneum. DR52 said that the literature says 40 degrees, but it depends on the patient and how far they can pull the foot back, "it's just something that you judge". When carrying out the X-ray, DR52 was giving instructions to DR3 from behind the screen by verbally stating to centre higher and collimate more. When DR3 was not doing it the way DR52 suggested, they walked around and took over.*
>
> *(FN, 01/05/2024)*

These examples demonstrate that theoretical knowledge was often treated as a starting point, acknowledged, but readily overridden by the more experiential and practical knowledge. Some radiographers noted that students held valuable knowledge regarding the theoretical domain.

> *"It might have been like an axial clavicle that we were angling for and none of us could remember how much to angle... I was like, oh, how much is the actual angle, because some people just angle and they don't think about how much it is anymore. We were discussing it and then, obviously, students' knowledge is fresh, and they have the Clark's [pocket positioning guide] book... they were like, yeah, we know how much angle it is."*
>
> *(DR7 – Interview 1, 21/05/2024)*

This theoretical knowledge is framed as 'textbook' and therefore may be considered as not practically or contextually relevant. This may lead to the assumption that student's knowledge is overly academic, or rigid compared to the intuitive judgement based on the experiential knowledge of radiographers. However, there were times when the theoretical knowledge held by students appeared useful for improving radiographer practice.

> *Watching various lateral knee X-rays I have noticed there is a lack of understanding of how to improve these X-rays when they are inadequate. DR21 did one and had to repeat it. They moved it the correct way, but the image was still inadequate, they asked DR2 for advice and DR2 said 'yeah just roll it out a bit more'. SR6 was observing silently, and I asked if they had a good way of remembering how to improve these images. They went to find an index card which had the theoretical information and a tip on how to do it.*
>
> *(FN, 22/03/2024)*

Despite the student being able to reference theoretical and practical information and being closer to the radiographer carrying out the X-ray, they weren't considered by the radiographer and equally didn't deem it appropriate for them to share this knowledge.

There was a clear distinction between knowing and doing which was reinforced when the development of professional knowledge is discussed. There was a shared sentiment that 'real' learning began after qualification which was related to the development of autonomy.

> *"SR6 kept talking about how they didn't feel ready to qualify and that things feel overwhelming especially when they need to adapt their technique. DR21 explained the process of learning like driving. 'You learn to pass your test, then once qualified you learn how to really drive'. DR2 agreed, saying that it was when they had to make decisions for*

> *themselves on night shifts and when they were uncomfortable that they learned the most.*
>
> *(FN, 22/03/2024)*

Students also noted that theory feels disconnected to practice and that they struggled to make it 'fit' with the adaptive nature of practice.

> *SR6 talked about memorisation of information coming easily to them but then it is the application of that information which they found particularly difficult in the CLE.*
>
> *(FN, 21/03/2024)*

Despite the implicit deference to practical and experiential knowledge, when questioned, actors suggested that the most important bits of knowledge to them were related to organisational or procedural domains.

> *"The protocols and the policies. 100%... especially with things changing... before it used to be just one set protocol, but now there's a hospital referral one and then there's the GP one."*
>
> *(Interview 6 – DR22, 03/06/2024)*

> *"I think it's like having the different bands as well... like a band 5 tries to work it out themselves but they know if they can't there's always the band 6 that probably knows... we've got like loads of protocols... intranet... and like knowing where to find them."*
>
> *(Interview 1 – DR7, 21/05/2024)*

These perceptions differed dependent on the role or expertise of radiographers. In the case of Managers/AdPr's and PE's there were different responses.

> *"As a radiographer you need to have the balance between the clinical expertise and being able to interact with people. You know, as a clinical educator I need to be able to talk to radiographers about issues... But also, the knowledge to be able to look at the X-ray and discuss what's going wrong. That applies in every area that you're working in, being able to interact with the patients, communication, being able to have that small talk with patients, which a lot of people don't seem to bother with anymore."*
>
> *(DR4 - Interview 2, 23/05/2024)*

> *"Patient care, patient care, patient care. I think that's gone out of the window too."*

(DR13 - Interview 4, 30/05/2024)

Whilst early career radiographers appear to rely heavily on practical and procedural domains, more experienced or specialised radiographers draw on multiple domains, and place emphasis on patient care and soft skills. As seen in previous data theoretical knowledge was also demonstrated mostly by these more senior specialists. These radiographers, who appeared most capable of making these integrative links between domains, were often those least present in the CLE, due to other office-based duties, and therefore least likely to interact with students daily.

These data show that students possess strong theoretical knowledge but struggle to apply it and to recognise it in practice. Their perceived limited understanding of the domains favoured by radiographers may explain their standing in the knowledge hierarchy and affect their capacity to practice KS/S. Early-career radiographers, who most frequently supervise students, appear less likely to explicitly articulate theoretical and soft-skill domains when sharing knowledge. In contrast, more experienced radiographers are more likely to draw across multiple domains when explaining or justifying practice.

6.5.2. Value

Value is a condition which attends to the implicit value actors place on knowledge. It is demonstrated through who is afforded higher status and what is rewarded or 'punished' in practice. Across the dataset, knowledge which visibly assists in carrying out technical and clinical tasks appears to hold the highest value and is thus treated as the most useful in radiographers' everyday practice. This knowledge, related to image acquisition, patient positioning, protocol adherence, and efficiency, is consistently prioritised and sought out over theory, communication, patient care, and research. These implicit valuations are embedded in the daily routines, modelled behaviours, and in what goes unsaid or unchallenged.

This concept was evidenced in how radiographers responded to clinical tasks and in what they communicated with students. In Vignette 1, the radiographer comments repeatedly on the students' use or non-use of X-ray markers. This indicated a clear priority placed on procedural accuracy, yet no discussion was encouraged around the students' interaction with the patient.

Interactions with patients and their carers often fell below my own expectations, as witnessed in this observation.

> *"I helped to bring an older patient into the X-ray room who was accompanied by their relative. I assisted with manual handling to slide the patient across onto the X-ray table*

> *and noticed the relative seemed quite stressed and was hovering over us whilst we did this. The actors were all focused on getting the X-ray done and positioning the equipment to take the X-ray. As the relative still seemed anxious, I asked if everything was ok. They stated that the patient had paper thin skin, so they were worried about them being moved. Whilst I had this conversation, DR41, DR51 and SR11 were all carrying out the X-ray without any verbal communication."*
>
> *(FN, 30/04/2024)*

In some cases, problems in communicating with patients caused distress among the patient and the actors.

> *A male patient came for an abdominal X-ray and was given an inclusive pregnancy form to complete, which they refused to do… DR14 consulted DR13… DR13 explained to the patient that it was 'policy' and that they could not proceed unless they did this… This encouraged further debate and conversation amongst the team about how they felt uncomfortable asking this, although they stated that they knew it was something they had to do for their job.*
>
> *(FN, 07/03/2024)*

In this case, rather than reflecting on potential communication strategies, actors positioned the issue as part of a procedural domain - that the issue was the policy itself rather than the practice of communicating it. In discussion with DR13, they indicated an awareness of a gap in patient care knowledge, but appeared at a loss as to how to improve this.

> *"If an inpatient comes [for their X-ray] and they wet themselves… [the radiographers] think it's not their responsibility… Once they got that patient under their care… that's the duty of care… But I think that's lacking. And I feel like, you know what, I try my best, but I can't teach it. I can't teach it."*
>
> *(Interview 4 – DR13, 30/05/2024)*

Whilst these data demonstrated that some radiographers valued softer skills such as attending to a patient's needs, such knowledge was not embedded culturally and therefore was perceived to be unteachable. Despite this, some radiographers reflected on how more holistic knowledge aids them in completing clinical tasks.

> *Had a discussion with DR9 about academia and research. They talked about how they look at social media a lot and see what people are getting up to. They have gained*

> *knowledge of autism on there, and they feel this has affected the way they talk to patients. They feel they are able to pick up on patient needs more effectively. They also discussed the short amount of time that they have with patients to be able to judge their needs. They counteract this by trying to gauge this during the walk to the X-ray room. They seemed to enjoy discussing this, but students were not around to hear it.*
>
> *(FN, 29/02/2024)*

This suggests that soft skills were valuable but often self-motivated and self-directed. When used in isolation by radiographers, it was unlikely to be seen by others, particularly students who remain on the periphery, focused on seeing the result of an imaging interaction rather than the process. The value of technical and procedural knowledge was also reinforced by what students were primarily expected to achieve, directed by their portfolios and assessments.

> *Got talking to SR5, who said they needed to do a spine and portable assessment, so that was their target. Shortly after a spine arrived, the student went with DR15 to do it. There was little verbal communication, and DR15 started doing the exam with SR5 closely watching in the room.*
>
> *(FN, 14/03/2024)*

As stated in the domains section, radiographers earlier in their career tend to focus on more procedural domains and move to value other domains as they progress. In interviews, the order in which DR22 discusses the knowledge they deemed important indicated the value hierarchy they attached to different types of knowledge.

> *"The protocols and the policies. 100%... And everything like patient care and stuff like that... when it's busy, you just feel like 'let's just get this done'... So, I think definitely understanding them [patients]... communication is very important in making them feel like safe."*
>
> *(Interview 6, 03/06/2024)*

Previous data demonstrated how more experienced and specialised radiographers value and utilise these different domains of knowledge in a more balanced way. However, their absence in the CLE means their values are less consistently modelled. In their absence, students therefore internalise and attribute higher value to more procedural and task-driven domains.

The misalignment of knowledge *value* across the CLE community creates ambiguity about which knowledge counts in practice. As students spend most of their time with early-career

radiographers, they are predominantly exposed to knowledge framed around technical competence and efficiency. As a result, the knowledge most frequently witnessed and reinforced is that which enables the immediate completion of clinical tasks. Softer skills and theoretical reasoning may be enacted tacitly, but they are less often foregrounded as domains requiring deliberate attention or articulation. This has implications not only for patient care but also for KS/S itself, as relational and dialogic dimensions of practice remain under-articulated and undervalued.

6.5.3. Justification

The final professional condition is that of knowledge *justification*. In the CLE, knowledge is rarely legitimised through theoretical reasoning alone; it is negotiated through practical outcomes, interpersonal agreement, and alignment with cultural norms. Throughout the fieldwork, it is apparent that new knowledge is accepted if it results in successful imaging outcomes or is modelled by radiographers with higher epistemic status. This represents a culture of accepting 'what works' practically rather than what aligns with training or explicit reasoning.

In Vignette 3, the radiographer drew on procedural knowledge through protocols to understand and make a decision on the sacrum request. However, they quickly defaulted to an internet search, allowing them to decide on a more pragmatic approach, stating "just an AP will be fine". The decision was not defended through reference to explicit standards but was accepted by the second radiographer as it was an efficient and practical outcome. Similarly, another interaction saw multiple radiographers working together to achieve an unfamiliar and challenging X-ray view of the shoulder.

> *DR2 was X-raying a patient on a trolley, the request specifically asked for an axial view. The patient was on a trolley and had difficulty moving their arm, so they had to do an inferior/superior [X-ray from underneath the arm]. DR2 looked unsure about what to do, and DR4 went to assist. DR13 also came to help. They took some time positioning, and the resultant image was inadequate and needed to be repeated; the radiographers seemed unsure of how to achieve this image. DR13 asked me if I had any ideas. I stated that I would put the detector between the head and shoulder, but that this might be difficult due to the detector size. The resultant image was adequate. SR6 was observing and stated that they thought this looked too difficult and seemed intimidated. DR13 seemed excited that we had all worked together to produce this image and said that they wanted to try and get all staff to take pride in their work like this.*
>
> *(FN, 22/03/2024)*

This demonstrated that the observable outcome of the adequate image and peer endorsement was not inherently problematic. However, due to the seemingly trial-and-error approach, the reasoning behind the actions lacked transparency and explanation, especially to the student who thought that the task was too challenging and daunting.

This lack of critical reasoning leaves students exposed to contradictory practices with minimal explanation. When asked, SR11 stated that when they carried out an X-ray in a particular way misaligned with the supervising radiographer, they would be challenged as to why they were doing it that way.

> *"So, you have to constantly explain yourself... [they say] you should do it this way. But then sometimes... a radiographer will say do it the other way, so they contradict each other."*
>
> *(SR11 – Interview 5, 03/06/2024)*

Similarly, when taught something theoretical, they would be told by a radiographer in the CLE that the knowledge isn't useful and they should discount it.

> *"Apparently, we don't really do like the 10-day rule or like the 28-day rule [at the CLE]. And that was something [the lecturer] really dug into us. Then we come on placement to find out, oh, we don't really do that."*
>
> *(SR11 – Interview 5, 03/06/2024)*

These examples demonstrate that students are left to reconcile inconsistencies without any explanation or guidance. These localised or personal practices overruled theoretical knowledge, and students were expected to adapt and accept knowledge rather than question it.

When radiographers clearly disagreed on practice, often there was no verbalised justification or negotiation which could be interpreted by the student observing.

> *Observed a humerus X-ray carried out by DR3, SR12 observed. There was no communication between them. When DR3 was carrying out the second view, DR52, who had been doing the computer side, suggested that DR3 do things a different way and went around the screen to move the patient into the right position. Part of the humerus was missing from the image, and DR3 went to send the patient away, but DR52 stopped them and said they needed to repeat it.*

> *No communication as to why there were different decisions here. This also prevented a clear understanding from my side of their decision making process, so maybe the student was also unable to make sense of this decision*.
>
> *(FN, 01/05/2024)*

Justification, therefore, becomes a privilege of experience and positions of power. Those with seniority or experience retrospectively frame their actions as appropriate. Whilst students have to conform, often blindly, without full access to the reasoning behind decisions. This, again, contributes to the epistemic hierarchy in that only specific actors can define what counts as justified knowledge.

6.5.4. Summary: Professional factors

Understanding of how professional knowledge is perceived through the concepts of domains, value, and justification underpins all KS/S in the CLE. Across practice, certain domains of knowledge, specifically practical, procedural, and experiential, are most visible and preferential, which makes them more readily mobilised between actors. In contrast, theoretical knowledge and soft skills are often assumed, marginalised, or treated as secondary. This not only impacts practice and makes it more task and efficiency focused, but also gives more power to those who hold knowledge in the favoured domains. The value given to these different domains is illustrated through what is corrected or actioned. Furthermore, how knowledge is justified and embedded in practice reinforces these ideals. Knowledge is legitimised through successful task outcomes or group consensus, rather than discussed and reasoned in relation to theoretical knowledge. These factors form the foundation of the knowledge hierarchy and demonstrate who holds power in the CLE and why.

6.6. Chapter summary

The sociocultural conditions discussed in this section are illustrated and summarised in Figure 6.1 and Table 6.1. These conditions fundamentally shape the dynamics of KS/S among actors in the CLE. Personal factors such as agency, experience and purpose influence individual engagement with KS/S. Social factors affect how and when actors interact and share knowledge. Organisational conditions, such as structure, stability and access, reinforce hierarchies and determine who can meaningfully contribute to KS/S. Professional norms govern how knowledge is categorised, valued, and justified, and maintain a culture which privileges efficiency and experience-based knowledge. These interwoven conditions create a culture in which students remain passive, peripheral participants. Furthermore, this culture reinforces the

expectation that knowledge holders should not be challenged and that knowledge gaps should not be exposed or supplemented by those with less power.

Chapters 5 and 6 reveal the contextual, relational, and culturally influenced nature of knowledge sharing in clinical UgDR education. In examining KS/S practices, I demonstrated that whilst knowledge is shared and sought through both non-verbal and verbal means, these practices often privilege experiential and procedural knowledge sharing. By favouring non-verbal KS/S, theoretical and interpersonal knowledge remains largely implicit and unacknowledged. Students remain firmly in the position of knowledge consumers, whilst radiographers who perform clinical tasks effectively and share practical knowledge through experience are perceived as knowledge holders.

Crucially, the findings identify that KS/S practices are not isolated from sociocultural factors but intrinsically connected and influenced by them. Without personal agency, a sense of purpose, and a strong rapport with others, students remain peripheral to KS/S. Yet these same concepts are undermined by organisational and professional factors such as stability, access, and the implicit valuation of knowledge. This creates a catch-22, where students are expected to develop autonomy, critically engage with knowledge, and bridge the theory-practice gap in a system and context that culturally inhibits them from doing so. Unless these conditions are addressed, knowledge sharing is likely to remain one-directional, limiting opportunities for reciprocal KS across all levels of experience and narrowing the knowledge which can inform practice.

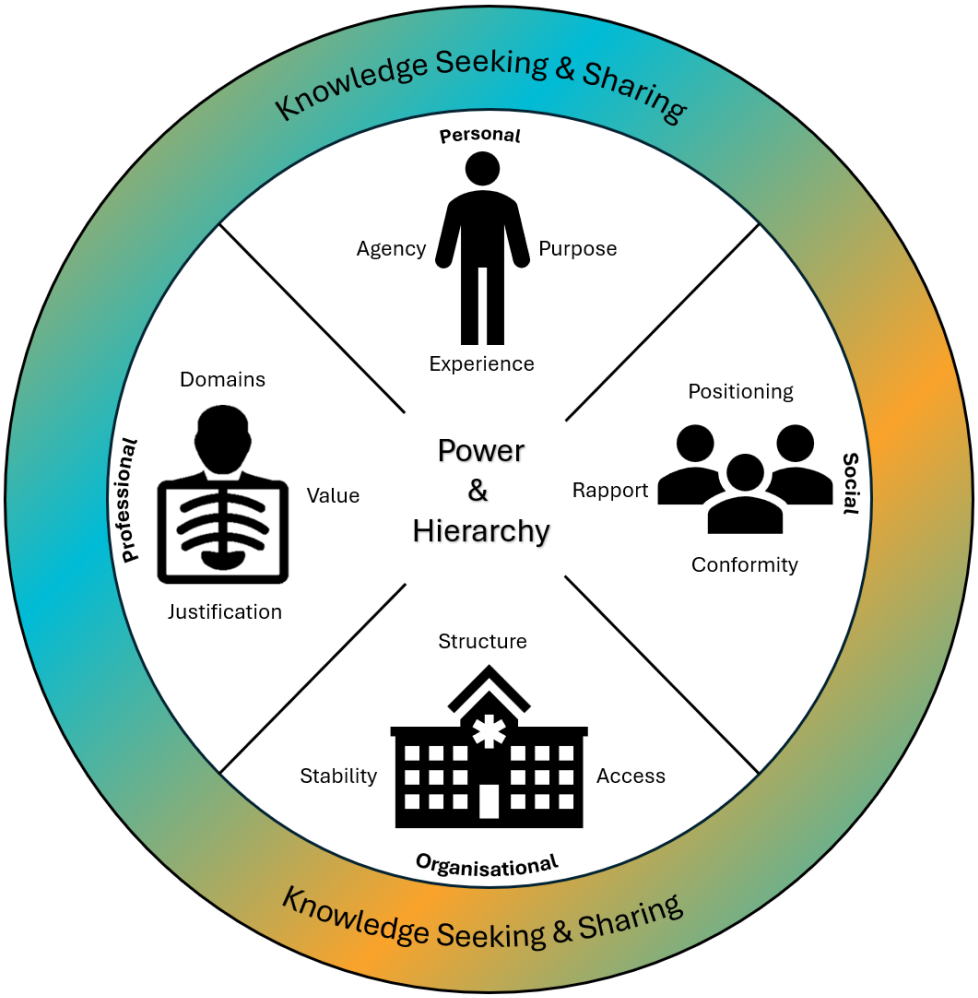

Figure 6.1. Sociocultural conditions of KS/S and power in the CLE

Table 6.1. Sociocultural conditions thematic mapping

Subtheme	Personal	Social	Organisational	Professional
Core Concept	***Agency***	***Rapport***	***Structure***	***Domains***
Analytical statement	*Agency is shaped by personal traits and internalised roles, which impact willingness or ability to participate in KS/S. Low agency can limit active participation and reinforce hierarchies, high agency enables challenge and reciprocity but is rarely modelled.*	*Rapport influences social comfort and willingness to engage in KS/S. When radiographers build connection, students gain agency. Without rapport, students default to non-verbal, passive roles, reinforcing their marginality in the CLE's knowledge hierarchy.*	*Structure refers to the formal systems that organise KS/S, but in practice these are selectively used, interpreted through social interaction and hierarchy, and often bypassed in favour of interpersonal or informal routes.*	*Knowledge domains are used unevenly in practice. Practical, procedural, and experiential knowledge are prioritised and shared visibly, while theoretical and interpersonal domains are often implicit or overlooked. This reinforces the theory-practice gap and limits students' participation in KS/S*
Example codes	agency, initiative, confidence, personal traits, student value	rapport building, humour, informal conversation, gossip, trust	protocol-policy, organisational knowledge, logistical knowledge, knowledge of knowledge sources	practice knowledge, theoretical knowledge, procedural knowledge, experiential knowledge, patient care knowledge, communication
Core Concept	***Experience***	***Status***	***Stability***	***Value***
Analytical statement	*Experience legitimises knowledge and practice, which is developed through exposure to practice, autonomy and making mistakes. Students' limited in these factors demonstrate low legitimacy, which subsequently reinforces power asymmetries and devalues contributions, restricting students' credibility and engagement in reciprocal KS/S.*	*Status reflects actors' social and epistemic standing. Implicit assumptions about knowledge value assign students subordinate roles, rarely questioned or clarified. This disempowers students and upholds hierarchical norms that limit mutual KS/S.*	*Stability reflects consistency in people, roles, and routines. Its absence undermines rapport, continuity, and agency, restricting students' ability to internalise knowledge or develop autonomous professional reasoning.*	*Value refers to which domains are prioritised in the CLE. Technical and task-focused knowledge is reinforced through expectations, feedback, and modelling. Soft skills like communication or patient care are less visible and often seen as intuitive rather than deliberately taught or shared.*

Example codes	experience levels, making mistakes, staff confidence in knowledge, layering knowledge, and autonomous practice	assumed student knowledge, expectations of staff knowledge, staff expectations of student learning, hierarchy, staff role regarding student learning	workload, environment, downtime, missed opportunity to involve students, student organisation	value attributed to holding knowledge, validation of own knowledge, student value, priority over holistic patient care
Core Concept	***Purpose***	***Conformity***	***Access***	***Justification***
Analytical statement	*Purpose directs actors' priorities and participation. Radiographers focus on clinical efficiency, while students are driven by academic requirements. This misalignment constrains KS/S and reproduces unequal roles, reinforcing a unidirectional flow of knowledge.*	*Conformity emerges from social pressure to align with dominant norms. Students mimic radiographer practices, even when contradictory to academic teaching, without questioning rationale. This inhibits critical reflection, restricts autonomy, and preserves a status quo that privileges procedural over developmental KS/S.*	*Access to knowledge depends on proximity, timing, context, and social dynamics. It is unequally distributed and shaped by spatial, relational, and cultural factors, often reinforcing existing hierarchies.*	*Justification is how actors legitimise decisions or knowledge. In the CLE, this occurs through successful outcomes or senior endorsement, not formal reasoning. This outcome-driven logic reinforces hierarchy and leaves students with limited access to how or why decisions are made.*
Example codes	sense of purpose, priorities, differing priorities, admin tasks, portfolio	role modelling, observing, lack of critical thought, unreasoned knowledge, and modification of student knowledge	proximity to person, visual stimulus, informal conversation, formal feedback, convenience, happenstance	reasoned knowledge, unreasoned knowledge, hierarchy, trust in the knowledge holder, clarification of understanding, gaps in staff knowledge
Critical Thread	**Power & Hierarchy**			

This page left intentionally blank

7. Chapter 7: Discussion

"What we know matters but who we are matters more"
- Brene Brown

(Brown, 2015: 22)

7.1. Chapter introduction

In this chapter, I critically discuss the findings of my study, explaining and aligning them with the research aim and questions, the literature review, and the theoretical framework. I begin by positioning the findings within the practice-based education landscape and arguing for a reframing of understanding through the application of mindlines theory. I provide an adapted framework of mindlines (the Mindlines in CLE (MiCLE) model) to illustrate how KS/S practices extend beyond formal teaching and learning, into tacit, embodied, and relational processes, influenced by individual, collective, and institutional conditions. Subsequent sections explore how these practices are facilitated and constrained in the CLE, drawing on existing literature to demonstrate where current knowledge is extended, challenged, or reframed. Through this discussion, I pose four theoretical suppositions which articulate the original contribution to knowledge in this thesis and offer a framework for future practice and inquiry. In these suppositions, I offer recommendations for dedicated stakeholder groups to improve and build on the practices and conditions apparent in the findings. The chapter culminates in my own reflexive account of how I see my ethnographic work as the embodiment of mindlines in researcher practice.

7.1.1. Research aims and objectives

The aim of this research was to explore how knowledge is accessed, shared, and developed between students and radiographers in an NHS CLE. The research was guided by the following questions:

> **RQ1:** What are the motivations for students/radiographers to share and develop their knowledge?
>
> **RQ2:** How do students/radiographers seek and share new knowledge?
>
> **RQ3:** How does the culture of the CLE impact knowledge sharing between students/radiographers?

7.2. Reframing clinical knowledge and learning through mindlines

7.2.1. Theoretical repositioning and reasoning

A key argument made at the beginning of this thesis was that radiography knowledge is often conceptualised in explicit categories and taught in silos. Despite some acknowledgement of tacit knowledge and its importance in clinical practice, there had been inadequate empirical study of how it was developed and shared in the CLE. It is apparent from this research that there is still a tendency to lean into these traditions and value certain types of knowledge which are primarily technical and practical. This pervading perspective limits the exploration of both tacit knowledge development and the visible integration of explicit and tacit knowledge, which are clearly apparent and deeply significant in the CLE. As stated in Chapter 2, the limited understanding we have of clinical learning in radiography education is often framed around pedagogical approaches such as SBE, reflection, and PBL. However, the findings of this study demonstrate the dynamic nature of clinical learning in a hospital which is ruled by organisational structures and instability, and professional knowledge value. Pedagogical approaches, although shown to add to student preparedness for clinical learning, may fall short in being directly transferable to the CLE.

7.2.1.1. Limitations of learning theories

Previous theories on learning within a workplace setting support findings from this study, stating that practical knowledge of the job is mostly learned in a clinical setting. Kolb's (1984) experiential learning theory (KELT) is at times applied to practice-based education in healthcare and has historically been used to discuss the way radiographers learn (Fewster-Thuente and Batteson, 2018; Flott and Linden, 2016; Fowler, 2002). KELT defines learning as a knowledge creation process where learners develop and modify their practice based on their experience in the learning environment. This assertion supports the findings of this study, which demonstrate that students in the radiographer CLE develop their knowledge through a dynamic and iterative process. Additionally, Eraut's (2004) workplace learning theory (WLT) also discusses the largely invisible learning essential in developing decision making and problem-solving skills. Both KELT and WLT emphasise the centrality of the *learner's* experience and how *teachers* should facilitate an optimal environment for learning. However, this focus on the learners leads to assumptions about how staff in the workplace prioritise and share their knowledge to create this supportive environment.

Guidance on practice-based learning states that education providers are responsible for ensuring quality, effective, and supportive environments for students, encouraging the use of

practice educators to do so (HCPC, 2017). However, it is clear from my findings that most radiographers have different priorities than students and often focus on efficiency and task completion over knowledge sharing with students. This is not necessarily surprising, considering they are healthcare professionals, not teachers. Although PEs are now commonplace, I found that they were not a consistent presence due to various responsibilities and limited numbers. Equally more experienced and senior staff were not as present due to the evolving demands of imaging departments. This leads to junior radiographers, who are still developing their own clinical knowledge and judgement, being a greater presence and influence on students. Rather than trying to counter these issues by ensuring senior and specialist radiographers become a more constant presence, there is an opportunity to encourage a relational culture of knowledge sharing by harnessing the processes already apparent, developing KS/S practices, and curating a KS environment. Not only will this aid students in their learning, but it will also highlight gaps in radiographer knowledge, which can be supplemented and modified accordingly by all actors. This would also highlight areas which could be explored or supported through research and encourage evidence-based practice in the long run.

7.2.1.2. The absence of a sustained CoP ethos

Communities of Practice (CoPs) and legitimate peripheral participation (LPP) are commonly used to examine how social interactions and shared experiences influence the transformation from novice to expert (Lave and Wenger, 1991). CoPs have been considered in the radiography context and have been suggested as a solution to the at times atheoretical approach of radiographers. They are considered to mitigate issues related to decision making, problem-solving and critical thinking and are also said to be beneficial to students in the CLE (Ramazan et al., 2024). However, the characteristics which make up effective CoPs include “shared enterprise”, “bringing in new ideas”, “regularity and rhythm”, and “a group that get on well”, allowing for constant social interaction to share their intersecting knowledge (Barab et al., 2006; Gabbay and le May, 2011). It is also suggested that learners should have practical experiences directly aligned with recent theoretical teaching, indicating that synchronisation between formal education and clinical practice is required for effective learning (Dong et al., 2021; Kolb, 1984).

The cultural landscape of Teaching Hospital, described initially in section 4.2.4, and the norms shared throughout the vignettes and findings chapters, suggest that the CLE demonstrated a partial CoP ethos among radiographers, but this was not consistently extended to students. Although elements of CoPs were apparent in radiographer-radiographer communication, particularly when sharing task-focused knowledge, several core CoP characteristics were

inconsistent and constrained, particularly for outsiders. Sustained collaborative engagement was limited by placement rotations and variable shift patterns, which restricted relational continuity. Opportunities for knowledge sharing were not consistently foregrounded within daily workflow, where service efficiency frequently took precedence. Furthermore, spatial organisation and technology constrained movement around the department and encouraged more localised interaction within individual rooms. Radiographers often engage in collective problem-solving and validation of practice, reflecting elements of mutual engagement and shared enterprise. However, students' participation remained structurally peripheral, with limited opportunity to progress towards fuller participation as described within LPP (Lave and Wenger, 1991). This suggests not an absence of community altogether, but an uneven realisation of CoP conditions.

CoP provides an essential conceptual foundation for learning as social, relational and contextual, underpinning aspects of mindlines theory itself (Gabbay and le May, 2011). Therefore, rather than rejecting CoP, I make a conscious move away from centring it within my theoretical framework, as to do so would overstate the stability, coherence, and continuity of student participation observed in this setting. The data demonstrate that the conditions necessary for a sustained and effective CoP culture, inclusive of students, were at best variable. In this sense, the lens of CoP has served in a comparative capacity, highlighting the aspects of the CLE which are perhaps absent and impede the movement of knowledge.

7.2.1.3. Reframing through mindlines

This work foregrounds mindlines as a conceptually appropriate and analytically powerful framework. As the theory originates from a study of clinical decision making and is founded on organisational knowledge creation theories, it holistically considers all the factors which impact knowledge mobilisation in the CLE (Gabbay and le May, 2004, 2011; Nonaka and Takeuchi, 1995). Notably, where sustained mutual engagement and inclusive participation were inconsistent, it was apparent that mindline development did not cease. Instead, it reflected the hierarchical and efficiency-driven approach to practice identified in my findings.

As outlined in my published paper and Chapter 3, mindlines is applicable to how practitioners develop internal, tacit guidelines, shaped by habit, experience, social interactions and contextual constraints (Patel, 2023a). Use of the word mindlines is therefore key to not only define this deeply embedded practice-based knowledge, but also how to interrogate how this knowledge is acquired and shared in this setting. The notion of mindlines further allows us to name and value the informal and relational nature of professional knowledge use in practice,

rather than treating it solely as intuition or experience. It also offers a clear vocabulary for describing how all professional knowledge, and in particular student knowledge, is never complete and constantly in transition. Actors are not just learners acquiring objective facts, but potential contributors to an evolving and situated body of shared understanding.

Using mindlines and the SECI spiral as analytical tools to view the findings in the previous chapter provides orientation on how knowledge flows and stalls across the tacit-explicit spectrum. In the CLE context, socialisation can be seen through observing and modelling practices. Externalisation is found in the verbal practices of instructing, responding and reflecting. Combination is initiated through knowledge seeking practices such as questioning and signalling. Whilst internalisation is conducted through enactment. These initial alignments will be further explored in the following sections and demonstrate the theory's underlying applicability to this study.

Although the flow of tacit/explicit knowledge is explored in WLT, the theory discusses decision making and problem-solving as key influences in knowledge internalisation (Eraut, 2004). Although my findings point to the same conclusion, mindlines allows us to ask why students do not appear to have the opportunity to solve problems and make decisions that would enable this integration of tacit/explicit knowledge. Moreover, when radiographers demonstrate these processes together, involvement of students is limited due to various factors, including spatial, hierarchical and social issues. In the absence or avoidance of verbal KS/S practices, students are left to try and unpick tacit knowledge through non-verbal practices such as observation and implicit signals, limiting understanding of the reasons behind radiographers' actions and potentially leading to students learning the practical actions without fully gleaning the theory underpinning them. The uneven presence of a sustained CoP ethos also shapes how these processes unfold and influences the extent to which participation is reciprocal or hierarchical.

These findings confirm that KS/S practices do not simply support learning or professional development but are the very processes by which professional mindlines are constructed, shared, and sustained. What actors know, and how they validate, supplement, and modify it, can be better understood not as isolated facts or events but as evolving socially reinforced *mindlines*. This further positions mindlines not merely as a theoretical and epistemological lens but as a valid vocabulary for professional knowledge in the radiography profession.

The KS/S practices observed and discussed are consistent with the pattern of informal and implicit knowledge mobilisation initially conceptualised by Gabbay and le May (2004). In this study, *questioning* and *responding* practices most clearly illustrated the social nature of shared

understanding and knowledge negotiation. For example, when actors asked questions or sought responses, they were doing so to seek validation, supplementation, or modification of their own practice to align with the knowledge norms in the CLE. These small, situated exchanges did not merely test individuals' knowledge but formed the foundation for actors' 'collectively reinforced internal guidelines' (Gabbay and le May, 2011). The data from this study further illustrates that whilst mindlines are co-constructed, their formulation is often asymmetrical between student and radiographer actors in the CLE. Power hierarchies profoundly shape who initiates KS/S, with radiographers typically positioned as initiators and validators of knowledge. This reinforces Gabbay and le May's (2011) argument that mindlines are determined by local epistemic authority and professional legitimacy. In my literature review, I discussed the suggestion of a hierarchy between students and radiographers in the literature. This was emphasised by research which demonstrated that students were perceived as outsiders within CoPs (Jackson, 2013). My findings go further to identify that this power dynamic impacts students' ability to participate holistically in KS/S.

When students did contribute, this would be mostly through observing, signalling, responding, and enacting. These processes are clearly aligned more to validate or change their knowledge rather than to question or challenge the knowledge being used by others. The imbalance in power was especially pronounced in non-verbal practices. Students used these silent methods so as not to feel like a burden and to maintain their position on the periphery. These behaviours align with LPP theory, where newcomers gradually internalise tacit knowledge through engaging on the margins of practice (Lave and Wenger, 1991). However, my findings complicate this gradual transition from newcomer to experienced member of a CoP. As students are consistently transient in the CLE due to rotations and fragmented clinical exposure, they are unlikely to become fully integrated. These findings extend mindlines theory through identifying student participation in mindline construction and access as partial, aspirational, and fragile.

Through mindlines theory, we can therefore reframe clinical UgDR education not as a didactic or even reflective exercise, but as a process of knowledge negotiation which is inherently relational. It illuminates *why students* so often stay peripheral to knowledge KS/S, not because they lack the willingness, but because the conditions for their integration are inconsistent, hampered, or absent. Conditions that closely resemble those identified within CoP as necessary for mutual engagement and shared learning; however, in the CLE, they are partial and restricted.

Furthermore, my findings show that knowledge KS/S is not intentionally designed into the CLE but emerges through happenstance, hierarchy, and cultural norms. Mindline theory does more than just describe the experience of the CLE but allows for challenging of these norms. It can help to reposition students as contributors to knowledge, emphasise the need for reflection and verbalisation, highlight where knowledge can be critiqued and modified, and develop environments that support and value humanity in our practice. Ultimately, applying mindlines theory in clinical education offers a challenge to pedagogical models which reinforce hierarchies of learners and teachers and offers a socially situated model which more accurately depicts the complex CLE setting.

7.2.2. Introducing the Mindlines in Clinical Learning Environments (MiCLE) model

In my study, the focus on education in a clinical setting differs from that of the initial work on mindlines, which focused on general practitioners' clinical decision making (Gabbay and le May, 2004). Work in the Netherlands goes some way to demonstrate the importance of applying mindlines theory in healthcare education; however, this provides evidence for curriculum development rather than how students may learn in CLEs (van Wijchen and Alme, 2023). Whilst curricular design in HEIs can be used to prepare students for mindline development, we require an approach to clinical education that considers knowledge holistically and views clinical learning and teaching as *knowledge sharing*.

I therefore propose the MiCLE model (Figure 7.1). MiCLE builds on the SECI spiral and mindlines (Gabbay and le May, 2011; Nonaka, 1994), by mapping the KS/S practices and socialcultural conditions which enable or constrain each aspect of mindline development. This model offers an analytical map of how knowledge flows from tacit to explicit, thus creating radiography mindlines. MiCLE extends the original mindlines SECI spiral (Figure 1.1) by suggesting that new knowledge is accessible at each stage of the SECI process, but that this knowledge is always mediated by specific sociocultural conditions. The KS/S practices are placed between the boundaries of each SECI process to illustrate how practices are fluid and bridge multiple SECI processes. KS/S practices often reflect a process such as externalisation, whilst also enabling or constraining progression into the next, i.e. combination. The following sections expand further on the MiCLE model by illustrating how KS/S practices align with each stage of the SECI spiral (Section 7.2.3) and how the sociocultural conditions shape, enable, or constrain this process (Section 7.2.4). Together, these sections demonstrate how the model provides both a theoretical extension of mindlines, situated within a CLE, and a practical lens for understanding knowledge sharing in clinical UgDR education.

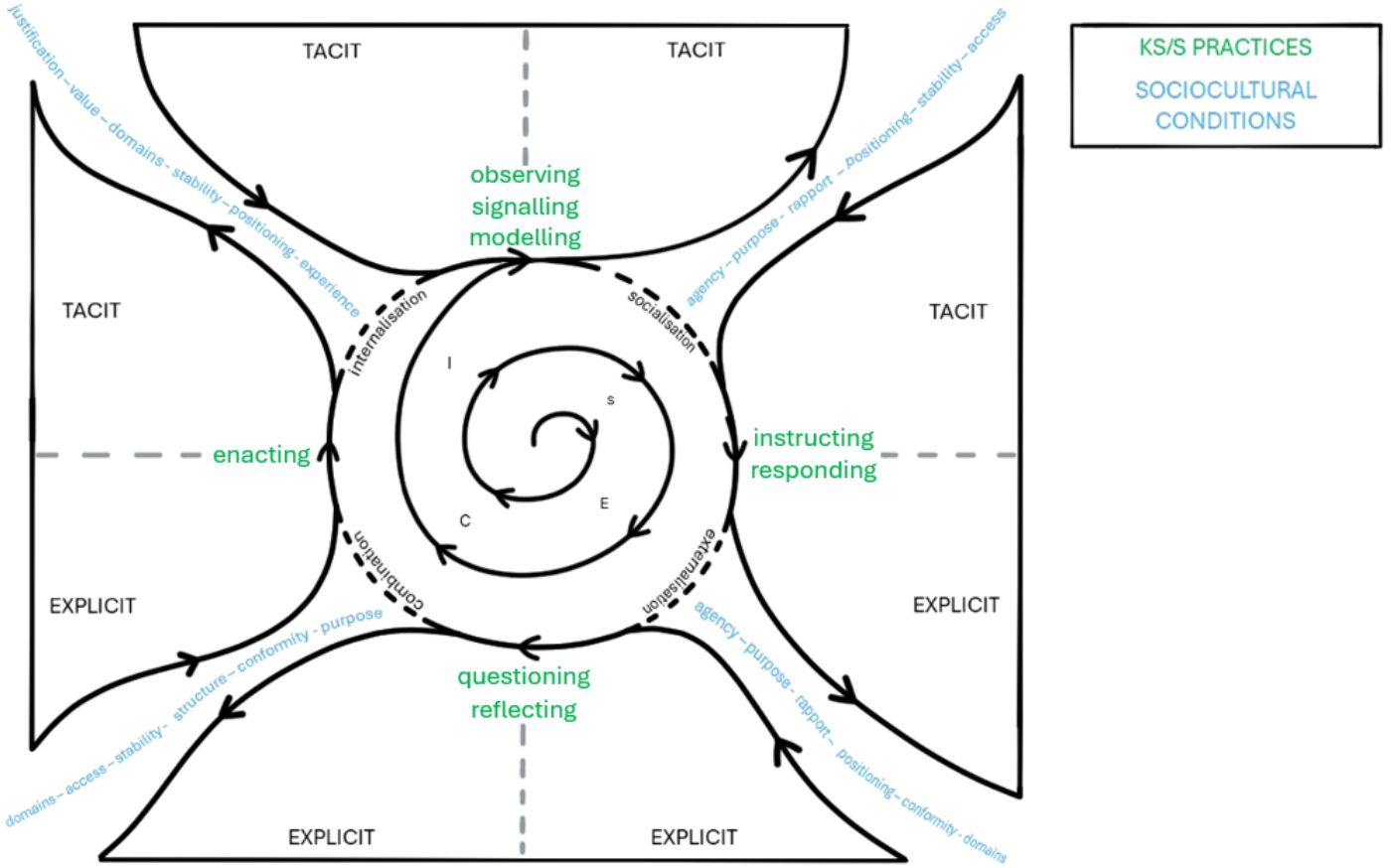

Figure 7.1. Mindlines in Clinical Learning Environments (MiCLE) model.

This model adapts the SECI and mindlines spirals (Gabbay and le May, 2011; Nonaka, 1994) to illustrate how knowledge flows across the CLE through social interaction. Socialisation, externalisation, combination, and internalisation processes transform knowledge from tacit-explicit-tacit, enabling the development of radiography mindlines. Green labels mark the KS/S practices which were apparent in the CLE, which are aligned with and bridge the SECI processes. Blue labels offer suggestions of the sociocultural conditions which most strongly influence each aspect of mindline development.

7.2.3. Reorienting KS/S practices in UgDR education

In Chapter 5, I highlighted KS/S practices as a central theme, driven by actors' motivations to initiate, assess, validate, supplement, and modify knowledge. In this section, I reorient those practices through the lens of the MiCLE model (Figure 7.1). KS/S practices are conceptualised here, not as discrete acts, but as bridging practices which sit between different stages of mindline development. These practices and how they are actioned have the capacity to enable or constrain the flow of knowledge across explicit and tacit domains. I will now discuss each of these KS/S practices both in terms of how they align with previous literature and in terms of the boundaries they bridge in the MiCLE model.

7.2.3.1. Socialisation to externalisation – instructing and responding

Instructing and responding both surface tacit knowledge into explicit advice or direction and are therefore positioned as bridges between socialisation and externalisation (Figure 7.1). Instruction is not directly approached in previous literature, but can be related to the more didactic educational approaches. There has been a traditional focus on competency and transfer of information to ensure students become proficient at radiographic imaging (England et al., 2016; Hendry, 2019; Holmström and Ahonen, 2016). The focus on ensuring students are capable of performing a range of procedures in a specific way has perhaps reinforced this approach in CLEs. This study shows that instructing does serve a purpose in motivating students to participate in clinical activities, but is limited in explanatory content. This, therefore, limits students' ability for sensemaking and leaves them without a rationale to interrogate and internalise into their own mindlines. These concepts extend existing knowledge by demonstrating that verbal knowledge seeking through instructing functions as a performance of competence, over mutual mindline development. Rather than inviting dialogue or reasoning, they reinforce hierarchical dynamics which impede the deeper collective sensemaking crucial in forming mindlines. When not accompanied by more substantial explanation, these practices risk reinforcing tacit, routine-based mindlines which go unexamined and are impermeable to new knowledge.

Responding was often conducted to offer brief validation, supplementation and modification of knowledge, often through advice giving. However, these interactions focused on ‘know-how’ and rarely delivered deeper reasoning or depicted theoretical knowledge to explain ‘know-why’. Although brief responses can efficiently address immediate tasks, the lack of elaboration may inadvertently prioritise performance over deeper learning. Again, this would suggest a link to the more didactic forms of knowledge transfer apparent in the literature. Although helpful in task completion, responding left students to resolve unexplained discrepancies between academic

and practice knowledge, amplifying the theory-practice gap discussed by many authors (Cunningham et al., 2015; Davies et al., 2022; Hyde, 2015; McAnulla, 2018). These findings suggest that instructing and responding can often stall progress into combination for deeper understanding and sensemaking. This highlights why the following practices of questioning and reflecting are critical in mindline development.

7.2.3.2. Externalisation to combination – questioning and reflecting

Questioning is seen as a central facet of development in pedagogical discourse, particularly with regard to critical thinking and allowing students to bridge the theory-practice gap (Meertens, 2016; Kay and Brogan, 2024). The importance of questioning to initiate externalisation has also been suggested (Meertens, 2016; Hendry, 2020). In my findings, questioning was mostly used by radiographers as an initiation or assessment tool; rarely did questioning prompt mutual exploration or critical discussion. While students appeared to want to ask questions, they hesitated due to social and organisational factors. This supports the idea that students need resilience and to feel part of the team if they are to feel comfortable in asking questions (Hyde, 2015; Khine et al., 2024). However, this research identifies the reasons behind why students have limited social safety and professional status in the practice of questioning. In the MiCLE model, questioning is considered a bridging practice between externalisation and combination, similar to reflecting, which will be discussed shortly. Despite the evidence in this study, which suggests questioning was purely a way to assess knowledge, there is the potential for questioning practices to be enhanced to allow for further dialogue and reasoning to occur.

Reflection has been documented as a key practice in UgDR education throughout the literature. It is seen as both an isolated method for knowledge creation and professional development (CoR, 2022b; HCPC, 2023; SoR, 2025a) and as supplementary in specific pedagogies such as SBE and PAL (Lawal et al., 2021; Partner et al., 2022; Shiner and Howard, 2019). Yet these discussions centre on reflection largely as a retrospective process, occurring in isolation or in academic settings, rather than spontaneously and collectively in the CLE. This study extended the view of reflecting as an active and social process, facilitated through storytelling, metaphor, and thinking aloud. Reflecting, therefore, strengthens both externalisation and combination in the MiCLE model (Figure 7.1). However, this was rare and generally performed in low-pressure moments and initiated by radiographers. This finding is supported by research indicating that students are often uncertain of the reasoning behind adaptations to practice due to a lack of verbal discussion and debriefing (Potts and White, 2024). Further to this, students are unlikely to initiate or engage in these moments due to their physical and hierarchical status. Without

consideration of the sociocultural conditions which make these practices rare in the CLE, radiography mindlines may become stagnant or rigid, impacting the profession as a whole.

7.2.3.3. Combination to Internalisation – enacting

Enacting is particularly common and valuable for internalisation of the embodied radiography practices (Figure 7.1). This is most aligned with the pedagogical strategy of SBE, where students enact these clinical tasks within the safety of simulated settings (England and McNulty, 2020). SBE has been heralded as a vital approach to bridging the theory-practice gap (Shiner, 2018). However, SBE is focused on students enacting practice rather than the knowledge sharing which happens through radiographers demonstrating and performing their practice. It also provides carefully curated experiences for students to practice enacting, which are then supplemented with verbal debriefing and reflecting. This differs from enacting in the CLE, which occurs sporadically, dependent on clinical happenings, without concurrent or retrospective reflecting practices to encourage internalisation. Enacting alone without the accompaniment of questioning or reflecting risks reinforcing conformity to practice based on the bridging practices of observing, signalling, and modelling.

7.2.3.4. Internalisation to socialisation – observing, signalling, and modelling

The findings showed that observation can limit student engagement and understanding when not supplemented with other KS/S practices, and that signalling can be misunderstood. CLEs are stated to provide exposure to clinical practice and to develop the softer skills associated with tacit knowledge, although this is often presented as a beneficial strategy for knowledge development (Hyde and Hardy, 2021; Mackay et al., 2015; Winter, 2019). Observing in this study was witnessed as a passive, distanced, and distracted process conducted behind lead screens whilst students carried out administrative tasks. Whilst, from a radiographer's perspective, observation was carried out through motivations to assess from a position of greater epistemic standing. In both instances, observing was rarely followed up by sensemaking dialogue, even when radiographers intervened, this was often done through taking control of the interaction rather than explanation. This therefore supports the idea that observation is a socialisation process of tacit learning but is limited as a KS/S practice on its own. In contrast, signalling is not identified in any of the UgDR literature but was seen in this study as a key process of knowledge seeking for students. They appeared to use this to request assistance when carrying out tasks, to minimise disruption and avoid being perceived as a burden. Through signalling, radiographers would take control of the situation by performing the task, which was sometimes supplemented by explanation, although often done silently.

Radiographers are also expected professionally to model desirable behaviours and knowledge (CoR, 2022b; HCPC, 2023), which is recognised as influential for students' professional growth (Hadwen, Harvey-Lloyd and Strudwick, 2020). This suggests that radiographers should be consciously aware of the impact their behaviours have on those around them and perform accordingly. However, my findings identify modelling as an unintentional non-verbal process of sharing priorities and values, aligned with socialisation (Figure 7.1). This reinforcing practice, which is habitual rather than reasoned, as leaving rationales hidden, reduces the opportunity for students to develop their critical thinking skills. The tacit knowledge modelled in the CLE often reinforces the need for efficiency and adherence to the power hierarchies, which limits space for reasoning and social interaction.

Collectively, these findings extend our current knowledge of UgDR education and respond directly to RQ1 and RQ2. They reorient our understanding from structured pedagogically led strategies toward more subtle, relational practices which have traditionally gone under-acknowledged and under-explored. While prior research has emphasised formalised and intentional approaches to knowledge sharing, these findings reiterate that the formation of mindlines is shaped by an assemblage of verbal and non-verbal practices. These practices show that knowledge sharing in the CLE rarely aligns neatly with one stage of mindline creation. Instead, as captured in the MiCLE model, practices operate fluidly as bridges which can either support or stall knowledge mobilisation and creation. Here, KS/S has been reframed as not purely evidence of learning and teaching, but as tools through which mindlines can be collectively formed, sustained, and crucially, contested. Importantly, this discussion signals a further critical direction for practice and research, the clear need to harness and strengthen the bridging of SECI practices suggested here, which will be approached in section 7.3.

7.2.4. Aligning sociocultural conditions with UgDR literature

This section discusses the findings from the second theme, sociocultural conditions of KS/S, which identified four key subthemes: personal, social, organisational, and professional. While the previous section discussed the practices of KS/S, this discussion highlights how they are embedded and reinforced within the broader sociocultural factors apparent in the CLE. The discussion highlights the concepts which interact to produce or inhibit radiography mindlines and further identifies how this research extends our understanding of theory-practice integration, relational dynamics, and power hierarchies. This section attempts to explain how these conditions act as contextual forces which mediate every stage of the MiCLE model (Figure. 7.1).

7.2.4.1. Personal conditions

The need for students to demonstrate resilience and confidence to fully participate in clinical learning has been clearly documented in the literature (Hyde, 2015; Khine et al., 2024). However, my findings offer a more granular view which demonstrates how these traits align with and impact the concept of *agency*. Rather than being exclusively the responsibility of the student, agency is influenced by cultural background, social comfort, and power dynamics in the CLE. In some cases, these dynamics were challenged depending on the radiographer's roles and priorities, for example, when PEs provided opportunities for students to share their knowledge more holistically. Furthermore, it was apparent that apprenticeship students who spend more time in the CLE as a core member of the team have a perceived higher level of agency than UgDR students. This complicates the assumption that student agency can be developed individually or pedagogically, enforcing that social and organisational conditions are inherently linked.

Students enter the CLE with limited *experience*, which is another core determinant of KS/S engagement for actors. These findings support the idea that professional radiography knowledge is typically rooted in practical experience, emerging through the *doing* of practice, and enforced through collective understanding (Jackson, 2013; Winter, 2019). The data shows that radiographers often cite making mistakes, lone working, and decision making as pivotal in their professional knowledge development. However, students are often limited in opportunities to engage in autonomous practice or to make mistakes, due to the keen supervision and priorities of efficiency seen by radiographers. Actors' perceived level of experience clearly indicated their hierarchical position in the CLE. As student knowledge remains in the domain of theory over experience, their perceived value or position in the hierarchy was lesser, reinforcing their role as knowledge consumers.

Competing priorities and clinical responsibilities were seen to impede the collective practice and sensemaking, which is critical to mindline development. Students' *purpose* was often aligned with the completion of their portfolio and assessments, whereas radiographers were more clinically focused. These competing agendas have been noted in literature (Cunningham et al., 2015; Forber et al., 2016; Ng, 2015), although this study extends beyond these observations, highlighting purpose as a lived tension which shapes how mindlines are enacted. Radiographers appeared aware of the purpose of students, often asking about their portfolio requirements, although these were often discussed almost as tick-box exercises rather than learning tools. This was further reinforced by students who appeared to use portfolio tasks to opt in and out of broader clinical activity. The use of portfolios as a competency-based

approach to clinical learning has been challenged in broader health education literature. In support of my findings, portfolios have been shown to encourage an 'evidence gathering' approach over holistic knowledge development (Gulden et al., 2023). This is likely due to the way in which portfolios reward 'sign off' over independent learning, which is key to developing flexibility and autonomy in practice (Cleland et al., 2014). It is suggested that for these learning tools to be effective, they need to be culturally embedded and supplemented with meaningful social interactions (Driessen et al., 2007). In conclusion, the academic tools provided to students drive their purpose away from that of other actors in the CLE. This can lead to disconnection and superficial participation, which ultimately impacts the situational dialogue which supports combination and internalisation processes critical for mindline development.

7.2.4.2. Social conditions

These personal conditions clearly had an impact on the social findings of rapport, status, and conformity. When radiographers made efforts to build *rapport* through social interactions or introductions, humour, or asking open questions, students would demonstrate more agency and engagement with KS/S. These findings support the importance placed on relational safety and the need for active support from practitioners in encouraging student engagement in CLEs (Clouder and Adefila, 2017; Kay and Brogan, 2024). Again, my findings extend these insights by showing how the absence of rapport does not simply limit participation. It actively positions students as peripheral, a position they go on to embody both physically and in their tasks. In the absence of these social efforts, students resort to the non-verbal KS/S practices and carrying out administrative tasks, which to them appear 'safe' and non-burdensome. Therefore, rapport is a prerequisite for externalisation and combination processes, determining whether students feel comfortable enough to verbally seek and articulate their knowledge, or whether they stay rooted within non-verbal practices, internalising tacit norms without critical interrogation.

Rapport, therefore, implicitly impacts *status*, although the latter proves a distinct mechanism for knowledge hierarchies to be reinforced. Radiographers often have implicit expectations and assumptions that students should show initiative and awareness of cultural norms, supported by radiographers' ability to predict what other radiographers require in clinical moments. However, these expectations were rarely communicated, and students, aware of their lower status and anxious about disrupting workflow, tended to withdraw from active participation, which strengthened the view that they lacked initiative. This echoes the assertion that students are rarely included in inclusive decision making or invited to discuss adaptations for patients in the CLE (Potts and White, 2024) and supports the idea that students are not full members of the CoP (Jackson, 2013). However, my study also demonstrates the interaction between social

status and spatial positioning, which is apparent through the organisational condition of access. This presents a key constraint in the combination of knowledge, as students are socially positioned away from the theoretical spaces where radiography mindlines are negotiated in the CLE.

A culture of deference and uncritical knowledge acceptance was reflected in the social concept of *conformity*. Students adapt their behaviours and practice to mirror radiographer preferences, which often comes at the expense of developing their own reasoning or theoretical understanding. This is influenced and supported by issues in other core conditions and supported through literature, which confirms that students often want to fit in over actively questioning practice (Hyde, 2015; McPake, 2021). Although my study identifies that conformity is sustained through discouragement of knowledge interrogation. When students are told that they do not need to know certain things, or when they witness contradictions with no explanation, they are socialised into this conformity due to their low agency and social position. New or divergent knowledge is therefore prevented from permeating collective radiography mindlines, which ultimately encourages stagnation of practice over evolution.

7.2.4.3. Organisational conditions

Structural elements within the CLE were found to support and limit the development of radiographers' and students' mindlines. Protocols and clinical information sourced through digital systems were used and acknowledged as valuable knowledge, particularly when radiographers were making clinical decisions and solving problems. This is unsurprising as the profession is inherently protocol-driven and requires radiographers to meticulously assess clinical information to justify radiation exposure (Department of Health and Social Care, 2017; SoR, 2025b). However, the use of such knowledge was rarely isolated from more social sensemaking processes, particularly when the explicit guidance was unclear or lacked context. This aligns with both mindlines and some UgDR literature suggesting that clinical judgement is inherently socially negotiated (Gabbay and le May, 2011, 2023; Wilkinson et al., 2024a; Winter, 2019). This explicit structural knowledge often serves as a springboard for further dialogue aimed at making sense of the situation, ensuring accordance with the appropriate guidance. However, whilst radiographers were active in combining different types of explicit knowledge to form a deeper tacit understanding, students would maintain their peripheral positioning during these interactions. The dominant structural tool of portfolios for students inhibited their engagement with the more collaborative sensemaking processes which occurred between radiographers. While portfolios are designed to promote reflection and track competence, these findings again support the idea that they reduce engagement to performative evidence

(Driessen et al., 2007; Gulden et al., 2023; Ng, 2015). These structures hinder externalisation and combination for students by framing knowledge as something to be documented and verified rather than reasoned and collectively negotiated. Furthermore, it reinforces the idea that knowledge can be individually codified rather than acknowledging it as complex and interconnected as mindlines.

The frequent rotation of students between departments and academic and clinical environments impacted the *stability* of their practical and relational experiences in the CLE. This instability has been previously identified as a barrier to learner integration and belonging (Green et al., 2022; Hyde, 2015; Wilkinson et al., 2024a). However, this study shows that it also disrupts the continuity necessary for collective knowledge sharing and mindline development. Actors were often unaware of who they would be working with from the opposite group, with this lack of continuity leading radiographers to be unclear on the students' goals or knowledge level. This further reinforced the surface-level engagement and reduced opportunities for students to fully participate in KS/S practices. The administrative instability, therefore, led to relational instability, which ultimately reinforced conformity over critical engagement. It is clear from the data and literature that CLE capacity for students is a challenge and that a balance between academic teaching and exposure to the CLE is deemed necessary (England et al., 2017; McNulty et al., 2021; Partner et al., 2022; Wilkinson and Cadogan, 2023). However, instability clearly undermines the conditions necessary for mindlines to be challenged, supplemented, and refined.

How actors *access* knowledge is shaped not only by presence but also by physical layout, convenience, and happenstance. Students frequently maintained a position behind the lead screen in X-ray rooms, where computers were situated. This encouraged them to focus on administrative tasks rather than patient-facing work in the X-ray room or collaborative activities in the viewing area. This physical separation mirrored and reinforced their peripheral epistemic status and echoed findings on the need for spatial inclusion in a clinical environment (Winter, 2019). Visual cues or clinical dilemmas, which occurred through happenstance, are key triggers for radiographer engagement with KS/S, although students were not routinely invited to participate actively in these moments. When they were, it would depend on the relational dynamics and inclinations of the radiographers rather than being a consistent cultural practice.

Feedback is often considered a key mechanism for accessing knowledge both professionally and pedagogically (CoR, 2022b; HCPC, 2023; Partner et al., 2022; Wilkinson and Cadogan, 2023). Issues in the delivery of formative feedback were suggested in the literature, such as time

constraints and lack of motivation (Bwanga, 2020b; Fowler and Wilford, 2016), although there is limited understanding of how feedback was actually enacted and perceived in the CLE. My findings demonstrate a perception of feedback as a formal and top-down process, which was triggered by errors or academic structures, rather than an embedded dialogic practice. Challenges in accessing knowledge then prove inhibitory to how mindlines are developed, which leaves them narrow and coincidental rather than intentional and meaningful.

7.2.4.4. Professional conditions

Lastly, the subtheme of professional conditions indicated how we categorise, value, and justify knowledge as a profession. The findings of professional knowledge *domains* and *value* are intrinsically linked and are indicative of the knowledge hierarchy discussed throughout this thesis. Practical and procedural knowledge, particularly that related to radiographic technique, protocol adherence, and equipment operation, was the most visible and valued *domain* of professional knowledge. Similar to the organisational condition of structure, this finding was anticipated due to professional expectations and priorities guided by standards and regulations (CoR, 2022b; Department of Health and Social Care, 2017; HCPC, 2023; SoR, 2025b). Experiential knowledge was also highly valued, and when prompted, allowed for articulation of reasoning through the reflective processes of storytelling and metaphor. By contrast, explicit theoretical knowledge is positioned as overly academic or abstract, causing it and those holding it to appear lower on the hierarchy. This caused students to struggle in reconciling their heavily theoretical knowledge with the contextualised knowledge, or mindlines, used in the CLE. These tensions clearly echo and speak to the longstanding concept of the theory-practice gap in UgDR education (Cunningham et al., 2015; Davies et al., 2022; Hyde, 2015). One concerning finding was that domains which appear more tacit or subjective, related to soft skills, patient care, and communication, appear to be marginalised by those actors most constant in the CLE. The devaluation of these domains in favour of those which make practice perceivably more accurate, efficient, and reproducible, contests the profession's stated commitment and move towards more holistic and inclusive patient-centred care (HCPC, 2023; Hyde et al., 2024; Hyde and Hardy, 2021). These patterns, or hierarchies, of valuation are reinforced by what is corrected, rewarded or prioritised in daily practice. Students are explicitly judged by their ability to 'do' rather than explain, critique, or communicate, demonstrating that procedural and cultural compliance is equated with competence. When students attempt to apply theory or seek clarification, being discouraged or told that they will develop the appropriate knowledge once they qualify sends the signal about what types of knowledge are legitimised. Furthermore, understanding how knowledge domains are valued indicates *who* is

valuable in the process of constructing mindlines, and therefore, who is sought out in cases of uncertainty.

These factors are further entrenched through the *justification* of professional knowledge. This is unlike the process of justification required through radiography regulations, whereby radiographers ensure that a patient is receiving an appropriate radiation dose for their clinical presentation (Department of Health and Social Care, 2017). This process of knowledge justification is more aligned with the process of developing tacit knowledge when personal knowledge equates to "justified, true belief" (Polanyi, 1966; Nonaka and Takeuchi, 1995: 21). Radiographers justify their actions and practice through what appears to be the pragmatic reasoning of 'this is what works [in my experience]', or 'this is how we do it here', rather than offering an explicit, evidence-based theoretical rationale.

While these types of justification are not inherently problematic, their implicit nature and the way in which they go unexamined limit opportunities for new knowledge to permeate individual and collective mindlines. Furthermore, more experienced radiographers and those with greater social status can deviate from protocols and act through their practised mindlines, while students are expected to adhere to procedures without the benefit of this. This creates a double standard, where those with more power have greater ability to influence mindline development through decision making, social discussion, and access to experience, whilst students conform, remain passive, and have to adapt to instability in experience. They are not just excluded from decision making; they are excluded from the dialogic, iterative processes which update and evolve mindlines over time. This imbalance matters because collective mindlines are strengthened through multiple perspectives, including those at the periphery, whose questions and uncertainties often surface taken-for-granted assumptions and knowledge gaps.

Discussion of these findings speaks directly to RQ3 and demonstrates the fragility and often exclusionary environment that students, alongside radiographers, must navigate to develop their professional mindlines. Personal factors are shown to be relationally and structurally contingent, shaped by cultural norms, rapport with staff, and the instability of students' clinical experiences. Whilst some organisational and professional conditions are designed to support practice and learning, they often reinforce narrow perceptions of knowledge and inhibit critical thinking. Without individual and systemic attention to these conditions, KS/S is likely to remain one-directional and bounded by epistemic hierarchies. Ultimately, this restricts professional capacity to evolve and adapt mindlines to new knowledge through inclusive, dialogic knowledge mobilisation.

As stated in Chapter 3, ethnographic work is inherently interpretive and grounded both in data and researcher positionality. The reflexive commentary that follows outlines how my own positionality, assumptions, and engagement with the field shape the key arguments and interpretations presented throughout this thesis.

7.3. Reflexive commentary: Embodying mindlines through ethnography

This study has been deeply informed and guided by my own knowledge, perceptions, and experiences. This section not only responds to the requirements for transparency and trustworthiness in qualitative and ethnographic research discussed in Section 3.6 but also speaks to the epistemological congruence of ethnographic methods and mindlines work.

Throughout this thesis, I argue that the theory of mindlines offers a crucial and realistic reframing of knowledge and how it is shared, created, and adapted in UgDR education. Here, I extend the theory to include me, the researcher, as an active actor in knowledge creation and mobilisation. I see my ethnography practice as the embodiment of mindline development, and this thesis as both a conduit for the evolution of those mindlines and a vessel for the externalisation of them. Throughout this section, I reflect on how I embody different aspects of the SECI spiral through my research journey, and how the factors discussed in my findings also influenced how I experienced the field and generated data. In expressing these ideas, I provide a layered and critical insight into the co-construction of knowledge within this project and the interdependence of theory, methodology, and positionality.

Researcher practices in ethnography can be seen to mirror SECI processes of knowledge creation and mobilisation (Nonaka, 1994). Participant observation offers an ethnographer the opportunity for socialisation, as they become a member of the community in which they are studying. Externalisation is demonstrated through the researcher writing fieldnotes and practising reflexivity, taking their tacit knowledge developed through socialisation, and creating explicit written knowledge. When these data are synthesised and developed into ideas for further investigation through interviews, this demonstrates combination. Subsequently, developing themes and discussion with regard to previous literature involves combining different forms of explicit knowledge. Utilising these processes in an inductive and iterative way then internalises that knowledge for the researcher, embedding it tacitly and impacting their findings and future practice. Finally, writing a narrative in the form of a thesis or paper allows these internalised tacit ideas and theories to be made explicit through further externalisation, and so the spiral starts anew. Ethnography, then, more so than other qualitative methods reliant on explicit texts or participants' verbalising their knowledge through interviews, *embodies* KMb

and the mindlines theory. Mindlines has therefore manifested as an epistemological position rather than purely a theoretical framework for this study.

7.3.1. Socialisation

As a radiographer, my mindlines on entering the field were already embedded with my radiography knowledge, terminology, and experiences, which aided in socialisation processes in the CLE. Additionally, my mindlines were imbued with epistemological and pedagogical principles gained through work on this PhD and lecturer role. On entry into the field, I therefore felt a sense of familiarity, although the awareness of my researcher role and positionality allowed me to expose my initial assumptions and interpretations. As fieldwork progressed, I noticed that my capacity to detect tacit knowledge and non-verbal practices as an observer was sharpened by my clinical background. I could anticipate the rhythms of clinical tasks, detect hesitations, and intuit actor needs.

This socialisation mirrored the very KS/S practices I later suggested in my findings. I was *observing* to glean these insights and paying attention to *modelling* to 'fit in' and develop rapport. I, too, picked up on these things tacitly through my proximity and presence in the CLE, just as students would. However, unlike students, I had the advantage that my radiography mindlines were already fortified to afford me professional familiarity. This both enabled deeper insight and created a dual positionality, at times insider, resonating with the culture of the CLE, otherwise an outsider, attuned to missed opportunities and times of disruption. These moments influenced the critical aspects of my data, where I was aware of feelings of inclusion/exclusion and tension/comfort.

Over time, I was drawn into the routines of the CLE, helping to clean equipment, engaging in casual conversations, and assisting with patient care. These moments allowed me to develop the knowledge of when to participate, whom to approach, and how to be included. I noticed how these interactions often relied on non-verbal moments of *signalling,* which I needed to tacitly interpret, rather than overt instruction or explanation. My ability to interpret these signals more clearly and readily, due to my mindlines, garnered more trust and ease with radiographer actors, which ultimately placed me higher on the power hierarchy than students. Through participation and observation, I was not only studying the topic but enacting my own iterative process of situated learning and sensemaking.

7.3.2. Externalisation and combination

The tacit knowledge I developed from my socialisation into the CLE was most obviously externalised through the process of writing field notes and reflexive activity. Initially, my field

notes were descriptive, capturing what happened, in what order, and who was involved. These details proved important for constructing a coherent record of activity and for jogging my memory for later interpretation and analysis. This is, in some ways, aligned with the KS/S practice of *responding,* providing knowledge with limited space for explanation or reasoning. This then represented only part of the picture; I found myself focusing too much on the obvious, not enough on the implicit dynamics and norms which were going unquestioned. This was captured in a reflexive note I wrote.

> *"I feel like I am looking at the sky and focusing on the stars, when the important bit is the invisible dark matter which holds everything together."*
>
> *(Research journal, 01/03/2024)*

This realisation and further discussion with my supervision team prompted a shift in the way I viewed my observations. I began *questioning* what I saw, 'why did that interaction go unexplained?' or 'why did the student who looked confused feel unable to ask a question?'. Externalising my tacit observations through this curiosity gave space for the practice of *reflecting,* allowing the knowledge to be interrogated against both theory and my own assumptions. As I wrote, I found myself externalising my feelings of frustration, relief, and discomfort. The duality of my position and, therefore, my emotions revealed the stakes of knowledge sharing for both students and radiographers in the CLE. In discussions with actors, I would sometimes reveal these reflections. These conversations were delicately balanced; I remained mindful of the risk that actors may change their behaviour in response to my interpretations. However, I found them to initiate invaluable moments of co-reflection, offering me the opportunity to validate, supplement, or modify my researcher mindlines.

Dialogue with supervisors offered similar externalisation and sensemaking opportunities, which further developed my mindlines. These conversations helped me to refocus my observations, balance my observer as participant role, and reframe and clarify interpretations. I often used these opportunities to think aloud, develop metaphors, and tell stories of what I was experiencing in the CLE, demonstrating a move into more sensemaking and reflecting practices, guiding further combination.

Where socialisation and externalisation were marked by immersion and articulation, combination marks the act of merging initial insights into broader analytical assertions with respect to triangulated data and wider knowledge. Through analysis of initial data, I developed insights which informed semi-structured interviews. This gave way to new insights and

supplementary data, facilitated by the trust and rapport I had developed throughout my observational work.

The blend of observation and interview methods customary in ethnographic work allows for greater realisation of combination. My position as a familiar presence in the field contributed to actors' willingness to share, elaborate, and be asked challenging questions in relation to situations witnessed through my observations. Clearly, then, the capacity for *questioning* is key in being able to initiate combination, as it allows for others to externalise their knowledge, and this to be interrogated by the knowledge receiver. Interview data were used in combination with field notes and reflexive entries to triangulate codes and themes, which guided the final findings. Subsequently, these findings were synthesised with previous knowledge in the form of theory and topical literature to make meaningful suppositions which demonstrate new knowledge, which represents the essence of combination within mindlines theory.

7.3.3. Internalisation

Both r*eflecting* and *enacting* have proved powerful in internalisation of my researcher mindlines. Writing reflexively throughout the doctoral journey has allowed me to revisit experiences, interpret data through evolving lenses of insight, and integrate multiple perspectives into an embodied sense of knowing. This is demonstrated when I initially internalised radiographers' responses to students as disinterested or dismissive, but through further socialisation, externalisation, and combination, I reconsidered that it may be a way for radiographers to preserve priorities of efficiency.

This accumulation and internalisation of mindlines aligns with the idea of tacit knowledge being "justified, true belief" (Polanyi, 1966; Nonaka and Takeuchi, 1995: 21). The interrogation of knowledge through cross-referencing data, testing through theoretical framings, and situating it within the broader context, has justified the knowledge and allowed me to internalise the insights tacitly. My mindlines are therefore not instinctual or uncritical but earned through the iterative processes of validation and negotiation.

This thesis, and in particular the vignettes in Chapter 4, are the purest embodiment of this acting as a continual process through which to make sense of my own mindlines and the data. Throughout the thesis, I portray the macro story of the development of my own mindlines, from the prologue, through the literature review, from field work to the epilogue at the end, my mindlines have evolved and expanded, now unrecognisable from those of the eager work experience student. The act of writing it was an iterative process of ordering, articulating, and self-discourse, which saw my internalised and tacit knowledge become externalised and

explicit. The micro stories provided in my vignettes paint the narrative, contextualised picture of the CLE. These reconstructions were tools through which I relived, reinterpreted, and gave form to my tacit experiences. Through this storytelling, I now invite the reader to engage in their own process of sensemaking and combination, in a bid to encourage modification of their own mindlines.

These mindlines are therefore now informing my practice and the way in which I enact knowledge as a researcher and educator. I have become more attuned to subtle dynamics which govern how individuals and collectives see and share knowledge. My findings around KS/S practices in particular have shifted the way in which I interact with individuals, utilising questioning and reflecting in order to balance hierarchies of knowledge, broaden my understanding, and effectively share reasoning.

7.3.4. Sociocultural conditions of researcher mindlines

Although the SECI spiral informs how my mindlines were created and have been shared, they are also shaped, constrained, and enriched through the same conditions inherent to the field CLE. One of the most palpable influences was the interpersonal dynamic between radiographers and me. My ability to *access* knowledge and build *rapport* through meaningful questioning and informal conversations was deeply influenced by my *agency, experience,* and *purpose*. This *status* led to greater power in the CLE, demonstrating a complex symbiotic relationship between personal and social conditions and access to knowledge. These dynamics were emphasised in moments of coldness or ambiguity when working with actors I had not developed as much rapport with. These experiences left me feeling hyperaware of my outsider status and reflective of how students may feel without the benefit of heightened experience and agency.

Organisational factors such as *structure* and *stability* also played a role in the formation of my mindlines. The transience of staff, students and myself meant that introductions were frequent and routines were different depending on personnel. This made the CLE feel disorienting at times, and I often felt drained when having to repeat my role and purpose regularly to new people. I reflected on how students were similarly expected to adapt to these transient structures, but again with limitations in the personal conditions, which may have facilitated more ease around this.

These reflexive insights are not isolated from the analytical findings of this thesis. Rather, they reinforce the central argument that knowledge creation and mobilisation in the CLE are shaped by relational standing, structural instability, and implicit cultural norms. It is from this combined

empirical and reflexive understanding that I have developed the following suppositions and recommendations.

7.4. Suppositions for reframing knowledge creation and sharing in clinical radiography education

A core contribution arising from this thesis, alongside the MiCLE model, is four interconnected suppositions which offer a conceptual and practical reframing of UgDR clinical education. The suppositions are not isolated findings, rather theoretically grounded suggestions which build on my critical arguments from the literature and synthesise empirical insights from my data. Together, they challenge the traditional and current approaches in radiography education, practice, and research, in capturing how knowledge is realistically developed and mobilised in the CLE. I align each supposition with a practical recommendations table, including suggestions for researchers, HEIs/Lecturers, CLEs/Practice Educators, radiographers, and students (Tables 7.1, 7.2, 7.3, and 7.4). As some recommendations are useful for multiple purposes, they may be repeated across suppositions. These recommendations provide a framework which can be utilised to direct future research, educational priorities, and professional development.

7.4.1. Supposition 1: *A move towards a holistic conceptualisation of knowledge*

There is a tendency for UgDR education to categorise knowledge into explicit, assessable categories or domains. This privileges procedural, objective, and easily codifiable knowledge over the inherently tacit, subjective, and social forms which are critical to KMb. This study furthers the idea that such distinctions are artificial and limiting in a CLE where knowledge is constructed and shared relationally, through iterative, integrative practices. Although previous practice-based learning models acknowledge tacit dimensions, there remains an institutional and cultural tendency to reward and value technical compliance over social reasoning and reflection. By applying KMb theories and using the holistic language of mindlines, this study reframes radiographer knowledge from policy and guideline-focused to a dynamic, socially negotiated understanding which evolves through use and discourse. To enact this supposition, there needs to be a conceptual shift in how all stakeholders define, share, and assess knowledge, focusing less on the prescribed or theoretical and more on fluid, adaptable knowledge shaped by experience, discussion, and contextual reasoning, as seen in the MiCLE model.

Table 7.1. Recommendations Table – Supposition 1

Stakeholder Group	**Recommendation**	**Rationale/Impact**
Researchers	• Utilise KMb theories, specifically mindlines to further explore how different types of knowledge are valued and how this impacts KMb in CLEs. (Also in Supposition 2, see Table 7.2.) • Design, implement, and evaluate strategies which aim to integrate soft skills, patient-centred care, and reasoning skills into KMb activities in CLEs.	• Positions future inquiry within a framework which reflects and accounts for the complexity of the CLE. • Develops evidence to rebalance the value placed on different knowledge types, challenging over-reliance on procedural knowledge, flattening the hierarchy of knowledge holders. • Supports the development of strategies which foster adaptable and holistic radiography mindlines.
HEIs/ Lecturers	• Reform assessment strategies to consider how theory, procedural skill, and relational/social activities are integrated by students over privileging technical competence. • Utilise pedagogical strategies embedded with reflection, such as SBE, PBL, and peer learning, which encourage the integration of different forms of knowledge and skills such as critical reasoning and decision making.	• Aligns assessment with the realities of knowledge use in the CLE. • Prepares students to apply critical thinking skills in practice, allowing better integration of theory and practice. • Reinforces the importance of reasoning and reflection as key professional skills.
CLEs/ Practice Educators	• Embed structured peer learning discussions where students lead on knowledge sharing with radiographers	• Demonstrates that students hold valuable knowledge and perspectives which could enable flattening hidden hierarchies.

	and students. E.g. asking a student to share a story about a clinical situation, encouraging group reflection. • Encourage feedback to include comments on social skills, reasoning ability, and verbalisation alongside technical performance.	• Ensures diverse forms of knowledge are valued and visible in daily practice and formal processes.
Radiographers	• When working with students, articulate reasoning based on more than just how to do the task. Explain factors around patient considerations, contextual factors, theoretical understanding, and personal experiences and reflections. • Invite students to share their recent academic insights and discussions. E.g., ask questions such as, "What have you learned about (procedure/policy/patient type) at university?"	• Normalises and makes visible how different aspects of knowledge are integrated during one task or procedure. • Signals that diverse perspectives are valued and encouraged. • Challenges the assumption that students are knowledge consumers.
Students	• Connect theoretical knowledge with practice through verbalisation of reasoning during or after clinical tasks. • Offer academic insights or recently acquired knowledge into discussions in the CLE, identifying where this may have practical relevance.	• Positions students as legitimate contributors to knowledge and encourages the development of identity as a knowledge sharer, not just a consumer. • Builds confidence in sharing and applying different types of knowledge in the CLE.

7.4.2. Supposition 2: *A move towards 'knowledge sharing' over traditional 'teaching and learning'*

While traditional pedagogies conceptualise education as unidirectional and didactic, there have been moves in academia to adopt a more constructivist approach. However, this study demonstrates that the CLE still holds a rigid hierarchy of knowledge, which suggests that radiographers are knowledge holders and students are knowledge consumers. The findings of this study revealed that most KS/S occurs informally and reactively, defined by relationships, space, timing, and motivations, rather than structured pedagogical intentions. The terms *teaching* and *learning* not only reinforce these hierarchies but also suggest intentional processes of imparting knowledge which do not fully reflect the social reality. Furthermore, as a radiographer's primary role is to carry out clinical tasks, not to *teach*, alienating those who do not feel like teachers per se. Equally, students are considered to be the learners, which may implicitly impact their agency to share their knowledge. Teaching and learning in the CLE may therefore be better understood as 'knowledge sharing'. Conceptually, this allows for the hierarchy to be flattened, where all actors, regardless of role, can contribute to the evolution of collective radiography mindlines. This speaks to the need for a sustained CoP ethos in which knowledge sharing is a collective responsibility rather than an incidental activity. In this environment, even transient students could be more meaningfully integrated into mindline development.

To realise this, stakeholders influential in the knowledge hierarchy, such as Managers, PEs, and AdPrs, alongside those who direct knowledge development from academia, must work together. The CLE needs to be reframed as a knowledge sharing environment, cultivating a culture that values contributions from those lower on the knowledge hierarchy, not just students and encourages ongoing mutual dialogue over one-directional instruction and non-verbal communication.

Table 7.2. Recommendations Table – Supposition 2

Stakeholder Group	**Recommendation**	**Rationale/Impact**
Researchers	• Apply KMb theories, like mindlines, to explore how perceived hierarchical status in CLEs impacts mutual knowledge sharing. • Develop, implement, and evaluate strategies which frame interactions as knowledge sharing rather than teaching to explore the impact on student agency and radiographer engagement.	• Extends theoretical understanding of how hierarchies influence the flow of knowledge. • Develops evidence for shifting towards a knowledge sharing perspective for clinical education.
HEIs/ Lecturers	• Prepare students to enter into the CLE as contributors to knowledge and KMb, not just recipients. • Include teaching on how to initiate and participate in KMb activities within the curriculum. • Collaborate with CLEs to ensure they are prepared for the shift in knowledge sharing attitudes and behaviours.	• Signals a shift in how students are positioned before entering the CLE. • Develops student confidence and agency to engage in mutual knowledge sharing. • Create shared understanding between academic and clinical boundaries.
CLEs/ Practice Educators	• Promote a culture where all actors are encouraged to participate in KMb. • Incorporate knowledge sharing practices into CPD sessions.	• Reinforces that KMb is a shared responsibility not soley for those who are “good at teaching”. • Provides incentive and models positive KMb behaviours and attitudes. • Flattens the hierarchy by valuing contributions from all levels.

	• Reward and acknowledge when radiographers facilitate and students participate in knowledge sharing.	
Radiographers	• Shift perspective to approach working with students as a social knowledge sharing activity rather than one where teaching is required. • Invite students to share their recent academic insights and discussions. E.g., ask questions such as, "What have you learned about (procedure/policy/patient type) at university?" (also in supposition 1 – see Table 7.1)	• Shifts mentality to a social and discursive process rather than the potentially daunting prospect of having to teach someone. • Creates two-way dialogue rather than one-way knowledge transfer, reducing perceptions around who holds knowledge. • Builds confidence and knowledge sharing ability of students. • Radiographers and, as a result, patients, benefit from the potentially valuable knowledge shared.
Students	• Prepare and be willing to contribute one's own understanding and knowledge to discussions. • Offer academic insights or recently acquired knowledge into discussions in the CLE, identifying where this may have practical relevance (also in supposition 1 – see Table 7.1)	• Shifts student perspective from knowledge consumer to active contributor. • Encourages reflective and discursive integration of theory and practice. • Reinforces and develops student agency in shaping professional knowledge.

7.4.3. Supposition 3: *A call to strengthen socialisation and externalisation*

This study demonstrated the heavy reliance on tacit and non-verbal forms of socialisation, such as observation, signalling, and enacting, as the primary means of KS/S. These practices are considered essential in mindlines development, but what is clear is that when not combined with other verbal KS/S, they risk perpetuating habitual or outdated knowledge. Externalisation processes are apparent but inconsistently used in the CLE, which not only impedes the development of mindlines through the MiCLE model but also illuminates reasoning for the theory-practice gap. Capacity for clinical reasoning and the critical challenge of knowledge is limited by ineffective use of questioning and reflecting practices. Strengthening of these opportunities for externalisation is crucial, and will require developing opportunities and spaces for collective reflection, encouraging verbal articulation of reasoning in the moment, and explicitly supporting and rewarding questioning. Institutionally, prioritisation of the social skills linked to knowledge sharing for both radiographers and students would be immeasurably beneficial to improve clinical education and, as a result, clinical practice.

Table 7.3. Recommendations Table – Supposition 3

Stakeholder Group	**Recommendation**	**Rationale/Impact**
Researchers	• Use KMb theories, specifically mindlines, to explore which sociocultural conditions most effectively support externalisation in the CLE. • Develop, implement, and evaluate strategies, such as "thinking-aloud", reflection in action, and structured questioning. • Explore the transferability of this study to clinical education in other healthcare professions.	• Develop evidence for strategies which help to bridge the theory-practice gap through externalisation. • Identify scalable and transferable approaches to aid in clinical education across healthcare.
HEIs/ Lecturers	• Embed verbal reasoning habits into HEI teaching and curriculum by prompting students to verbalise their rationale before giving answers. • Incorporate peer-learning and role-playing activities where students explain and share their knowledge with other students.	• Builds student confidence in externalising reasoning, both to enter the CLE and to ensure competence in KMb when qualified. • Normalises verbalisation of knowledge as a professional expectation. • Provides safe spaces to practice explaining rationale.
CLEs/ Practice Educators	• Schedule brief and regular reflective huddles to discuss diverse clinical decisions, not just when things go wrong. Invite both radiographers and students to input their experiences.	• Creates intentional space and time for externalisation in the high-pressure environment. • Reinforces that reasoning and professional discussion are valued behaviours, not distractions.

	• Provide CPD for radiographers on "thinking aloud" and externalisation to ensure there is motivation to do so.	• Aids in making tacit decision making processes visible to students.
Radiographers	• Ensure verbalisation of decision making in the moment, explaining the rationale for actions. Touch upon the theoretical knowledge, policy evidence, personal experience, and context-based reasons as to why the task was carried out that way. • Prompt students to suggest how they would carry out a task, and ask them to externalise their reasoning, framing this as collaborative decision making rather than a test.	• Makes tacit knowledge visible and open to discussion, potentially highlighting knowledge gaps. • Encourages mutual exploration and prevents reinforcement of outdated or habitual practice. • Supports students in developing adaptive mindlines informed by evidence.
Students	• Practice verbalising uncertainties and reasoning during CLE activities even when unsure. • Ask questions and request clarification of reasoning when observing, particularly when adaptations are made with limited rationale.	• Ensures contribution to collective reasoning and mindlines development. • Normalises asking for and offering rationale as part of mutual knowledge sharing. • Encourages active participation in externalisation, preparing students for when they qualify and work with other students.

7.4.4. Supposition 4: *A call to address barriers in knowledge combination and internalisation*

Difficulties in mindline development were not only identified in the externalisation phase, but also where externalised knowledge failed to move through combination and internalisation. As students were positioned peripherally, they were rarely invited to participate in the sensemaking and problem-solving activities, which proved so critical in integrating theory with practice. Instead, they conformed to local habits and protocols without explanation as to how theory informs these practices, and how radiographers make clinical decisions. This reinforces passive or generic practice over more adaptive mindlines. In contrast, when experienced and valued radiographers demonstrated their professional mindlines, these were shown to be informed by explicit knowledge such as protocols, imaging techniques, or clinical information, but tacitly and contextually conveyed. Addressing this supposition requires structural change, the function of portfolios to be reconsidered, inclusive, reflective and social spaces to be created, and student contributions to knowledge to be legitimised. The CLE must support all actors to not only 'do' but reason, critique, and evolve their practice, bullet-proofing the profession for the future.

Table 7.4. Recommendations Table – Supposition 4

Stakeholder Group	**Recommendation**	**Rationale/Impact**
Researchers	• Explore how portfolio design and application impact student engagement with sensemaking and integration of theory and practice. • Develop, implement, and evaluate strategies that enable student participation in decision making and problem solving, and assess how this impacts on mindline development.	• Develops evidence to inform the restructuring and design of portfolios which support the integration of theory and practice. • Strengthens the evidence base for clinical education and highlights strategies which may be scalable and transferable to other healthcare professions.
HEIs/ Lecturers	• Redesign portfolio requirements to include evidence of participation in knowledge sharing discourse, e.g. clinical problem solving, or highlighting and seeking out knowledge to fill knowledge gaps. • Prepare students to contribute to decision making by prioritising clinical judgement tasks and case-based reasoning in the curriculum.	• Encourages students to engage with the reasoning behind decisions rather than just task competency. • Aligns academic learning with the skills needed to be adaptable and develop context-sensitive mindlines in the CLE.
CLEs/ Practice Educators	• Create collaborative, reflective, and problem-solving spaces in the CLE. E.g. post-procedure debriefs, collaborative image review sessions. • Recognise when students have been active in KMb through formalised feedback.	• Normalises talking and reflecting on situations and highlighting knowledge gaps to ensure new knowledge can be accessed appropriately. • Rebalances knowledge use between evidence and experiential knowledge.

	• Create collaborative spaces for new knowledge to be applied in practice. E.g. CPD activities such as journal clubs, which update knowledge and provide discussion of how this could be applied to specific situations.	
Radiographers	• Actively involving students in decision making processes by inviting them to listen to conversations or offer suggestions on where to access the knowledge needed. • When demonstrating adaptations to normal practice or out-of-the-ordinary situations, discuss why and where knowledge is being accessed from.	• Provides opportunity for students to combine and access new knowledge through contextual decision making. • Supports internalisation through the process of making decisions and having to seek out the knowledge needed. • Reinforces the importance of justification and reasoning.
Students	• Seek opportunities to be involved in decision making conversations and offer own suggestions with rationale before deferring to radiographer input. • Reflect on instances where theoretical or explicit knowledge influenced actions.	• Encourages active participation in knowledge combination rather than peripheral observation. • Builds professional confidence to contribute in collaborative settings. • Strengthens and makes visible the links between theory and practice.

7.5. Strengths and Limitations

This research presents specific strengths and limitations, along with those apparent in all qualitative research projects, which need careful consideration when interpreting the findings. Ethnography, underpinned by critical constructivism and knowledge mobilisation theory, provides a robust and consistent framework throughout the thesis. Furthermore, ethnography allows for appreciation of the individual, social, and cultural factors which impact a specific group or phenomenon (Fetterman, 1998; Hammersley and Atkinson, 2019). Through ethnography and the associated research methods, the examination of the complex, tacit, and situated nature of knowledge creation and sharing at the Teaching Hospital was realised.

One of the key strengths of this study lies in the breadth and depth of data collected through longitudinal engagement with the field, various actors, and the data itself. 104 hours of participant observations carried out across a range of shift patterns allowed me to meet and interact with 71 actors and immerse myself within the CLE. Through this, the findings capture the verbal and non-verbal practices and dynamics which shape how knowledge is a collective, tacit, and ever-changing entity. The iterative and triangulated approach to data generation and analysis allowed me to create and share rich, contextualised accounts which can be further interrogated and deemed transferable by readers. These insights would likely have been less accessible through research methods which are less observational and focus purely on articulation, such as interviews alone.

Efforts were made to sample a broad range of actors across radiographer and student roles, which I believe I achieved effectively. However, this sample is constrained by the single NHS site in which the research was conducted. As such, the findings are contextually bound and may not be fully representative of UgDR CLEs as a whole. This is a limitation of qualitative research in general, and I have provided a rich description of the site in question to allow readers to ascertain transferability to other contexts. Further sampling critique can be drawn from the exclusion of patients from the participant group. This decision was made to ensure a narrower focus for this PhD project, which was time-limited, and to streamline ethical applications. Further limitations are apparent in the interview sampling. While observational data included a broad range of actors who were amenable to being watched, when requesting their participation in interviews, they were less willing or accessible. It was difficult to arrange mutually appropriate times for interviews for students in particular, which is reflected in the student interview sample. However, during observations, I felt I had more time to speak to students as they were less engaged with clinical tasks than radiographers, and therefore I feel their voice is effectively portrayed in the findings.

Through my positionality, I demonstrate meaningful reflexive practice which has been used to ensure transparency, credibility and consistency throughout the thesis. However, I acknowledge that this subjectivity provides the lens through which my interpretations have been created. The findings, therefore, represent an interpretive account rather than an objective truth developed through the co-construction of knowledge between the actors and me in the field.

Despite the apparent limitations, this study offers a significant contribution to the body of knowledge on UgDR education. To date, it is the first ethnographic study in the UK to explore knowledge sharing in a UgDR CLE through the lens of mindlines. Throughout the PhD, I have also disseminated knowledge through my research outputs seen in Appendix 2a-d (Patel, 2022, 2023a, 2023b, 2024). The core contributions of the MiCLE model and suppositions not only enhance our understanding of the complex interplay of professional knowledge use but also inform future strategies for practice, pedagogy, and research.

7.6. Conclusion

This study set out to explore how knowledge is accessed, shared and developed in clinical UgDR education. This, against the backdrop of literature which focuses on pedagogical strategies for sharing categories of knowledge within the academic environment. My findings address this gap in the literature and examine the relational and dynamic nature of knowledge creation and sharing in a CLE.

A core contribution of this thesis is the development of the MiCLE model. The inclusion of specific KS/S practices and sociocultural conditions offers a new conceptual lens for knowledge sharing and creation in a CLE. The model not only advances our theoretical understandings of mindlines in healthcare professions but can also be used as a practical tool. When considered alongside the four suppositions and recommendations, the MiCLE model provides educators, practitioners, and policymakers with a framework for designing CLEs that support and value the knowledge contributions of all participants. The four suppositions identify both conceptual and practical contributions to knowledge. Exposing how knowledge is created and shared in this context provides a foundation for reframing clinical education with this in mind. It also raises questions about the sufficiency of pedagogical models and perceptions of education when applied to the CLE. Furthermore, it uncovers knowledge hierarchies and power dynamics which constrain the flow of knowledge across social boundaries. The research also contributes methodologically and theoretically. Ethnographic work incorporating vignettes is rare in radiography and even more so in clinical education. My epistemological and reflexive application of the mindlines theory enables a layered

understanding not just of how mindlines are formed, but how theoretical understanding can *inform* their development.

Although the research scope is limited due to the single-site design, it provides significant implications for practice, education, and research. Practically, it offers a framework for future strategies for CLEs to provide more depth in knowledge sharing, socially through questioning, and informal reflection. Educationally, it challenges HEIs to move even further beyond competency-based models to make more space for dialogue, meaningful reflection, and decision making. Professionally and for research, it identifies the importance of valuing and studying holistic and less explicit forms of knowledge, those related to communication, empathy, judgement, and social interaction.

Epilogue

I close with a final reflection. My inquiry began with a question about knowledge in practice, but it ends with a deeper appreciation for people as social beings. In the CLE, as in life, our knowledge is filtered through our values, relationships, motivations, and goals. It matters less what someone knows, and whether that knowledge is "right", and more about whether they feel permitted and entitled to share it. Knowledge exists, evolves, and ceases to be in our actions and interactions. It therefore must be nurtured, not only through design, but through human connection with others.

I leave you now, half a life later, with another tale when I was recently working at an open day at a university. It illustrates how knowledge sharing reveals itself in everyday encounters, which are social, spontaneous, and unstructured. The following tale is about how curiosity, culture, and connection shape our knowledge, further reflecting the core themes of this thesis.

I lean against the worktop in the onsite X-ray room, waiting for prospective students and their parents to walk in, wanting to find out more about the profession and the course. A group of girls wander in, some clinging to each other, whispering and giggling nervously as they spot me.

"Hey! Come in, have a look around, this is our X-ray room where you would learn some of the techniques needed to be a radiographer," I announce as they hover by the door. I walk past them around the lead screen into the main room, waving my hands in encouragement.

They stand in the middle of the room in silence, waiting for me to speak. "Ok, be honest, what's made you all come here then? Parents? Friends? Have you had X-rays yourselves?" I enquire.

One of the girls who seems to be taking the lead reveals, "Actually, like half our class are applying!"

*"*Half?!*" I respond, shocked.*

Radiography always feels like one of those forgotten healthcare professions. Everyone knows about nurses, midwives, paramedics, and physios. But radiography? We just wander into resus undetected, on '24 Hours in A&E'. In 'Grey's Anatomy', they don't even use radiographers; the doctors do all the imaging.

"Yeah!" She nods.

"That's great, how come?! What's made you all so keen?" I ask.

She shrugs, giving me a look like I'm missing something, "TikTok. There's loads on there like people doing day in the life stuff and people having scans and stuff!"

I pause, contemplating how I heard about radiography through my mum, listing off all the departments in the hospital she worked at, thinking, 'Oh, that radiography one sounds interesting.'

"Oh, cool," I respond, covering my ignorance, "I just thought radiography was something people tended to stumble into, but that's great, you must know how to do an X-ray already, then?" I tease.

They all laugh quietly, "Uhm, I wouldn't say that! I know that's a chest X-ray though," she says, pointing at one of the images we have on the screens.

"Yep! Come on, let's see if we can live up to TikTok," I say as they all pull apart slightly and walk over to get a closer look at the X-ray.

As I start asking them questions and talking them through the image, I reflect on how much conversation, unexpected moments, and people's nature shape our capacity for knowledge sharing. These moments are special in that they aren't just about sharing what we know, but ultimately, they are initiated through social connection, regardless of our supposed roles.

This page left intentionally blank

References

Ackoff, R. L. (1989) From Data to Wisdom. *Journal Of Applied Systems Analysis*, 16(1), pp.3–9.

Adams, K., Hean, S., Sturgis, P. and Clark, J. M. (2006) Investigating the factors influencing professional identity of first-year health and social care students. *Learning in Health and Social Care*, 5(2), pp.55–68 https://doi.org/10.1111/j.1473-6861.2006.00119.x.

Adamson, E., King, L., Foy, L., McLeod, M., Traynor, J., Watson, W. and Gray, M. (2018) Feedback in clinical practice: Enhancing the students' experience through action research. *Nurse education in practice*, 31, pp.48–53 https://doi.org/10.1016/j.nepr.2018.04.012.

Adamson, H. K., Chaka, B., Hizzett, K., Williment, J. and Hargan, J. (2023) An exploration of communication skills development for student diagnostic radiographers using simulation-based training with a standardised patient: UK-based focus-group study. *Journal of Medical Imaging and Radiation Sciences*, 54(3), pp.465–472 https://doi.org/10.1016/j.jmir.2023.06.004.

Age UK (2024) State of Health and Care of Older People in England 2024. *Age UK*, Available at: https://www.ageuk.org.uk/discover/2024/september/state-of-health-and-care-of-older-people-in-england-2024/ (Accessed 25 April 2025).

Ahmed, S. K. (2024) The pillars of trustworthiness in qualitative research. *Journal of Medicine, Surgery, and Public Health*, 2 Available at: https://www.sciencedirect.com/science/article/pii/S2949916X24000045 (Accessed 15 August 2024).

Akudjedu, T., Torre, S., Khine, R., Katsifarakis, D., Newman, D. and Malamateniou, C. (2023) Knowledge, perceptions, and expectations of Artificial intelligence in radiography practice: A global radiography workforce survey. *Journal of Medical Imaging and Radiation Sciences*, 54(1), pp.104–116 Available at: https://www.sciencedirect.com/science/article/pii/S1939865422006750 (Accessed 3 October 2023).

Alasuutari, P., Bickman, L. and Brannen, J. (2008) *The SAGE Handbook of Social Research Methods*. London: SAGE Publications Available at: http://ebookcentral.proquest.com/lib/bcu/detail.action?docID=1046489 (Accessed 15 April 2025).

Angrosino, M. (2007) *Doing Ethnographic and Observational Research*. *Doing Ethnographic and Observational Research*, SAGE Publications Ltd https://doi.org/10.4135/9781849208932.

Association of Social Anthropologists (2021) Ethical Guidelines 2021 for good research practice. Available at: https://www.theasa.org/ethics/ (Accessed 27 April 2022).

Atkinson, P. (1995) *Medical talk and medical work: the liturgy of the clinic*. London: Sage.

Aveyard, H. (2018) *Doing a Literature Review in Health and Social Care: a Practical Guide*. Open University Press.

Baethge, C., Goldbeck-Wood, S. and Mertens, S. (2019) SANRA—a scale for the quality assessment of narrative review articles. *Research Integrity and Peer Review*, 4(1), pp.2–8 https://doi.org/10.1186/s41073-019-0064-8.

Bain, P., Wareing, A. and Henderson, I. (2017) A review of peer-assisted learning to deliver interprofessional supplementary image interpretation skills. *Radiography*, 23, pp.S64–S69 https://doi.org/10.1016/J.RADI.2017.05.002.

Barab, S., Warren, S. J. and del Valle, R. T. (2006) Coming to Terms with Communities of Practice: A definition and operational criteria. In: Pershing, J. A., ed. *Handbook of Human Performance Technology*, 3rd edn. San Fransisco: Pfeiffer.

Barley, S. (1990) The Alignment of Technology and Structure through Roles and Networks. *Technology, Organizations, and Innovation*, 35(1), pp.61–103 Available at: https://www.jstor.org/stable/2393551.

Barter, C. and Renold, E. (1999) The Use of Vignettes in Qualitative Research. *Social Research Update*, (25) Available at: https://sru.soc.surrey.ac.uk/SRU25.html (Accessed 11 December 2024).

BCU (2020) Code of good research conduct.

BCU (2023) Data Protection Policy.

BCU (2024) Research data retention schedule.

Beauchamp, T. and Childress, J. (2001) *Principals of Biomedical Ethics*. Oxford: Oxford University Press.

Becker, H.S., Geer, B., Hughes, E.C. and Strauss, A.L. (1961). *Boys in white: student culture in medical school*. University of Chicago Press.

Bell, K. (2014) Resisting Commensurability: Against Informed Consent as an Anthropological Virtue. *American Anthropologist*, 116(3), pp.511–522 https://doi.org/10.1111/aman.12122.

Bentley, M., Fleury, S. C. and Garrison, J. (2007) Critical Constructivism for Teaching and Learning in a Democratic Society. *Journal of Thought*, 42(3–4), pp.9–22 Available at: https://www.jstor.org/stable/jthought.42.3-4.9.

Bergen, N. and Labonté, R. (2020) 'Everything Is Perfect, and We Have No Problems': Detecting and Limiting Social Desirability Bias in Qualitative Research. *Qualitative Health Research*, 30(5), pp.783–792 https://doi.org/10.1177/1049732319889354.

Berger, R. (2015) Now I see it, now I don't: researcher's position and reflexivity in qualitative research. *Qualitative Research*, 15(2), pp.219–234 https://doi.org/10.1177/1468794112468475.

Bleiker, J., Morgan-Trimmer, S., Knapp, K. and Hopkins, S. (2019). Navigating the maze: Qualitative research methodologies and their philosophical foundations. *Radiography*, 25, pp.S4–S8 https://doi.org/10.1016/J.RADI.2019.06.008.

Bloor, M. and Wood, F. (2006) Keywords in Qualitative Methods. *Keywords in Qualitative Methods*, https://doi.org/10.4135/9781849209403.

Boell, S. K. and Cecez-Kecmanovic, D. (2014) A hermeneutic approach for conducting literature reviews and literature searches. *Communications of the Association for Information Systems*, 34(1), pp.257–286 https://doi.org/10.17705/1cais.03412.

Bradbury-Jones, C., Breckenridge, J., Clark, M. T., Herber, O. R., Wagstaff, C. and Taylor, J. (2016) The state of qualitative research in health and social science literature: a focused mapping review and synthesis. Available at: https://www.tandfonline.com/doi/full/10.1080/13645579.2016.1270583 (Accessed 20 April 2025).

Bramer, W. M., Rethlefsen, M. L., Kleijnen, J. and Franco, O. H. (2017) Optimal database combinations for literature searches in systematic reviews: a prospective exploratory study. *Systematic Reviews*, 6(1) https://doi.org/10.1186/S13643-017-0644-Y.

Braun, V. and Clarke, V. (2021a) *Thematic Analysis: A Practical Guide*. ed. A. Maher Sage Publications Ltd.

Braun, V. and Clarke, V. (2021b) To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. *Qualitative Research in Sport, Exercise and Health*, 13(2), pp.201–216 https://doi.org/10.1080/2159676X.2019.1704846.

Brown, B. (2015) *Daring greatly: how the courage to be vulnerable transforms the way we live, love, parent and lead*. UK: Penguin Life.

Brown, P., Jones, A. and Davies, J. (2020) Shall I tell my mentor? Exploring the mentor-student relationship and its impact on students' raising concerns on clinical placement. *Journal of clinical nursing*, 29(17–18), pp.3298–3310 https://doi.org/10.1111/jocn.15356.

Bukamal, H. (2022) Deconstructing insider–outsider researcher positionality. *British Journal of Special Education*, 49(3), pp.327–349 https://doi.org/10.1111/1467-8578.12426.

Bwanga, O. (2020a) Developing a Framework Strategy for Supporting Radiographers in the Clinical Supervision of Radiography Students in Zambia: A Mixed Methods Study. *Ethiopian journal of health sciences*, 30(6), pp.971–980 https://doi.org/10.4314/ejhs.v30i6.15.

Bwanga, O. (2020b) Giving constructive feedback to radiography students on clinical performance. *African Journal of Health, Nursing and Midwifery*, 3(4), pp.1–12.

Bwanga, O. and Lidster, J. (2019) Radiography students' perceptions and experiences of their clinical placements: A qualitative systematic review. *East African Scholars Journal of Medical Sciences*, 2(7), pp.367–380 Available at: https://www.researchgate.net/publication/342201279_Radiography_Students'_Perceptions_and_Experiences_of_their_Clinical_Placements-_A_Qualitative_Systematic_Review.

Canadian Interagency Advisory Panel on Research Ethics (2020) Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans – TCPS 2 (2018). Available at:

https://ethics.gc.ca/eng/tcps2-eptc2_2018_chapter3-chapitre3.html#a (Accessed 18 August 2022).

Cardillo, L., Cahill, F., Wylie, H., Williams, A., Zylstra, J., Davies, A., Fullwood, L. and Van Hemelrijck, M. (2018) Patients' perspectives on opt-out consent for observational research: Systematic review and focus group. *British Journal of Nursing*, 27(22), pp.1321–1329 https://doi.org/10.12968/bjon.2018.27.22.1321.

Carrier, J. (2020) An ethnographic exploration of the social organisation of general practice nurses' knowledge use: more than 'mindlines'? *Journal of Research in Nursing*, 25(7), pp.604–615 https://doi.org/10.1177/1744987120937411.

Chamunyonga, C., Singh, A., Gunn, T. and Edwards, C. (2020) Strategies to develop student support mechanisms in medical radiation sciences clinical education. *Journal of Medical Imaging and Radiation Sciences*, pp.512–517 Available at: https://www.sciencedirect.com/science/article/pii/S1939865420302174 (Accessed 3 October 2023).

Charmaz, K. (2014) *Constructing Grounded Theory*. Los Angeles: SAGE.

Chau, M., Arruzza, E. and Johnson, N. (2022) Simulation-based education for medical radiation students: A scoping review. *Journal of Medical Radiation Sciences*, 69, pp.376–381 https://doi.org/10.1002/jmrs.572.

Cleland, J., Reeve, J., Rosenthal, J. and Johnston, P. (2014) Resisting the tick box culture: refocusing medical education and training. *British Journal of General Practice*, 64(625), pp.422–423 https://doi.org/10.3399/bjgp14X681169.

Clouder, L. and Adefila, A. (2017) Empowerment of physiotherapy students on placement: The interplay between autonomy, risk, and responsibility. *Physiotherapy Theory and Practice*, 33(11), pp.859–868 https://doi.org/10.1080/09593985.2017.1357153.

Cloutier, C. and Ravasi, D. (2021) Using tables to enhance trustworthiness in qualitative research. *Strategic Organization*, 19(1), pp.113–133 https://doi.org/10.1177/1476127020979329.

Coffey, A. (2018) *Doing Ethnography*. *Doing Ethnography*, SAGE Publications Ltd https://doi.org/10.4135/9781526441874.

Complete University Guide (2025) Undergraduate Radiography Courses. Available at: https://www.thecompleteuniversityguide.co.uk/courses/search/undergraduate/radiography (Accessed 31 March 2025).

Conroy, T. (2017) A beginner's guide to ethnographic observation in nursing research. *Nurse Researcher*, 24(4), pp.10–14 https://doi.org/10.7748/nr.2017.e1472.

CoR (2022a) Approval and Accreditation Board Annual Report. Available at: https://www.collegeofradiographers.ac.uk/about-the-college/document-library/documents-and-reports/aab-annual-report-21-22 (Accessed 16 July 2025).

CoR (2022b) Education and Career Framework for the Radiography Workforce (4th edition). Available at: https://www.collegeofradiographers.ac.uk/education-and-career-framework-ecf (Accessed 16 July 2025).

Cortazzi, M. (2001) *Handbook of Ethnography*. SAGE Publications Ltd https://doi.org/10.4135/9781848608337.

Cowdell, F. (2018) Knowledge mobilisation: An ethnographic study of the influence of lay mindlines on eczema self-management in primary care in the UK. *BMJ Open*, 8 https://doi.org/10.1136/bmjopen-2018-021498.

Cowdell, F. (2019) Knowledge mobilisation: an ethnographic study of the influence of practitioner mindlines on atopic eczema self-management in primary care in the UK. *BMJ open*, 9(7), p.e025220 https://doi.org/10.1136/bmjopen-2018-025220.

Crilly, T., Jashapara, A., Trenholm, S., Peckham, A., Currie, G. and Ferlie, E. (2013) *Knowledge mobilisation in healthcare organisations: Synthesising evidence and theory using perspectives of organisational form, resource based view of the firm and critical theory*. Available at: https://www.researchgate.net/publication/260798626_Knowledge_mobilisation_in_healthcare_organisations_Synthesising_evidence_and_theory_using_perspectives_of_organisational_form_resource_based_view_of_the_firm_and_critical_theory (Accessed 7 May 2022).

Cubellis, L., Schmid, C. and von Peter, S. (2021) Ethnography in Health Services Research: Oscillation Between Theory and Practice. *Qualitative Health Research*, 31(11), pp.2029–2040 https://doi.org/10.1177/10497323211022312.

Cunningham, J., Baird, M. and Wright, C. (2015) Managing clinical education through understanding key principles. *Radiologic Technology*, 86(3), pp.257–273.

Currie, G. and White, L. (2012) Inter-professional barriers and knowledge brokering in an organizational context: The case of healthcare. *Organization Studies*, 33(10), pp.1333–1361 https://doi.org/10.1177/0170840612457617.

Dammann, O. (2018) Data, information, evidence, and knowledge: A proposal for health informatics and data science. *Online Journal of Public Health Informatics*, 10(3) https://doi.org/10.5210/OJPHI.V10I3.9631.

Daniel, B. K. and Harland, T. (2017) Ontology and epistemology. In: Daniel, B. K., Harland, T., and Wald, N., eds. *Higher Education Research Methodology*, 2nd edn. Routledge.

Data Protection Act (2018) Data Protection Act. Available at: https://www.legislation.gov.uk/ukpga/2018/12/contents/enacted (Accessed 27 December 2021).

Davies, B. H., Manning-Stanley, A. S. and Hughes, V. (2022) Gonad shield placement accuracy in pelvic radiographs for male patients: A prospective phantom study and survey of third year undergraduate diagnostic radiography students". *Radiography*, 28, pp.366–371 https://doi.org/10.1016/j.radi.2022.02.001.

Davies, H. T. O., Powell, A. E. and Nutley, S. M. (2015) Mobilising knowledge to improve UK health care: learning from other countries and other sectors - a multimethod mapping study. *Health Services and Delivery Research*, 3(27) https://doi.org/10.3310/hsdr03270.

De Koning, M., Meyer, B., Moors, A. and Pels, P. (2019) Guidelines for anthropological research: Data management, ethics, and integrity. *Ethnography*, 20(2), pp.170–174 https://doi.org/10.1177/1466138119843312.

Decker, S. (2006) On Being a Radiographer: Identity Construction and the Radiographer. In: Milnes, K., ed. *Narrative, Memory and Knowledge: Representations, Aesthetics and Contexts*, University of Huddersfield.

Delamont, S. & Atkinson, P. (2011) *SAGE qualitative research methods.* Los Angeles CA; SAGE.

Delamont, S. and Atkinson, P. (2018) The Ethics of Ethnography. In: Iphofen, R. and Tolich, M., eds. *The SAGE Handbook of Qualitative Research Ethics*, London: SAGE Publications Ltd pp. 119–132.

Department of Health and Social Care (2017) Ionising Radiation (Medical Exposure) Regulations (IR(ME)R) 2017. *GOV.UK*, Available at: https://www.gov.uk/government/publications/ionising-radiation-medical-exposure-regulations-2017-guidance/guidance-to-the-ionising-radiation-medical-exposure-regulations-2017 (Accessed 22 April 2025).

Dodgson, J. E. (2019) Reflexivity in Qualitative Research. *Journal of Human Lactation*, 35(2), pp.220–222 https://doi.org/10.1177/0890334419830990.

Dong, H., Lio, J., Sherer, R. and Jiang, I. (2021) Some Learning Theories for Medical Educators. *Medical Science Educator*, 31(3), p.1157 https://doi.org/10.1007/S40670-021-01270-6.

Driessen, E., Van Tartwijk, J., Van Der Vleuten, C. and Wass, V. (2007) Portfolios in medical education: why do they meet with mixed success? A systematic review. *Medical Education*, 41(12), pp.1224–1233 https://doi.org/10.1111/j.1365-2923.2007.02944.x.

Efron, S. E. and Ravid, R. (2018) *Writing the literature review: A practical guide*. New York: Guilford Publications.

Elliott, J. (2021) Task-specific short PowerPointsTM for effective off-campus learning in Diagnostic Radiography. *Journal of Learning Development in Higher Education*, (21) Available at: https://repository.canterbury.ac.uk/item/8z163/task-specific-short-powerpointstm-for-effective-off-campus-learning-in-diagnostic-radiography (Accessed 2 February 2022).

Emerson, R., Fretz, R. and Shaw, L. (2011) *Writing Ethnographic Fieldnotes*. Chicago: University of Chicago Press.

England, A., Azevedo, K. B., Bezzina, P., Henner, A. and McNulty, J. P. (2016) Patient safety in undergraduate radiography curricula: A European perspective. *Radiography*, 22, pp.S12–S19 https://doi.org/10.1016/j.radi.2016.10.004.

England, A., Geers-van Gemeren, S., Henner, A., Kukkes, T., Pronk-Larive, D., Rainford, L. and McNulty, J. P. (2017) Clinical radiography education across Europe. *Radiography*, 23, pp.S7–S15 https://doi.org/10.1016/J.RADI.2017.05.011.

England, A. and McNulty, J. P. (2020) Inclusion of evidence and research in European radiography curricula. *Radiography*, 26, pp.S45–S48 Available at:

http://www.radiographyonline.com/article/S1078817420300705/fulltext (Accessed 23 September 2021).

Enosh, G. and Ben-Ari, A. (2016) Reflexivity: The Creation of Liminal Spaces—Researchers, Participants, and Research Encounters. *Qualitative Health Research*, 26(4), pp.578–584 https://doi.org/10.1177/1049732315587878.

Eraut, M. (2004) Informal learning in the workplace. *Studies in Continuing Education*, 26(2), pp.247–273 https://doi.org/10.1080/158037042000225245.

Ferlie, E., Crilly, T., Jashapara, A. and Peckham, A. (2012) Knowledge mobilisation in healthcare: A critical review of health sector and generic management literature. *Social Science and Medicine*, 74(8), pp.1297–1304 https://doi.org/10.1016/j.socscimed.2011.11.042.

Ferrari, R. (2015) Writing narrative style literature reviews. *Medical Writing*, 24(4), pp.230–235 https://doi.org/10.1179/2047480615z.000000000329.

Fetterman, D. (1998) *Ethnography: Step by Step*. London: SAGE Publications Inc.

Fewster-Thuente, L. and Batteson, T. J. (2018) John Colbert Kolb's Experiential Learning Theory as a Theoretical Underpinning for Interprofessional Education. *Source: Journal of Allied Health*, 47(1), pp.3–8 Available at: https://www.jstor.org/stable/48722018.

Finch, J. (1987) The Vignette Technique in Survey Research. *Sociology (Oxford)*, 21(1), pp.105–114 https://doi.org/10.1177/0038038587021001008.

Finlay, L. and Gough, B. (2003) *Reflexivity: A Practical Guide for Researchers in Health and Social Sciences*. Oxford: Blackwell Science Ltd.

Flickinger, M. (2021) Storytelling As Part Of Effective Leadership. *Forbes*, Available at: https://www.forbes.com/sites/markflickinger/2021/07/19/storytelling-as-part-of-effective-leadership (Accessed 29 May 2025).

Flott, E. A. and Linden, L. (2016) The clinical learning environment in nursing education: A concept analysis. *Journal of Advanced Nursing*, 72(3), pp.501–513 https://doi.org/10.1111/jan.12861.

Forber, J., DiGiacomo, M., Carter, B., Davidson, P., Phillips, J. and Jackson, D. (2016) In pursuit of an optimal model of undergraduate nurse clinical education: An integrative review. *Nurse education in practice*, 21, pp.83–92 https://doi.org/10.1016/j.nepr.2016.09.007.

Fowler, P. (2002) Learning styles of radiographers. *Radiography*, 8(1), pp.3–11 https://doi.org/10.1053/radi.2001.0343.

Fowler, P. and Wilford, B. (2016) Formative feedback in the clinical practice setting: What are the perceptions of student radiographers? *Radiography*, 22, pp.e16–e24 https://doi.org/10.1016/j.radi.2015.03.005.

Francis, A., Hills, C., MacDonald-Wicks, L., Johnston, C., James, D., Surjan, Y. and Warren-Forward, H. (2016) Characteristics of an ideal practice educator: Perspectives from practice educators in diagnostic radiography, nuclear medicine, nutrition and dietetics, occupational therapy and physiotherapy and radiation therapy. *Radiography*, 22, pp.287–294 http://dx.doi.org/10.1016/j.radi.2016.04.001.

Freytag, G. and MacEwan, E. J. (1900) *Freytag's Technique of the drama : an exposition of dramatic composition and art. An authorized translation from the 6th German ed. by Elias J. MacEwan*. Chicago : Scott, Foresman Available at: http://archive.org/details/freytagstechniqu00freyuoft (Accessed 23 April 2025).

Gabbay, J. and le May, A. (2004) Evidence based guidelines or collectively constructed "mindlines?" Ethnographic study of knowledge management in primary care. *BMJ*, 329 https://doi.org/10.1136/bmj.329.7473.1013.

Gabbay, J. and le May, A. (2011) *Practice-based evidence for healthcare: Clinical mindlines*. *Practice-based Evidence for Healthcare: Clinical Mindlines*, London: Routledge Taylor & Francis Group https://doi.org/10.4324/9780203839973.

Gabbay, J. and le May, A. (2023) *Knowledge transformation in health and social care : putting mindlines to work*. Oxon: Routledge Available at: https://www.routledge.com/Knowledge-Transformation-in-Health-and-Social-Care-Putting-Mindlines-to/Gabbay-May/p/book/9780367746162 (Accessed 11 January 2023).

GDPR (2018) Guide to the General Data Protection Regulation (GDPR).

Goffman, E. (1991) *Asylums: essays on the social situation of mental patients and other inmates*. Harmondsworth: Penguin.

Gold, R. L. (1958) Roles in Sociological Field Observations. *Social Forces*, 36(3), pp.217–223 Available at: https://www.jstor.org/stable/2573808 (Accessed 22 September 2022)

Golden-Biddle, K. and Locke, K. (1993) Appealing Work: An Investigation of How Ethnographic Texts Convince. *Organization Science*, 4(4), pp.595–616 Available at: https://www.jstor.org/stable/2635082 (Accessed 20 April 2025).

Goodson, L. and Vassar, M. (2011) An overview of ethnography in healthcare and medical education research. *Journal of Educational Evaluation for Health Professions*, 8, p.4 https://doi.org/10.3352/jeehp.2011.8.4.

Graham, I. D., Logan, J., Harrison, M. B., Straus, S. E., Tetroe, J., Caswell, W. and Robinson, N. (2006) Lost in knowledge translation: Time for a map? *The Journal of Continuing Education in the Health Professions*, 26(1), pp.13–24 https://doi.org/10.1002/chp.47.

Grant, M. J. and Booth, A. (2009) A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information and Libraries Journal*, 26(2), pp.91–108 https://doi.org/10.1111/J.1471-1842.2009.00848.X.

Green, D., Heales, C. J., Hughes, D., Marsden, A. and Mills, J. A. (2022) Exploring current undergraduate student perspectives on the introduction of the degree apprenticeship scheme in diagnostic radiography–a single institution. *Radiography*, 28, pp.1058–1063 https://doi.org/10.1016/j.radi.2022.08.002.

Green, J. and Thorogood, N. (2018) *Qualitative Methods for Health Research*. London: SAGE.

Greener, I. (2014) Designing Social Research: A Guide for the Bewildered. *Designing Social Research: A Guide for the Bewildered*, https://doi.org/10.4135/9781446287934.

Greenhalgh, T. (2023) Knowledge Transformation in Healthcare: Putting Mindlines to Work edited by John Gabbay and Andrée le May. *BJGP Life*, Available at: https://bjgplife.com/mindlines (Accessed 29 May 2025).

Greenhalgh, T., Thorne, S. and Malterud, K. (2018) Time to challenge the spurious hierarchy of systematic over narrative reviews? *European Journal of Clinical Investigation*, 48(6) https://doi.org/10.1111/eci.12931.

Greenhalgh, T. and Wieringa, S. (2011) Is it time to drop the 'knowledge translation' metaphor? A critical literature review. *Journal of the Royal Society of Medicine*, 104(12), pp.501–509 https://doi.org/10.1258/jrsm.2011.110285.

Greenway, K., Butt, G. and Walthall, H. (2019) What is a theory-practice gap? An exploration of the concept. *Nurse Education in Practice*, 34, pp.1–6 https://doi.org/10.1016/J.NEPR.2018.10.005.

Guba, E. G. (1981) Criteria for Assessing the Trustworthiness of Naturalistic Inquiries. *Educational Communication and Technology*, 29(2), pp.75–91 Available at: https://link.springer.com/article/10.1007/BF02766777 (Accessed 12 August 2024).

Guillemin, M. and Gillam, L. (2004) Ethics, Reflexivity, and "Ethically Important Moments" in Research. *Qualitative Inquiry*, 10(2), pp.261–280 https://doi.org/10.1177/1077800403262360.

Gulden, R. van der, Timmerman, A. A., Sagasser, M. H., Kramer, A., Haan, N. S., Thoonen, B. and Heeneman, S. (2023) How does portfolio use support self-regulated learning during general practitioner specialty training? A qualitative focus group study. https://doi.org/10.1136/bmjopen-2022-066879.

Gupta, S., Howden, S., Moffat, M., Pope, L. and Kennedy, C. (2024) Placement or displacement: An ethnographic study of space in the clinical learning environment. *Medical Teacher*, 46(5), pp.672–681 https://doi.org/10.1080/0142159X.2023.2273783.

Hadwen, H., Harvey-Lloyd, J. and Strudwick, R. (2020) From selection to registration, and beyond: Supporting the student diagnostic radiographer in becoming a compassionate professional. *Journal of Practice Teaching & Learning*, 17(2), pp.78–90 https://doi.org/10.1921/JPTS.V17I2.1312.

Hammersley, M. (1992) Some reflections on ethnography and validity. *International Journal of Qualitative Studies in Education*, 5(3), pp.195–203.

Hammersley, M. and Atkinson, P. (2007) *Ethnography : principles in practice*. Routledge.

Hammersley, M. and Atkinson, P. (2019) *Ethnography: Principles in Practice*. Oxford: Taylor & Francis Group.

Have, P. ten (2004) *Understanding Qualitative Research and Ethnomethodology*. SAGE Publications Ltd https://doi.org/10.4135/9780857020192.

Hayre, C. M. (2016) *Radiography Observed: An Ethnographic Study Exploring Contemporary Radiographic Practice*. Canterbury Christ Church University.

Hayre, C. M. and Strudwick, R. M. (2019) Ethnography for Radiographers: A Methodological Insight for Prospective Researchers. *Journal of Medical Imaging and Radiation Sciences*, 50(3), pp.352–358 https://doi.org/10.1016/j.jmir.2019.06.049.

Hazell, L., Lawrence, H. and Friedrich-Nel, H. (2020) Simulation based learning to facilitate clinical readiness in diagnostic radiography. A meta-synthesis. *Radiography*, 26, pp.e238–e245 https://doi.org/10.1016/j.radi.2020.03.006.

HCPC (2017) *Standards of education and training guidance*. Available at: https://www.hcpc-uk.org/standards/standards-relevant-to-education-and-training/set/. (Accessed 16 July 2025).

HCPC (2023) *Radiographers Standards of Proficiency*. Available at: https://www.hcpc-uk.org/standards/standards-of-proficiency/radiographers/ (Accessed 16 July 2025).

HCPC (2025a) Standards of education and training. *HCPC UK*, Available at: https://www.hcpc-uk.org/standards/standards-relevant-to-education-and-training/set/ (Accessed 12 April 2025).

HCPC (2025b) Who we regulate. *Health and Care Professions Council*, Available at: https://www.hcpc-uk.org/about-us/who-we-regulate/ (Accessed 25 April 2025).

Hendry, J. (2019) Promoting compassionate care in radiography – What might be suitable pedagogy? A discussion paper. *Radiography*, 25, pp.269–273 https://doi.org/10.1016/j.radi.2019.01.005.

Hendry, J. A. (2013) Are radiography lecturers, leaders? *Radiography*, 19, pp.251–258 Available at: https://www.sciencedirect.com/science/article/abs/pii/S1078817413000096?casa_token=zGAd-66HhjcAAAAA:8xuNXRUZnJ_DQ2jeP-Ewffw9e1yIOiV4FBQzH5kFswEyuq3XMQJYPysgcF-aUa1P4ghTBlposD0 (Accessed 14 March 2022).

Hendry, J. A. (2020) Educational perspectives in radiography. In: Hayre, C. M. and Cox, W. A., eds. *General radiography: Principles and practices*, CRC Press pp. 233–247.

Hewitt-Taylor, J. (2017) *The essential guide to doing a health and social care literature review*. Taylor & Francis.

Higgins, R. (2017) Using Research-informed Teaching experience (RiTe) to support learning and practice in undergraduate radiography education. Available at: http://usir.salford.ac.uk/id/eprint/43120 (Accessed 14 March 2022).

Higgins, R., Robinson, L. and Hogg, P. (2014) Integrating research-informed teaching within an undergraduate diagnostic radiography curriculum: Results from a level 4 (year 1) student cohort. *Radiography*, 20(2), pp.100–106 https://doi.org/10.1016/J.RADI.2014.02.002.

Hinton, J. (2016) An exploration of Operating Department Practice students' experiences of placement support during their first perioperative clinical placement. *Nurse education in practice*, 16(1), pp.242–250 https://doi.org/10.1016/j.nepr.2015.09.005.

Hizzett, K. and Snaith, B. (2022) Career intentions, their influences and motivational factors in diagnostic radiography: A survey of undergraduate students. *Radiography*, 28, pp.162–

167 Available at: https://www.sciencedirect.com/science/article/pii/S1078817421001474?casa_token=yu_J_hsdAaEAAAAA:khlSUgH6o10FiXExJ3tFwrGBMWVBBHFKppNwlNVWH4bC5g-kqsmPUWsn-FbyJAmPFKzSHGOdZGw (Accessed 2 February 2022).

Holmström, A. and Ahonen, S. (2016) Radiography students' learning: A literature review. *Radiologic Technology*, 87(4), pp.371–379 Available at: https://www.researchgate.net/publication/299187894_Radiography_Students'_Learning_A_Literature_Review (Accessed 23 September 2021).

Howell, K. E. (2013) *An Introduction to the Philosophy of Methodology*. London: SAGE Publications Ltd Available at: https://methods.sagepub.com/book/mono/an-introduction-to-the-philosophy-of-methodology/toc (Accessed 15 April 2025).

Hyde, E. (2015) A critical evaluation of student radiographers' experience of the transition from the classroom to their first clinical placement. *Radiography*, 21(3), pp.242–247 https://doi.org/10.1016/j.radi.2014.12.005.

Hyde, E. and Hardy, M. (2021) Patient centred care in diagnostic radiography (Part 3): Perceptions of student radiographers and radiography academics. *Radiography*, 27, pp.803–810 Available at: https://www.sciencedirect.com/science/article/pii/S1078817420302777 (Accessed 2 February 2022).

Hyde, E., Hardy, M., Strudwick, R. M. and Upton, A. (2024) The impact of a massive open online course on levels of awareness of patient centred care in UK-based diagnostic radiographers. *Journal of Practice Teaching and Learning*, 22(1–2) https://doi.org/10.1921/jpts.v20i3.2211.

Jack, K., Levett-Jones, T., Ylonen, A., Ion, R., Pich, J., Fulton, R. and Hamshire, C. (2021) 'Feel the fear and do it anyway' ... nursing students' experiences of confronting poor practice. *Nurse education in practice*, 56, p.103196 https://doi.org/10.1016/j.nepr.2021.103196.

Jackson, M. (2013) *Conceptualising radiography knowledge and the role of radiography educators: perspectives and experiences of a radiography education community*. Kingston University.

Jacobsen, K. H. (2020) *Introduction to Health Research Methods: A Practical Guide*. Burlington: Jones & Bartlett Learning, LLC.

Jarzabkowski, P., Bednarek, R. and Lê, J. K. (2014) Producing persuasive findings: Demystifying ethnographic textwork in strategy and organization research. *Strategic Organization*, 12(4), pp.274–287 https://doi.org/10.1177/1476127014554575.

Junior, J. P. B. (2022) Social desirability bias in qualitative health research. *Revista de Saúde Pública*, 56, p.101 https://doi.org/10.11606/s1518-8787.2022056004164.

Karnieli-Miller, O., Strier, R. and Pessach, L. (2009) Power Relations in Qualitative Research. *Qualitative Health Research*, 19(2), pp.279–289 https://doi.org/10.1177/1049732308329306.

Kay, M. and Brogan, K. (2024) The perceptions and experiences of final year undergraduate diagnostic imaging students when facilitating peer-assisted learning within the

simulated learning environment. *Radiography*, 30, pp.138–142 https://doi.org/10.1016/j.radi.2024.11.001.

Kell, C. (2014) Placement education pedagogy as social participation: what are students really learning? *Physiotherapy research international : the journal for researchers and clinicians in physical therapy*, 19(1), pp.44–54 https://doi.org/10.1002/pri.1561.

Keogh, L., Jovanovski, N., MacLean, S. and Chenhall, R. (2023) 'Theory' in qualitative research: a framework that synthesises existing academic advice. In: Liamputtong, P., ed. *How to conduct qualitative research in social science*.

Khine, R., Harrison, G. and Flinton, D. (2024) What makes a good clinical practice experience in radiography and sonography? An exploration of qualified clinical staff and student perceptions. *Radiography*, 30(1), pp.66–72 https://doi.org/10.1016/j.radi.2023.09.013.

Kincheloe, J. (2005) From Constructivism to Critical Constructivism. In: *Critical Constructivism Primer*, New York: Peter Lang US.

Kincheloe, J. L. and Mclaren, P. (2011) Rethinking Critical Theory and Qualitative Research. In: Hayes, K., Steinberg, S., and Tobin, K., eds. *Key Works in Critical Pedagogy*, SensePublishers pp. 285–326.

King, R. (2019) *Knowledge mobilisation in discharge decision making by advanced nurse practitioners in a UK emergency department: an ethnographic study*. University of Sheffield Available at: https://etheses.whiterose.ac.uk/23790/ (Accessed 7 May 2022).

Knapp, K. M. and Courtier, N. (2021) The future role of radiographers. *Radiography*, 27, pp.S1–S2 https://doi.org/10.1016/j.radi.2021.08.005.

Kolb, D. A. (1984) *Experiential Learning: Experience As The Source Of Learning And Development*. Englewood Cliffs, NJ: Prentice Hall.

Körner, M., Weber, C. H., Wirth, S., Pfeifer, K.-J., Reiser, M. F. and Treitl, M. (2007) Advances in Digital Radiography: Physical Principles and System Overview. *RadioGraphics*, 27(3), pp.675–686 https://doi.org/10.1148/rg.273065075.

Lave, J. and Wenger, E. (1991) *Situated learning: legitimate peripheral participation*. Cambridge: University Press.

Lawal, O., Ramlaul, A. and Murphy, F. (2021) Problem based learning in radiography education: A narrative review. *Radiography*, 27(2), pp.727–732 https://doi.org/10.1016/J.RADI.2020.11.001.

Lee, R. R., McDonagh, J. E., Farre, A., Peters, S., Cordingley, L. and Rapley, T. (2021) Data protection, information governance and the potential erosion of ethnographic methods in health care? *Sociology of Health & Illness*, 44(1), pp.211–217 https://doi.org/10.1111/1467-9566.13408.

Liamputtong, P., (2023) *How to conduct qualitative research in social science.* Northampton: Edward Elgar Publishing.

Lichterman, P. (2017) Interpretive reflexivity in ethnography. *Ethnography*, 18(1), pp.35–45 https://doi.org/10.1177/1466138115592418.

Lincoln, Y. S. and Guba, E. G. (1985) *Naturalistic inquiry*. Beverly Hills: Sage.

Long, Q. (2022) Confucius's Educational Thoughts in the Analects. *Open Journal of Social Sciences*, 10(3), pp.345–351 Available at: https://www.scirp.org/journal/paperinformation?paperid=116115 (Accessed 6 February 2025).

Lundvall, L. L., Dahlström, N. and Dahlgren, M. A. (2021) Radiography Students' Learning During Clinical Placements: Developing Professional Knowing in Practice. *Vocations and Learning*, 14(3), pp.439–457 https://doi.org/10.1007/s12186-021-09269-1.

Lune, H. and Berg, B. (2017) *Qualitative research methods for the social sciences*. Essex: Pearson Education Limited.

van Maanen, J. (2011) *Tales of the field: on writing ethnography*. 2nd ed. London: University of Chicago Press.

MacDonald, I. (2020) Education matters in radiography. In: Hayre, C. M. and Cox, W. A. S., eds. *General radiography: Principles and practices*, CRC Press pp. 219–232.

Mackay, S. J., White, P., Mcnulty, J. P., Lane, S. and Lewis, S. J. (2015) A benchmarking and comparative analysis of emotional intelligence in student and qualified radiographers: an international study. *Journal of Medical Radiation Sciences*, 62(4), pp.246–252 https://doi.org/10.1002/jmrs.130.

Madison, D. S. (2020) *Critical Ethnography: Method, Ethics, and Performance*. *Critical Ethnography: Method, Ethics, and Performance*, SAGE Publications, Inc https://doi.org/10.4135/9781071878965.

Malterud, K., Siersma, V. D. and Guassora, A. D. (2016) Sample Size in Qualitative Interview Studies: Guided by Information Power. *Qualitative Health Research*, 26(13), pp.1753–1760 https://doi.org/10.1177/1049732315617444.

Manning, V. (2017) Learner-Centered Teaching. *Radiologic Science & Education*, pp.23–32 Available at: http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=10785450&AN=126794824&h=363EdBuKWHf76oJibI7G6FJXWCDWp5K7ArtiQ%2FMnNs6oF0%2BeR8mRFAUWaXBdXwzKUPzzPp%2FN7Mk6rdsnfVGr7g%3D%3D&crl=c (Accessed 2 February 2022).

Marshall, F., Langley, J., Booth, A., Evans, C., Morling, J. and Such, E. (2024) The contributions of creative approaches towards knowledge mobilisation in public health interventions: a scoping review. https://doi.org/10.6084/m9.figshare.27135822.v1.

Maso, I. (2003) Necessary Subjectivity: exploiting researchers' motives, passions and prejudices in pursuit of answering 'true' questions. In: Finlay, L. and Gough, B., eds. *Reflexivity: A Practical Guide for Researchers in Health and Social Sciences*, Oxford: Blackwell Science Ltd pp. 39–51.

Mason, M. (2010) Sample Size and Saturation in PhD Studies Using Qualitative Interviews. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 11(3) https://doi.org/10.17169/FQS-11.3.1428.

Mays, N. and Pope, C. (2000) Qualitative research in health care: Assessing quality in qualitative research. *BMJ*, 320 https://doi.org/10.1136/bmj.320.7226.50.

McAnulla, S. (2018) *A two-phase study to explore whether student radiographer attrition can be predicted and to improve understanding of high attrition rates from undergraduate diagnostic radiography degrees in England*. University of Exeter.

McAnulla, S., Ball, S. and Knapp, K. (2020) Understanding student radiographer attrition: Risk factors and strategies. *Radiography*, 26, pp.198–204 Available at: https://www.sciencedirect.com/science/article/pii/S1078817419302573 (Accessed 2 February 2022).

McAvoy, V. and Waite, M. (2019) Belongingness: Student ODPs' learning experiences in clinical placements. *Journal of perioperative practice*, 29(1–2), pp.17–23 https://doi.org/10.1177/1750458918788774.

McEvoy, F. J., Shen, N. W., Nielsen, D. H., Buelund, L. E. and Holm, P. (2017) Online radiology reporting with peer review as a learning and feedback tool in radiology; Implementation, validity, and student impressions. *Journal of Digital Imaging*, 30(1), pp.78–85 https://doi.org/10.1007/S10278-016-9905-X.

McKnight, K. L. (2019) *'So, what are we looking at here?' - Research, its position and pedagogy in the UK radiography profession*. Birmingham City University Available at: http://www.open-access.bcu.ac.uk/id/eprint/10986 (Accessed 2 February 2022).

McKnight, K. L. (2022) Research pedagogy in a UK radiography education setting. *Radiography*, 28(1), pp.80–87 https://doi.org/10.1016/J.RADI.2021.08.002.

McNulty, J. P., England, A. and Shanahan, M. C. (2021) International perspectives on radiography practice education. *Radiography*, 27, pp.1044–1051 Available at: https://www.sciencedirect.com/science/article/pii/S1078817421000432 (Accessed 14 March 2022).

McNulty, J. P., Knapp, K. M. and Brown, P. (2017) Radiography education in the spotlight. *Radiography*, 23, pp.S1–S2 https://doi.org/10.1016/j.radi.2017.07.007.

McPake, M. (2021) How do the attitudes of therapeutic radiographers affect students' learning during practice placement? *Radiography*, 27(1), pp.37–42 https://doi.org/10.1016/J.RADI.2020.05.009.

Meertens, R. (2016) Utilisation of a peer assisted learning scheme in an undergraduate diagnostic radiography module. *Radiography*, 22(1), pp.e69–e74 https://doi.org/10.1016/j.radi.2015.08.004.

Merriam, S. B. and Tisdell, E. J. (2016) *Qualitative Research: A Guide to Design and Implementation*. San Fransisco: Jossey-Bass.

Miller, W. (1955) Death of a genius: His fourth dimension, time, overtakes Einstein. *LIFE*, pp.61–64.

Morrow, K. and Mackay, S. (2024) Diagnostic radiography students' attitudes towards gender inclusive pregnancy status checks. *Radiography*, 30(3), pp.784–792 https://doi.org/10.1016/j.radi.2024.02.021.

Murad, M. H., Asi, N., Alsawas, M. and Alahdab, F. (2016) New evidence pyramid. *Evidence-Based Medicine*, 21(4), pp.125–127 https://doi.org/10.1136/EBMED-2016-110401.

National Careers Service (2025) Radiographer. *Explore Careers*, Available at: https://nationalcareers.service.gov.uk/job-profiles/radiographer (Accessed 31 March 2025).

Naylor, S., Ferris, C. and Burton, M. (2016) Exploring the transition from student to practitioner in diagnostic radiography. *Radiography*, 22(2), pp.131–136 https://doi.org/10.1016/J.RADI.2015.09.006.

Naylor, S., Harcus, J. and Elkington, M. (2015) An exploration of service user involvement in the assessment of students. *Radiography*, 21(3), pp.269–272 https://doi.org/10.1016/j.radi.2015.01.004.

Ng, C. K. C. (2015) Evidence-based education in radiography. In: Brown, T. and Williams, B., eds. *Evidence-based education in the health professions*, London: Radcliffe Publishing Ltd pp. 428-448.

NHS (2025) Diagnostic radiographer. *Health Careers*, Available at: https://www.healthcareers.nhs.uk/explore-roles/allied-health-professionals/roles-allied-health-professions/roles-allied-health-professions/diagnostic-radiographer (Accessed 31 March 2025).

NHS England (2025) Diagnostic Imaging Dataset Statistical Release. Available at: https://www.england.nhs.uk/statistics/statistical-work-areas/diagnostic-imaging-dataset/diagnostic-imaging-dataset-2024-25-data/ (Accessed 16 July 2025).

NHS Pay Review Body (2023) NHS Pay Review Body Thirty-Sixth Report. Available at: https://assets.publishing.service.gov.uk/media/64b00cdf8bc29f000d2cccf7/NHSPRB_2023_Bookmarked.pdf (Accessed 16 July 2025).

NHSE (2024) Education and training tariffs 2024 to 2025. *GOV.UK*, Available at: https://www.gov.uk/government/publications/healthcare-education-and-training-tariff-2024-to-2025/education-and-training-tariffs-2024-to-2025 (Accessed 12 April 2025).

NMC (2023) Standards for pre-registration nursing programmes.

Nonaka, I. (1994) A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1), pp.14–37 https://doi.org/10.1287/orsc.5.1.14.

Nonaka, I. and Takeuchi, H. (1995) *The knowledge creating company*. Oxford: Oxford University Press.

Nowell, L. S., Norris, J. M., White, D. E. and Moules, N. J. (2017) Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, 16, pp.1–13 Available at: https://journals.sagepub.com/doi/10.1177/1609406917733847 (Accessed 20 April 2025).

Office for National Statistics (2023) Rising ill-health and economic inactivity because of long-term sickness, UK - Office for National Statistics. *Office for National Statistics*, Available at: https://www.ons.gov.uk/employmentandlabourmarket/peoplenotinwork/economicinact

ivity/articles/risingillhealthandeconomicinactivitybecauseoflongtermsicknessuk/2019to2023 (Accessed 25 April 2025).

Orb, A., Eisenhauer, L. and Wynaden, D. (2000) Ethics in qualitative research. *Journal of Nursing Scholarship*, 33(1), pp.93–96 https://doi.org/10.1111/j.1547-5069.2001.00093.x.

O'Reilly, K. (2009) *Key Concepts in Ethnography*. *Key Concepts in Ethnography*, SAGE Publications Ltd https://doi.org/10.4135/9781446268308.

Oswald, D., Sherratt, F. and Smith, S. (2014) Handling the Hawthorne effect: The challenges surrounding a participant observer. *Review of Social Studies*, 1(1), pp.53–73.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N. and Hoagwood, K. (2015) Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. *Administration and Policy in Mental Health and Mental Health Services Research*, 42(5), pp.533–544 https://doi.org/10.1007/s10488-013-0528-y.

Partner, A., Shiner, N., Hyde, E. and Errett, S. (2022) First year student radiographers' perceptions of a one-week simulation-based education package designed to increase clinical placement capacity. *Radiography*, 28(3), pp.577–585 https://doi.org/10.1016/j.radi.2022.04.007.

Patel, K. (2022) What is 'knowledge mobilisation' and how can it improve radiography education? In: *UK Imaging and Oncology Conference*. Liverpool, 4th July 2022.

Patel, K. (2023a) Introducing clinical mindlines : A discussion of professional knowledge sharing in clinical radiography education. *Radiography*, 29, pp.577–581 https://doi.org/10.1016/j.radi.2023.03.011.

Patel, K. (2023b) Radiography Mindlines: An ongoing ethnographic study of knowledge sharing in clinical radiography education. In: *Achieving Excellence in Radiography Education and Research*. Ipswich, 24th November 2023.

Patel, K. (2024) Logistics of setting up an ethnographic study in the NHS: Experiences of a doctoral student. In: *UK Imaging and Oncology Conference*. Liverpool, 10th June 2024.

Paterson, A. (2012) Cancer: Implications for pre-registration radiography curricula. *Radiography*, 18(1), pp.47–50 https://doi.org/10.1016/J.RADI.2011.11.002.

Pillow, W. (2003) Confession, catharsis, or cure? Rethinking the uses of reflexivity as methodological power in qualitative research. *International Journal of Qualitative Studies in Education*, https://doi.org/10.1080/0951839032000060635.

Polanyi, M. (1966) The logic of tacit inference. *Philosophy*, 41(155), pp.1–18.

Polkinghorne, D. E. (1995) Narrative Configuration in Qualitative Analysis. *International Journal of Qualitative Studies in Education*, 8(1), pp.5–23.

Potts, B. and White, H. P. (2024) Student radiographers' confidence of adapting practice for autistic patients: A qualitative survey on the role of placement experiences. *Radiography*, 30, pp.34–41 https://doi.org/10.1016/J.RADI.2024.09.055.

Prentakis, A. G., Stefanoyiannis, A. P., Georgiadis, K., Coleman, L., Foley, S. J., Herlig, D., Kollas, P., Kowalik, A., Tomczak, J. and Chatziioannou, S. N. (2016) Education, training, and professional issues of radiographers in six European countries: a comparative review. *Journal of European CME*, 5(1), p.31092 Available at: https://www.tandfonline.com/doi/abs/10.3402/jecme.v5.31092 (Accessed 22 November 2021).

Price, R. and Paterson, A. (2021) *The Society of Radiographers: 100 Years*. London: SoR.

QSR International (2021) NVivo: Version 12. Available at: https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home.

Quality Assurance Agency for Higher Education (QAA) (2024) UK Quality Code for Higher Education: Advice and Guidance: Learning and Teaching. Available at: https://www.qaa.ac.uk/the-quality-code/2024 (Accessed 6 May 2025).

Ramazan, F., Graham, Y. and Hayes, C. (2024) Communities of practice: An alternative approach to bridging the theory-practice gap in radiography? *Radiography*, 30(4), pp.1167–1172 https://doi.org/10.1016/j.radi.2024.05.015.

Ramlaul, A. (2018) *An exploration of the meaning and development of critical thinking in diagnostic radiography*. University of Hertfordshire Available at: http://uhra.herts.ac.uk/handle/2299/21278 (Accessed 2 February 2022).

Ramlaul, A., Duncan, D. and Alltree, J. (2021) The meaning of critical thinking in diagnostic radiography. *Radiography*, 27, pp.1166–1171 https://doi.org/10.1016/J.RADI.2021.06.009.

RCN (2009) *Research ethics: RCN guidance for nurses*. *Royal College of Nursing*, https://doi.org/10.1016/s1542-0124(12)70032-0.

Rea-Holloway, M. and Hagelman, S. (2020) Ethnographers in Scrubs Ethnographic observation within healthcare. In: Hackett, P. and Hayre, C., eds. *Handbook of Ethnography in Healthcare Research*, Taylor & Francis.

Richards, M., Maskell, G., Halliday, K. and Allen, M. (2022) Diagnostics: a major priority for the NHS. *Future Healthcare Journal*, 9(2), pp.133–137 https://doi.org/10.7861/fhj.2022-0052.

Robertson FHEA, A. (2019) *Storytelling for learning in a diagnostic radiography community of practice*. Available at: https://search.proquest.com/openview/dcb2ff72807329ed3a0c9c46430855eb/1?pq-origsite=gscholar&cbl=18750&diss=y (Accessed 2 February 2022).

Rolfe, G. (2006) Validity, trustworthiness and rigour: quality and the idea of qualitative research. *Journal of Advanced Nursing*, 53(3), pp.304–310 https://doi.org/10.1111/j.1365-2648.2006.03727.x.

Sá dos Reis, C., Pires Jorge, J., York, H., Flaction, L., Johansen, S. and Mæhle, S. (2018a) A comparative study about motivations, expectations and future plans for professional development in four European radiography programs. *Radiography*, 24, pp.e91–e97 https://doi.org/10.1016/J.RADI.2018.05.007.

Sá dos Reis, C., Pires-Jorge, J. A., York, H., Flaction, L., Johansen, S. and Maehle, S. (2018b) Curricula, attributes and clinical experiences of radiography programs in four European educational institutions. *Radiography*, 24(3), pp.e61–e68 https://doi.org/10.1016/J.RADI.2018.03.002.

Shiner, N. (2018) Is there a role for simulation-based education within conventional diagnostic radiography? A literature review. *Radiography*, https://doi.org/10.1016/j.radi.2018.01.006.

Shiner, N. and Howard, M. L. (2019) The use of simulation and moulage in undergraduate diagnostic radiography education: A burns scenario. *Radiography*, 25(3), pp.194–201 https://doi.org/10.1016/J.RADI.2018.12.015.

Sloane, C. and Hyde, E. (2019) Diagnostic radiography education: Time for a radical change? *Imaging & Therapy Practice*, (August), pp.5–10.

Sloane, C. and Miller, P. K. (2017) Informing radiography curriculum development: The views of UK radiology service managers concerning the 'fitness for purpose' of recent diagnostic radiography graduates. *Radiography*, 23, pp.S16–S22 https://doi.org/10.1016/j.radi.2017.05.013.

SoR (2005) Implementing Radiography Career Progression: Guidance for Managers. Available at: https://www.sor.org/learning-advice/professional-body-guidance-and-publications/documents-and-publications/policy-guidance-document-library/implementing-radiography-career-progression-guidan (Accessed 31 March 2025).

SoR (2011) Roles and Responsibilities in Clinical Education. Available at: https://www-sor-org.webpkgcache.com/doc/-/s/www.sor.org/getmedia/ec30e173-42a8-4f33-ba50-bdd017612b1e/Roles%20and%20Responsibilities%20in%20Clinical%20Education_1 (Accessed 8 February 2022).

SoR (2012) Quality standards for practice placements. Available at: https://www.collegeofradiographers.ac.uk/CMSPages/GetFile.aspx?guid=3efc947d-bcf6-43eb-9952-cd535c98efc5&versionhistoryid=19401 (Accessed 11 April 2022).

SoR (2022) Diagnostic Radiography Workforce UK Census. Available at: https://www.sor.org/getmedia/6994cd5d-0155-4a7e-a8a7-32a9bbda81c3/Diagnostic-Radiography-Workforce-UK-Census-2022-report.pdf (Accessed 16 July 2025).

SoR (2023) Written evidence submitted by The Society of Radiographers. Available at: https://committees.parliament.uk/writtenevidence/120672/pdf/ (Accessed 29 March 2025).

SoR (2025a) Code of Professional Conduct. Available at: https://www.sor.org/learning-advice/professional-body-guidance-and-publications/documents-and-publications/policy-guidance-document-library/code-of-professional-conduct-2025 (Accessed 13 April 2025).

SoR (2025b) Scope of Practice. Available at: https://www.sor.org/learning-advice/professional-body-guidance-and-publications/documents-and-publications/policy-guidance-document-library/scope-of-practice-2025 (Accessed 16 July 2025).

Spradley, J. (1979) Asking descriptive questions. In: *The ethnographic interview*, Wadsworth Group.

Spradley, J. (1980) Participant Observation. Long Grove: Holt, Rinehart and Winston.

St John-Matthews, J., Gibbs, V. and Messer, S. (2013) Extending the role of technology enhanced learning within an undergraduate radiography programme. *Radiography*, 19, pp.67–72 http://dx.doi.org/10.1016/j.radi.2012.10.003.

Strudwick, R. (2021) *The Ethnographic Radiographer*. Singapore: Palgrave Macmillan.

Strudwick, R. and Harvey-Lloyd, J. (2013) Preparation for practice through service user involvement in the diagnostic radiography curriculum at University Campus Suffolk. *International Journal of Practice-based Learning in Health and Social Care*, 1(2), pp.37–46 https://doi.org/10.11120/pblh.2013.00016.

Strudwick, R. M. (2011) *An Ethnographic Study of the Culture in a Diagnostic Imaging Department*. University of Salford.

Strudwick, R. M. and Taylor, K. (2017) An investigation into breast imaging as part of the undergraduate (UG) education of diagnostic radiography students in the UK. *Radiography*, 23, pp.141–146 https://doi.org/10.1016/j.radi.2016.12.007.

Sutton, R. (2013) *A focused ethnography of radiotherapy students' learning on their first clinical placement*. Cardiff University Available at: http://orca.cf.ac.uk/id/eprint/56955 (Accessed 22 November 2021).

Teherani, A., Martimianakis, T., Stenfors-Hayes, T., Wadhwa, A. and Varpio, L. (2015) Choosing a Qualitative Research Approach. *Journal of Graduate Medical Education*, 7(4), pp.669–670 https://doi.org/10.4300/JGME-D-15-00414.1.

Thomas, J. (1993) *Doing Critical Ethnography*. London: SAGE Publications Inc.

Thomas, J., Jinks, A. and Jack, B. (2015) Finessing incivility: The professional socialisation experiences of student nurses' first clinical placement, a grounded theory. *Nurse education today*, 35(12), pp.e4-9 https://doi.org/10.1016/j.nedt.2015.08.022.

Thucydides (1910) *The Peloponnesian War Translated by R. Crawley*. Available at: https://www.perseus.tufts.edu/hopper/text?doc=Perseus:text:1999.01.0200:book=2:chapter=60:section=6 (Accessed 29 May 2025).

Tolich, M. and Tumilty, E. (2020) Practicing ethics and ethics praxis. *Qualitative Report*, 25(13), pp.16–30 https://doi.org/10.46743/2160-3715/2020.4753.

Tremblay, D., Turcotte, A., Touati, N., Poder, T. G., Kilpatrick, K., Bilodeau, K., Roy, M., Richard, P. O., Lessard, S. and Giordano, É. (2022) Development and use of research vignettes to collect qualitative data from healthcare professionals: a scoping review. *BMJ open*, 12(1), pp.1–13 https://doi.org/10.1136/bmjopen-2021-057095.

UKRI (2024) Understanding health research. *UK Research and Innovation*, Available at: https://www.ukri.org/councils/mrc/facilities-and-resources/find-an-mrc-facility-or-resource/mrc-regulatory-support-centre/understanding-health-research/ethical-approval/ (Accessed 24 April 2025).

Ward, V. (2016) Why, whose, what and how? A framework for knowledge mobilisers. *Evidence & Policy*, 13(3), pp.477–97 https://doi.org/10.1332/174426416X14634763278725.

Wareing, A. K., Henderson, I. (2015) Contemporary practice education: Exploring student perceptions of an industrial radiography placement for final year diagnostic radiography students. *Radiography,* 21(2), pp.176-180 https://doi.org/10.1016/j.radi.2014.10.008

Wenger, E. (1998) *Communities of practice: Learning, meaning, and identity*. New York, NY, US: Cambridge University Press pp. xv, 318 https://doi.org/10.1017/CBO9780511803932.

Wieringa, S. and Greenhalgh, T. (2015) 10 years of mindlines: A systematic review and commentary. *Implementation Science*, 10(1) https://doi.org/10.1186/s13012-015-0229-x.

van Wijchen, J. and Alme, M. N. (2023) On becoming a (physio)therapist. In: Gabbay, J. and le May, A., eds. *Knowledge transformation in health and social care*, Oxon: Routledge.

Wilkinson, E. (2023) Survey of clinical placements within pre-registration diagnostic radiography programmes in the UK and Ireland. *Radiography*, 29(1), pp.247–254 https://doi.org/10.1016/j.radi.2022.12.002.

Wilkinson, E. and Cadogan, E. (2023) Radiographers' perceptions of first year diagnostic radiography students' performance following implementation of a simulation-based education model. *Radiography*, 29(4), pp.721–728 https://doi.org/10.1016/j.radi.2023.05.002.

Wilkinson, E., Gill, A. and Hardy, M. (2024a) Diagnostic radiography workforce expectations of learners against the 2023 HCPC standards of proficiency: Results of a UK Delphi study. *Radiography*, 30, pp.1–9 https://doi.org/10.1016/J.RADI.2024.08.014.

Wilkinson, E., Gill, A. and Hardy, M. (2024b) What do the revised UK standards of proficiency mean for diagnostic radiography training? A regional radiographer focus group study. *Radiography*, 30(1), pp.375–381 https://doi.org/10.1016/J.RADI.2023.12.007.

Wilks, T. (2004) The Use of Vignettes in Qualitative Research into Social Work Values. *Qualitative social work : QSW : research and practice*, 3(1), pp.78–87 https://doi.org/10.1177/1473325004041133.

Winter, P. (2019) *Bodies of Seeing: A video ethnography of academic X-ray image interpretation training and professional vision in undergraduate radiology and radiography education*. University of Sheffield Available at: https://etheses.whiterose.ac.uk/27904/ (Accessed 14 March 2022).

Winter, P. D. and Linehan, M. J. (2014) Bernstein's theory of pedagogic discourse as a theoretical framework for educators studying student radiographers' interpretation of normality vs. abnormality. *Radiography*, 20, pp.58–64 Available at: https://www.sciencedirect.com/science/article/pii/S1078817413001144 (Accessed 2 February 2022).

Wong, G., Greenhalgh, T., Westhorp, G., Buckingham, J. and Pawson, R. (2013) RAMESES publication standards: Meta-narrative reviews. *Journal of Advanced Nursing*, 69(5), pp.987–1004 https://doi.org/10.1111/jan.12092.

Wonnacott, L., Banerjee, S., Hicks, B. and Daley, S. (2023) Understanding the experience of time for dementia education programme on undergraduate radiography students. *Radiography*, 29, pp.S46–S51 https://doi.org/10.1016/j.radi.2023.02.020.

Wutich, A., Beresford, M. and Bernard, H. R. (2024) Sample Sizes for 10 Types of Qualitative Data Analysis: An Integrative Review, Empirical Guidance, and Next Steps. *International Journal of Qualitative Methods*, 23, pp.1–14 https://doi.org/10.1177/16094069241296206/FORMAT/EPUB.

Wye, L., Bolton, H., Thomas, C., Hopewell-Kelly, N. and Gibson, A. (2021) Knowledge mobilisation, communications & PPI compared. *NIHR Health Protection Research Unit in Behavioural Science and Evaluation at University of Bristol*, Available at: https://www.hprubse.nihr.ac.uk/knowledge-mobilisation/ (Accessed 7 December 2021).

Wye, L., Cramer, H., Beckett, K., Farr, M., Le May, A., Carey, J., Robinson, R., Anthwal, R., Rooney, J. and Baxter, H. (2020) Collective knowledge brokering: the model and impact of an embedded team. *Evidence & Policy*, 16(3), pp.429–452 Available at: https://www.ingentaconnect.com/content/tpp/ep/2020/00000016/00000003/art00007 (Accessed 7 May 2022).

Wye, L., Cramer, H., Carey, J. and Anthwal, R. (2019) Knowledge brokers or relationship brokers? The role of an embedded knowledge mobilisation team. *Evidence & Policy: A Journal of Research, Debate and Practice*, 15(2), pp.277–292 Available at: https://www.ingentaconnect.com/content/tpp/ep/2019/00000015/00000002/art00008 (Accessed 7 May 2022).

Yang, L., Xu, X., Lan, X. Y., Liu, Z., Guo, S., Shi, Y., Qu, H. and Cao, N. (2022) A Design Space for Applying the Freytag's Pyramid Structure to Data Stories. *IEEE Transactions on Visualization and Computer Graphics*, 28(1), pp.922–932 https://doi.org/10.1109/TVCG.2021.3114774.

Yardley, L. (2000) Dilemmas in qualitative health research. *Psychology and Health*, 15(2), pp.215–228 https://doi.org/10.1080/08870440008400302.

Yardley, S., Teunissen, P. W. and Dornan, T. (2012) Experiential learning: AMEE Guide No. 63. *Medical Teacher*, 34(2), pp.e102-115 https://doi.org/10.3109/0142159X.2012.650741.

Yeo, R. and Dopson, S. (2018) Getting lost to be found: the insider–outsider paradoxes in relational ethnography. *Qualitative Research in Organizations and Management: An International Journal*, https://doi.org/10.1108/QROM-06-2017-1533.

Zotero (2025) Zotero [computer program]. Available at: https://www.zotero.org/ (Accessed 6 June 2025).

This page left intentionally blank

Appendices

Appendix 1: KMb literature searches

Search Terms	Databases	Dates of search
knowledge mobili* AND healthcare education mindlines AND healthcare education mindlines AND knowledge mobilisation theory-practice gap AND knowledge sharing AND health	PubMed WoS Scopus	May 2022

Appendix 2: Outputs arising from the PhD

Appendix 2a – Conference paper (Patel, 2022)

Patel, K. (2022) What is 'knowledge mobilisation' and how can it improve radiography education? In: *UK Imaging and Oncology Conference*. Liverpool, 4th July 2022.

Appendix 2b – Published paper (Patel, 2023a)

Patel, K. (2023a) Introducing clinical mindlines : A discussion of professional knowledge sharing in clinical radiography education. *Radiography*, 29, pp.577–581 https://doi.org/10.1016/j.radi.2023.03.011.

Appendix 2c – Conference paper (Patel, 2023b)

Patel, K. (2023b) Radiography Mindlines: An ongoing ethnographic study of knowledge sharing in clinical radiography education. In: *Achieving Excellence in Radiography Education and Research*. Ipswich, 24th November 2023.

Appendix 2d – Conference poster (Patel, 2024)

Patel, K. (2024) Logistics of setting up an ethnographic study in the NHS: Experiences of a doctoral student. In: *UK Imaging and Oncology Conference*. Liverpool, 10th June 2024.

Appendix 3: BCU FAEC Approval

BIRMINGHAM CITY University

Faculty of Health, Education & Life Sciences Research Office
Seacole Building, 8 Westbourne Road
Birmingham
B15 3TN

HELS_Ethics@bcu.ac.uk

15/Mar/2023

Mrs Kirsty Patel

kirsty.patel@mail.bcu.ac.uk

Dear Kirsty ,

Re: Patel /#10556 /sub1 /R(C) /2023 /Feb /HELS FAEC - Radiography mindlines: An ethnographic study of professional knowledge sharing in a diagnostic radiography clinical learning environment.

Thank you for your application and documentation regarding the above study. I am pleased to confirm that Birmingham City University has agreed to take on the role of Sponsor for BCU's part in the research.

The Faculty Academic Ethics Committee has approved this activity for review by the external ethics committee(s) stated in the application.

Birmingham City University can confirm that our insurance indemnity cover includes the actions of researchers working in suitable premises and under appropriate supervision. Our policy cover will not apply to liability that is more specifically insured under any policy covering medical negligence, malpractice or indemnity, professional errors, omissions or negligence.

A copy of BCU's insurance details is available at:
https://icity.bcu.ac.uk/Legal-Services-and-Compliance/Insurance/Index

If you wish to make any changes to your proposed study (by request or otherwise), then you must submit an Amendment application to us. Examples of changes include (but are not limited to) adding a new study site, a new method of participant recruitment, adding a new method of data collection and/or change of Project Lead.

Please also note that the Committee should be notified of any serious adverse effects arising as a result of this activity.

Keep a copy of this letter along with the corresponding application for your records as evidence of approval.

If you have any queries, please contact HELS_Ethics@bcu.ac.uk

If you would like to provide feedback on the ethics process, please complete the feedback form using this link.

I wish you every success with your study.

Yours Sincerely,

Mrs. Clair Zawada

On behalf of the Health, Education and Life Sciences Faculty Academic Ethics Committee

Page 1 of 1

Appendix 4: HRA Ethics Approval

Ymchwil Iechyd a Gofal Cymru
Health and Care Research Wales

NHS
Health Research Authority

Mrs Kirsty Patel
Graduate Researcher / Teaching Assistant
Birmingham City University
Department of Radiography, Seacole Building
Birmingham City University: City South Campus
Birmingham
B15 3TN

Email: approvals@hra.nhs.uk
HCRW.approvals@wales.nhs.uk

04 September 2023

Dear Mrs Patel

HRA and Health and Care Research Wales (HCRW) Approval Letter

Study title:	**Radiography mindlines: An ethnographic study of professional knowledge sharing in a diagnostic radiography clinical learning environment.**
IRAS project ID:	**329252**
Protocol number:	**N/A**
REC reference:	**23/EM/0170**
Sponsor	**Birmingham City University**

I am pleased to confirm that HRA and Health and Care Research Wales (HCRW) Approval has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications received. You should not expect to receive anything further relating to this application.

Please now work with participating NHS organisations to confirm capacity and capability, in line with the instructions provided in the "Information to support study set up" section towards the end of this letter.

How should I work with participating NHS/HSC organisations in Northern Ireland and Scotland?
HRA and HCRW Approval does not apply to NHS/HSC organisations within Northern Ireland and Scotland.

If you indicated in your IRAS form that you do have participating organisations in either of these devolved administrations, the final document set and the study wide governance report

(including this letter) have been sent to the coordinating centre of each participating nation. The relevant national coordinating function/s will contact you as appropriate.

Please see IRAS Help for information on working with NHS/HSC organisations in Northern Ireland and Scotland.

How should I work with participating non-NHS organisations?
HRA and HCRW Approval does not apply to non-NHS organisations. You should work with your non-NHS organisations to obtain local agreement in accordance with their procedures.

What are my notification responsibilities during the study?

The standard conditions document "*After Ethical Review – guidance for sponsors and investigators*", issued with your REC favourable opinion, gives detailed guidance on reporting expectations for studies, including:

- Registration of research
- Notifying amendments
- Notifying the end of the study

The HRA website also provides guidance on these topics, and is updated in the light of changes in reporting expectations or procedures.

Who should I contact for further information?
Please do not hesitate to contact me for assistance with this application. My contact details are below.

Your IRAS project ID is **329252**. Please quote this on all correspondence.

Yours sincerely,
Kelly Rowe

Approvals Manager

Email: approvals@hra.nhs.uk

Copy to: *Dr K L McKnight*

Appendix 5: Student PIS

Participant Information Sheet – DR Students
18/08/2023 – Version 3
IRAS Project ID: 329252

BIRMINGHAM CITY University

Radiography mindlines: Professional knowledge sharing in radiography education.

Introduction & Brief Summary

Hello, my name is Kirsty Patel and I am a doctoral researcher at Birmingham City University. I have been a diagnostic radiographer since 2011 and have always had a keen interest in clinical radiography education.

I am conducting this research with an aim to understand how clinical radiography staff and radiography students create, share, and access professional knowledge in the clinical learning environment.

You have been given this information sheet to inform you of the project as it will be carried out at your clinical placement site.

Please take your time to read through all pages of this information sheet to understand what the research will entail. Thank you.

Contact Details

If you have any questions about this research please contact me:
Kirsty.patel@mail.bcu.ac.uk
This doctoral research is supervised by academics at BCU.
Director of studies:
Dr. K. L. McKnight
louise.mcknight@bcu.ac.uk
Second supervisors:
Prof. F. Cowdell, Dr. T. Hopkins

If you wish to express any concerns or have a complaint please contact the faculty ethics committee:
HELS_Ethics@bcu.ac.uk

Key things to consider:

- You have been sent this information as you attend the radiography department participating in this research for your clinical placement. Your experiences, perceptions, and knowledge of learning in this department are valuable to the outcomes of this research.
- You may see me in the department observing your everyday activities and interactions with staff and other students. I may also ask you some questions during these observational periods.
- This research adopts an 'opt-out' approach whereby you can opt out of being included in the research at any time. The research will be conducted over a period of 6-8 months. You can withdraw consent to be observed at any time with no reason needed.
- Please contact me if anything is unclear or you would like more information.
- Birmingham City University is sponsoring this study.
  - In this research study we will use information from you. We will only use information that we need for the research study. We will let very few people know your name or contact details, and only if they really need it for this study.
  - Everyone involved in this study will keep your data safe and secure. We will also follow all privacy rules.
  - At the end of the study we will save some of the data in case we need to check it and for future research.
  - We will make sure no-one can work out who you are from the reports we write.

1

Participant Information Sheet – DR Students
18/08/2023 – Version 3
IRAS Project ID: 329252

BIRMINGHAM CITY University

Why am I doing this research?

Diagnostic radiography is crucial in providing patients with effective healthcare throughout diagnosis, treatment, and recovery. Research into radiography education often concerns the university environment, however radiography students spend up to half of their time in a clinical learning environment (CLE), or placement site. Research into how radiography students and clinical radiography staff work together and share their professional knowledge in the clinical setting is currently limited.

The purpose of this project is to understand how radiography students and staff create, share, and access professional knowledge in the CLE. The research will involve observing students and clinical staff in practice, understanding the perceptions of what participants think professional knowledge is, and observing the processes they use to access new knowledge in this setting.

What will your participation involve?

This research will be conducted through ethnographic methods which involve observation and interviews. I will be present in the radiography department as an observer, participating in some of your daily activities and routines, and at times may ask you some questions.

Observations will be carried out over a period of 6-8 months. I will attend the radiography department 3-4 times a week and observation periods will be 4 hours at a time. During observation periods I will ask if you are happy to be observed and I will take some notes about your activity, discussions, and the interactions with other students and clinical staff. Observations will focus on how knowledge is shared in the department and not on your radiographic practice.

During the research you may be asked if you wish to participate in a one-to-one interview with me, this will be discussed with you at the time and written consent will be asked for. Interviews can take place online through MSTeams or in-person and this will be discussed with you when you are invited to participate. Participation in observation does not mean that you must participate in the interviews.

What are the benefits of participation?

You will be able to share your experiences and perceptions about clinical radiography education and offer an insight into what you feel are effective ways of sharing knowledge and the challenges you face in this setting. Although there are unlikely to be any direct benefits to you. The research will help to understand how students and clinical staff learn and access knowledge in the clinical setting and therefore may help to improve radiography education and practice in the future. I will feedback the research findings to you and keep you regularly updated on how the research is progressing.

What are the risks of participation?

I do not anticipate any risks arising from participation in this study. I will not ask you to change anything about the way you work, and you do not have to take part if you do not want to.

In observational healthcare research there is the potential that the researcher may observe practice that is harmful to patients or other healthcare workers. If this happens, I have an obligation to report this to an appropriate person in line with the research protocol. If patients are likely to come to any harm, I have the professional obligation as a researcher and radiographer to step in and prevent this from happening.

Participant Information Sheet – DR Students
18/08/2023 – Version 3
IRAS Project ID: 329252

If at any point you feel uncomfortable during observations or interviews, then you have the right to withdraw consent.

Your personal tutors and placement liaison tutors have been informed of this research and are available to you if you wish to discuss any concerns relating to your experiences during the research.

Will my information be kept confidential?

Yes.

Notes that are taken in the process of observations or interviews will be anonymised. Interviews will be undertaken on MSTeams or recorded on an encrypted dictaphone, the recordings will be transcribed, verified, and then deleted. When findings are reported all data will be anonymised with pseudonyms used to mask your identity.

All research data and any personal identifiable data that you choose to share with me (names, job role, and email addresses) will be stored securely and retained in line with GDPR and university policies.

How will the data be used?

I will use notetaking as the primary way to generate data during observations. These notes will then be digitized and analysed to create themes which answer the aims and objectives of the research. Interview transcriptions will similarly be used to examine and develop these themes further.

How is informed consent gained?

You will be invited to attend an online research briefing where you will have the opportunity to ask me any questions. This briefing will be recorded and sent to anyone unable to attend. During the observation periods, I will have further conversations with you to ensure that you are happy for me to observe you at that time. You can discuss any concerns with me each time we meet and choose to opt-out of the research at any time during any of the observational periods. This type of consent is called process consent and is often used in ethnographic research. If you are invited to take part in an interview you will be given a consent form to record written consent.

Birmingham City University is Sponsoring this project:

How will we use information about you?

We will need to use information from you and your employer for this research project.

This information will include your name and student email address. People will use this information to do the research or to check your records to make sure that the research is being done properly.

People who do not need to know who you are will not be able to see your name or contact details. Your data will have a code number instead.

We will keep all information about you safe and secure.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

3

Participant Information Sheet – DR Students
18/08/2023 – Version 3
IRAS Project ID: 329252

BIRMINGHAM CITY University

What are your choices about how your information is used?

You can stop being part of the study at any time, without giving a reason, but we will keep information about you that we already have.

We need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.

Where can you find out more about how your information is used?

You can find out more about how we use your information by asking one of the research team via the contact numbers on the first page of this information sheet.

If you do not wish to be part of this research at all, please inform me at the beginning of this research project and I will schedule observations during times when you are not working in the observational area.

4

Appendix 6: Radiographer PIS

Participant Information Sheet – CLE Staff
18/08/2023 – Version 3
IRAS Project ID: 329252

BIRMINGHAM CITY University

Radiography mindlines: Professional knowledge sharing in radiography education.

Introduction & Brief Summary

Hello, my name is Kirsty Patel and I am a doctoral researcher at Birmingham City University. I have been a diagnostic radiographer since 2011 and have always had a keen interest in clinical radiography education.

I am conducting this research with the aim to understand how clinical radiography staff and radiography students create, share, and access professional knowledge in the clinical learning environment.

You have been given this information sheet to inform you of the project as it will be carried out in your radiography department.

Please take your time to read through all pages of this information sheet to understand what the research will entail. Thank you.

Contact Details

If you have any questions about this research please email me:
Kirsty.patel@mail.bcu.ac.uk
This doctoral research is supervised by academics at BCU.
Director of studies:
Dr. K. L. McKnight
louise.mcknight@bcu.ac.uk
Second supervisors:
Prof. F. Cowdell, Dr. T. Hopkins

If you wish to express any concerns or have a complaint please contact the faculty ethics committee:
HELS_Ethics@bcu.ac.uk

Key things to consider:

- You have been sent this information as you work in the radiography department which is the setting for this research. Your experiences, perceptions, and knowledge of working in this department are valuable to the outcomes of this research.
- You may see me in the department observing your everyday activities and interactions with students and other staff. I may also ask you some questions during these observational periods.
- This research adopts an 'opt-out' approach whereby you can opt out of being included in the research at any time. The research will be conducted over a period of 6-8 months. You can withdraw consent to be observed at any time with no reason needed.
- Please contact me if anything is unclear or you would like more information.
- Birmingham City University is sponsoring this study.
  - In this research study we will use information from you. We will only use information that we need for the research study. We will let very few people know your name or contact details, and only if they really need it for this study.
  - Everyone involved in this study will keep your data safe and secure. We will also follow all privacy rules.
  - At the end of the study we will save some of the data in case we need to check it and for future research.
  - We will make sure no-one can work out who you are from the reports we write.

1

Participant Information Sheet – CLE Staff
18/08/2023 – Version 3
IRAS Project ID: 329252

BIRMINGHAM CITY University

Why am I doing this research?

Diagnostic radiography is crucial in providing patients with effective healthcare throughout diagnosis, treatment, and recovery. Research into radiography education often concerns the university environment, however radiography students spend up to half of their time in a clinical learning environment (CLE), or placement site. Research into how radiography students and clinical radiography staff work together and share their professional knowledge in the clinical setting is currently limited.

The purpose of this project is to understand how radiography students and staff create, share, and access professional knowledge in the CLE. The research will involve observing students and clinical staff in practice, understanding the perceptions of what participants think professional knowledge is, and observing the processes they use to access new knowledge in this setting.

What will your participation involve?

This research will be conducted through ethnographic methods which involve observation and interviews. I will be present in the radiography department as an observer, participating in some of your daily activities and routines, and at times may ask you some questions.

Observations will be carried out over a period of 6-8 months. I will attend the radiography department 3-4 times a week and observation periods will be 4 hours at a time. During observation periods I will ask if you are happy to be observed and I will take some notes about your activity and discussions with other staff and students. Observations will focus on how knowledge is shared in the department and not on your radiographic practice.

During the research period I may ask you if you wish to participate in a one-to-one interview with me, this will be discussed with you at the time, and you will be asked to sign a consent form. Interviews can take place online through MSTeams or in-person and this will be discussed with you when you are invited to participate. Participation in observation does not mean that you must, or will be asked to, participate in the interviews.

What are the benefits of participation?

You will be able to share your experiences and perceptions about clinical radiography education and offer an insight into what you feel are effective ways of sharing knowledge and the challenges you face in this setting. Although there are unlikely to be any direct benefits to you, the research will help to understand how students and clinical staff learn and access knowledge in the clinical setting and therefore may help to improve radiography education and practice in the future. I will feedback the research findings to you and keep you regularly updated on how the research is progressing.

What are the risks of participation?

I do not anticipate any risks arising from participation in this study. I will not ask you to change anything about the way you work, and you do not have to take part if you do not want to.

In observational healthcare research there is the potential that the researcher may observe practice that is harmful to patients or other healthcare workers. If this happens, I have an obligation to report this to an appropriate person in line with the research protocol. If patients are likely to come to any harm, I have the professional obligation as a researcher and radiographer to step in and prevent this from happening.

Participant Information Sheet – CLE Staff
18/08/2023 – Version 3
IRAS Project ID: 329252

BIRMINGHAM CITY University

If at any point you feel uncomfortable during observations or interviews, then you have the right to withdraw consent at that moment with no reason needed.

Will my information be kept confidential?

Yes.

Notes that are taken in the process of observations or interviews will be anonymised. Interviews will be undertaken on MSTeams or recorded on an encrypted dictaphone, the recordings will be transcribed and then deleted. When findings are reported all data will be anonymised with pseudonyms used to mask your identity.

All research data and any personal identifiable data that you choose to share with me (names, job role, and email addresses) will be stored securely and retained in line with GDPR and university policies.

How will the data be used?

I will use notetaking as the primary way to generate data during observations. These notes will then be digitized and analysed to create themes which answer the aims and objectives of the research. Interview transcriptions will similarly be used to examine and develop these themes further.

How is informed consent gained?

You will be invited to attend an online research briefing where you will have the opportunity to ask me any questions. This briefing will be recorded and sent to anyone unable to attend. During the observation periods, I will have further conversations with you to ensure that you are happy for me to observe you at that time. You can discuss any concerns with me each time we meet and choose to opt-out of the research at any time during any of the observational periods. This type of consent is called process consent and is often used in ethnographic research. If you are invited to take part in an interview you will be given a consent form to record written consent.

Birmingham City University is Sponsoring this project:

How will we use information about you?

We will need to use information from you and your employer for this research project.

This information will include your name and trust email address. People will use this information to do the research or to check your records to make sure that the research is being done properly.

People who do not need to know who you are will not be able to see your name or contact details. Your data will have a code number instead.

We will keep all information about you safe and secure.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

What are your choices about how your information is used?

You can stop being part of the study at any time, without giving a reason, but we will keep information about you that we already have.

Participant Information Sheet – CLE Staff
18/08/2023 – Version 3
IRAS Project ID: 329252

BIRMINGHAM CITY University

We need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.

Where can you find out more about how your information is used?

You can find out more about how we use your information by asking one of the research team via the contact numbers on the first page of this information sheet.

If you do not wish to be part of this research at all, please inform me at the beginning of this research project and I will schedule observations during times when you are not working in the observational area.

Appendix 7: Staff poster

BIRMINGHAM CITY University

RADIOGRAPHY EDUCATION RESEARCH

Please be aware that there may be a doctoral student (Kirsty) in this department carrying out observations of radiography students and staff.

For Radiography staff and students:

- **My name is Kirsty and I am a doctoral student and qualified radiographer. I am interested in how knowledge is created, shared, and accessed between radiography students and staff in this radiography department.**
- **I will be spending time in the plain film areas of the radiography department, participating in and observing your daily activities as staff and students.**
- **I may ask you some questions about what I have observed.**
- **Hopefully you have attended an online briefing with me to discuss this project and ask me any questions.**
- **However, if you are not aware of the research and you see me in the department then please feel free to ask me about it and discuss your participation.**
- **If at any time you would like me to stop observing then please let me know.**
- **If you would like to opt-out of being part of the research completely please let me know, either in person, or send me an email on the contact details below.**
- **If you would like further information please ask or contact me and I will be happy to answer any questions and provide you a participation information sheet.**

Doctoral Student: Kirsty Patel
Email: kirsty.patel@mail.bcu.ac.uk | Twitter: @kirstypatel7 | LinkedIn: kirstypatel7
Version: 1. 08/02/2023

Appendix 8: Public poster

BIRMINGHAM CITY University

RESEARCH IN RADIOGRAPHY

Please be aware that there may be a doctoral student (Kirsty) in this department carrying out observations of radiography students and staff.

For Patients:

- **You will be informed if Kirsty is present when you are being seen by the radiographer or student.**
- **If you wish to be seen without her present please feel free to ask the radiographer.**
- **Your personal information will not be required or collected as she is observing activity and discussions between the radiography staff and students only.**
- **For more information on this research please feel free to email Kirsty at the contact details below.**

For Staff:

- **If you are entering the radiography department please be aware that there may be a doctoral student observing in this area.**
- **Kirsty is here to observe radiography students and radiography staff only but may be present when you are working in the department.**
- **Please feel free to ask Kirsty not to observe during your time working with the radiography team.**

Doctoral Student: Kirsty Patel
Email: kirsty.patel@mail.bcu.ac.uk | Twitter: @kirstypatel7 | LinkedIn: kirstypatel7
Version: 2. 18/08/2023
IRAS Project ID: 329252

Appendix 9: Interview consent form

Interview Consent Form
08/02/2022 – Version 1

BIRMINGHAM CITY University

IRAS ID: 329252

Centre Number:

Study Number:

Participant Identification Number for this trial:

CONSENT FORM

Title of Project: Radiography mindlines: An ethnographic study of professional knowledge sharing in a diagnostic radiography clinical learning environment.

Name of Researcher: Kirsty Patel

	Please initial box
1. I confirm that I have read the information sheet dated 08/02/2023 (version 2) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
2. I understand that my participation is voluntary and that I am free to ask the researcher to change the interview topic, take a break from the interview, or withdraw at any time without giving any reason.	☐
a. I understand that if I wish to withdraw from the project after data has been analysed that it may not be possible for my data to be removed from the data set.	☐
b. I understand that the researcher will provide me a date at the point of interview with which I can withdraw my data fully.	☐
3. I understand that the information collected about me will be used to support other research in the future and may be shared anonymously with other researchers.	☐
4. I agree to be interviewed for this study.	☐
a. I agree for the interview to be recorded by either an encrypted dictaphone device, or through MSTeams.	☐
b. I understand that this recording will be deleted once transcription has taken place.	☐
5. I understand my right to anonymity and confidentiality and agree to the publication of anonymised quotes.	☐
6. I understand that all data will be stored securely and all personal information such as my name and job role/year of study will be pseudonymised to ensure that I cannot be identified.	☐

Name of Participant	Date	Signature
Name of person seeking consent	Date	Signature

Appendix 10: Radiographer interview guide

Student Interview Guide:

Can you talk about a typical day working here.

- How do you perceive/feel about your role and what are you goals?
- Who do you work with

I have noticed there are times when students take part in tasks and others when they do not (carry out processing tasks). Can you tell me what motivates you to carry out a clinical task e.g. a particular examination?

What do you think are the most important things that help you to develop your knowledge in the CLE?

How do you think what you learn academically factors into your clinical work?

- Thoughts/perceptions on the portfolio approach.

What encourages you to seek out knowledge?

- How do you go about this?
- What sources do you use?

If someone told you a different way to do something or shared some new knowledge. What factors would influence you in using this in your practice.

- E.g. different way of X-raying a body part or some new piece of research

How do you know you are doing the right things or a good job?

Tell me about situations where you might share your thoughts, knowledge with someone else?

- Do you ever share knowledge with radiographers?

Appendix 11: Student interview guide

Staff Interview Guide:

Can you talk about a typical day working here, what is your role and main priorities?

Tell me about your experience with students here.

- How do things differ when students are not around?
- What are your thoughts about student portfolios?
- Do you feel like you ever learn anything from students?

Can you tell me about the key influences you had in developing your knowledge and becoming a radiographer?

What would you say are the most important bits of knowledge that you use in your role?

Tell me how you would go about solving a difficult clinical problem?

- E.g. clinical indications inadequate to justify the request or you were struggling to get an image
- Would your approach change if there is a student present?

Tell me about how you find out about changes to practice and how you feel about these processes.

- How do you see research used in practice if at all?

If someone told you a different way to do something or shared some new knowledge.

- E.g. piece of research on imaging protocols or on student education
- What factors would influence you in using this in your practice.

How do you know you are doing the right things or a good job in your role?

Can you think of any situations where you might share your own knowledge/experiences with someone else? Who, where, when?