Narrative Review

Introducing clinical mindlines: A discussion of professional knowledge sharing in clinical radiography education

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ABSTRACT

Objective: Diagnostic radiography education research is often aimed at developing new academic theory or *pedagogy* to instil evidence-based practice and bridge the theory-practice gap. However, there has been little empirical research of how knowledge is created and shared in the clinical learning environment. This paper offers a new perspective on professional knowledge sharing in radiography education through the theory of clinical mindlines.

Key findings: Scrutinising clinical mindlines theory against current radiography education literature highlights issues with our conceptualisation of knowledge, and gaps in our understanding of how professional knowledge is created, shared, and accessed in radiography education. Empirical research exploring these factors, particularly in the clinical learning environment is largely absent from the current literature.

Conclusion: Discourse on knowledge sharing in radiography education has historically been dictated by pedagogical theory and established within an academic setting. Using the clinical mindlines theory offers terminology and a framework which is rooted in clinical and organisational contexts, allowing us to study clinical learning and education more effectively.

Implications for practice: Clinical mindlines have been effectively used across the healthcare landscape to understand and improve the movement of knowledge across boundaries. Radiography educators and researchers can use this new perspective to recognise the processes which aid knowledge sharing between diverse stakeholder groups. Radiographers and students can use this concept to reflect on their teaching and learning in practice to identify moments for more effective knowledge sharing.

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Introduction

In the United Kingdom (UK), undergraduate diagnostic radiography (UgDR) students spend, on average, 50% of their time in a clinical learning environment (CLE),[1] developing their professional knowledge and aiming to bridge the 'theory-practice gap'.[2] This learning is facilitated by clinical radiographers who share the professional knowledge they use to practice effectively. However, it has been reported that the DR profession is often reticent to adopt evidence-based changes to practice,[3] and although this is now being acknowledged, empirical understanding of why radiography practice is somewhat impermeable to new evidence is scant. Similarly, identification of the processes that *do* facilitate the successful breakthrough of new knowledge into practice is unclear. If professional knowledge and practice is misaligned with new research knowledge, and there is limited understanding of the tools needed to adapt or update it, then we may be fated to see the same issues in practice shared with students and embedded for generations.

In academic UgDR education, methods of teaching, or *pedagogical* processes, are often used and researched to share knowledge more effectively with students, and to understand the knowledge students have gained or produced as a result.[4–9] Discussion around clinical education in UgDR is now becoming established and highlights various themes, such as the structure of clinical education,[1,10] stakeholder perspectives,[2,11] the role of practice educators,[12,13] and pedagogical methods to bridge the theory-practice gap.[14] Further, it is acknowledged that clinical

education does not only rely on dedicated clinical educators, but also on the community, systems, and structures that are apparent in the CLE.[15] However, there is still limited understanding of the embedded processes in a clinical setting that facilitate the effective sharing and creation of knowledge between students and clinical staff.

This theoretical discussion paper differs from those debating the implementation processes which aim to get new knowledge *into* practice.[3] Instead, it argues that embedded processes within a CLE could be harnessed to ensure knowledge is created, supplemented, and shared effectively amongst all stakeholders. Recently, McKnight[16] has demonstrated how the use of diverse theory allows for alternative perspectives on complex issues such as these. This paper, therefore, aims to introduce the theory of clinical mindlines as a novel and valuable perspective on professional knowledge sharing in clinical radiography education, and highlights its potential use for further research in this area.

History of clinical mindlines

The concept of clinical mindlines, now often referred to simply as *mindlines*, was developed by Gabbay and Le May in 2004.[17—19] They aimed to explore how general practitioners (GPs) and practice nurses used evidence in their daily healthcare decision making. Their ethnographic study found that rather than referring to explicit evidence or research, GPs use 'knowledge-in-practice-in-context',[18] where new knowledge is accessed through informal networks with colleagues and other professionals, guidelines are infrequently referred to, and individual professional knowledge is derived, in part, from early education and personal experiences. This is somewhat reflective of the assertions that radiographers tend to use knowledge from their early training and are reticent to adapting to new explicit research-based knowledge.[3] Gabbay and Le May[17] concluded that practitioners used internalised implicit guidelines or *mindlines*, to make decisions and practice effectively.

More recently, Wieringa and Greenhalgh's[20] meta narrative systematic review argued that mindlines are a paradigm opposed to much of the evidence-based practice (EBP) literature, due to the contrasting view on the value of different types of knowledge, or *evidence*, and how knowledge itself is created. However, others have effectively used mindlines to identify how we can encourage and promote new evidence-based knowledge and embed this into practice more effectively.[21—25] Further to this, despite the indication by Gabbay and Le May[18] that education is key in developing mindlines, there has been little empirical study using the concept, directly related to health education. However, before mindlines can

be seen to be useful in UgDR education, the concept of knowledge, and the words we use to describe it in this context, must be examined.

The nature and terminology of knowledge in healthcare

Epistemology is the branch of philosophy which explores the theory of knowledge. These debates highlight conflicting views of the definition of knowledge, and that knowledge can mean different things to different people in different contexts.[26] In healthcare, the process of understanding knowledge becomes problematic due to the terms that are used synonymously with it, such as evidence and information, which can change our perception of what knowledge actually is, or can be. In healthcare research, the terms knowledge, evidence, and information are regularly used but not often defined.[27,28]

There have been efforts to define these different terms and understand how they may be related. Ackoff's[29] seminal work on a hierarchy of data, information, knowledge, understanding, and wisdom, demonstrates that these terms should not be used synonymously and are individually valuable in different situations. Specifically, *knowledge* in this model is determined as 'know-how' gained through communication between people or learning from experience. If we accept this as a definition of knowledge, then it is difficult to categorise research-evidence as knowledge without it evolving through some form of social or environmental intervention. However, Ackoff's[29] work was centred around information and knowledge management disciplines,[30] and perhaps lacks the context of healthcare that this discussion is positioned within. Latterly, Dammann's[28] Data, Information, Evidence, and Knowledge (DIEK) framework builds on Ackoff's work and aims to situate these terms in the realms of healthcare, acknowledging *evidence* as a core and distinct component of this hierarchy. These models are demonstrated in Fig. 1.

Pertinent to this discussion is the difference between evidence and knowledge, as these terms are commonly found in the associated literature. Dammann[28] defines *evidence* as "useful, contextualised information" and that it is determined by supporting hypotheses, analysis, and decision making. In comparison, *knowledge* is defined as "predictive, testable, consistently successful belief".[21] This definition of knowledge is reminiscent of traditional philosophical opinions which define personal knowledge to be "justified true belief",[31] although, using the words predictive and testable in a definition of knowledge, suggests that knowledge needs to be gained through a scientific process. However, cognitive, and social processes such as reasoning and consensus can also be methods in which we test knowledge.[28] This social and
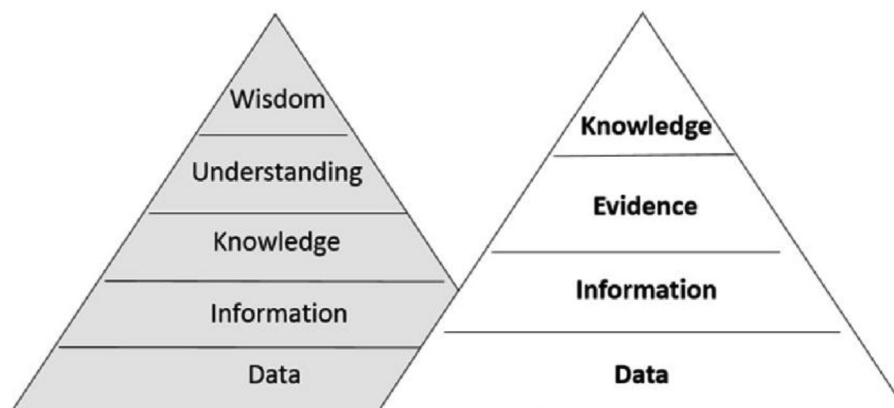

Figure 1. Ackoff's knowledge hierarchy (left), Dammann's DIEK model (right).[28]

environmental construction of knowledge forms the foundation for the arguments in this discussion paper.

The mindlines theory is underpinned by Nonaka's[26] work on 'organisational knowledge creation' theory which explores different types of knowledge and how they are shared and created in a specific context. Nonaka[32] identifies that knowledge can be associated with the terms *explicit* or *tacit* and is continuously transformed between these paradigms through interactions between people.[32] Naturally, the term *explicit* recognises knowledge that is overt, unconcealed, can be expressed in verbal and written forms, and easily shared between people.[31] The concept of *tacit* knowledge, originally theorised by Polanyi,[33] depicts knowledge that cannot be explicitly stated or its origins fully understood, however, is highly valuable in decision making and practical activities. Despite the indication that knowledge can be categorised into these two terms, there is a complex interaction between explicit and tacit knowledge, "... *all knowledge is either tacit or rooted in tacit knowledge. A wholly explicit knowledge is unthinkable.*".[33] This suggests that in order to *know* something, there is some element of *unknowing* taking place subconsciously in our minds. This interaction between tacit and explicit knowledge is acknowledged by Nonaka and Von Krogh[34] who demonstrate that knowledge flows on this explicit-tacit spectrum. Hence, our ability to operationalise new explicit knowledge is determined by our capacity to tacitly comprehend it.

Despite the argument that knowledge is never wholly explicit or tacit, they represent two ends of a spectrum that are useful poles for understanding how knowledge is currently perceived in UgDR education. Rather than attempting to categorise knowledge in this way, the aim is to demonstrate our inclination to value knowledge that is more perceptibly explicit, and the paucity of UgDR literature exploring the influence and understanding of tacit knowledge in this context.

Mindlines and the SECI spiral

The concept of mindlines is founded on a model of organisational knowledge creation called the SECI spiral.[35] This model demonstrates how knowledge moves across the explicit-tacit spectrum *between* people and *throughout* an organisation via the processes of socialisation, externalisation, combination, and internalisation (SECI). Gabbay and Le May[18] include an additional aspect, demonstrating where mindlines are supplemented with new knowledge, to their own SECI model (Fig. 2).

Socialisation

Tacit knowledge is created and shared between people through *socialisation* or shared experiences, often without the use of verbal

Figure 2. SECI Spiral for developing and sharing mindlines.[18]

communication but through observation and imitation.[31] Information without context or shared experience is believed to lack meaning and therefore can be very difficult to tacitly acknowledge. Different pedagogies used in DR education such as interprofessional learning and peer learning can be identified as more social and constructivist approaches to education.[36] In these methods, students learn by working with others and sharing experiences. However, the socialisation process is not purely about 'know how', but as Gabbay and Le May[18] state "*it is learning 'how we do things here'*". In this respect, these structured pedagogies do not allow discovery of the sociocultural factors that would be apparent in a CLE setting. Mindlines are often created and developed when members of the community implicitly communicate the way things are done and the way individuals should act. This has been demonstrated in staff rooms, clinical areas, and staff meetings and can involve all stakeholders from practitioners to patients.[18] In this regard, it is important to understand the significance of shared experience, observation, and imitation, across the range of diverse staff groups and situations in the CLE.

Externalisation

The process of *externalisation* is when hard to verbalise tacit knowledge is communicated, frequently through the dialogue of reflection and metaphor.[31] Reflection and feedback are heavily represented in the DR education literature and professional documents.[7,9,37–41] Yet, these processes are often seen as structured ways to provide evidence of continuing professional development (CPD) or carried out after student assessments or formal learning. Hendry[42] however advocates for the use of consistent and informal reflection and feedback practices in the form of 'teaching moments', though there is limited empirical evidence of this being carried out in a CLE. There is also evidence that students do not recognise reflective practice as a skill required for radiographers,[43] suggesting that it is not often observed or modelled by radiographers in the CLE. Empirically, Gabbay and Le May[18] observed externalisation through informal processes such as joke and storytelling. They determined that these interactions facilitated a collective 'sense-making' of tacit knowledge resulting in the creation of more explicit knowledge which could be understood by all. These informal acts of joke and storytelling are yet to be explored in the literature and could be key to how professional knowledge is shaped in the DR CLE.

Combination and accessing new knowledge

Next, this explicit knowledge is synthesised with other explicit knowledge to create new insights in the process of *combination*. It is in this stage that Gabbay and Le May[18] determine that new knowledge is sought to supplement and validate the prior tacit knowledge and inform new policy, guidelines, or practice decisions. This suggests that the pursuit for explicit knowledge is at times founded upon more tacit notions and aligns with the previous argument that all knowledge is rooted in tacit thought processes.[33] It is commonly stated that critical thinking is an important skill for DR students to develop to ensure effective EBP is provided and the development of the profession.[39,44,45] Critical thinking is the process by which we validate and regulate knowledge and is often explored through academic processes such as written assignments rather than considering the tacit foundations of critical thinking that may be developed in the CLE.[44]

Mindlines studies often seek to highlight where professionals seek out this new knowledge. In a study on nurse-practitioners in an emergency department setting, formal explicit knowledge in the form of local and national guidelines formed just one small part of
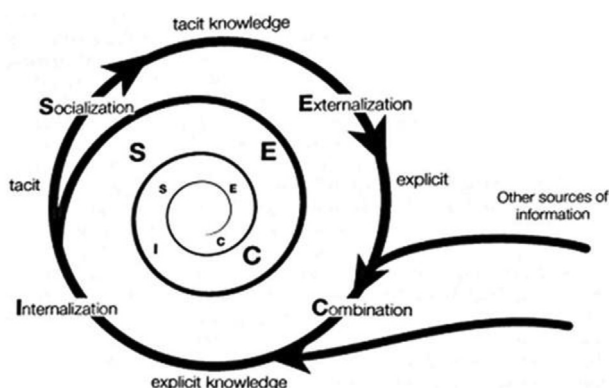
the decision-making process and often less experienced staff sought new knowledge from more senior colleagues and consultants, which was viewed as a more efficient knowledge acquisition process.[46] Empirical understanding of these processes and knowledge sources in clinical UgDR education may assist in our efforts to both bridge the theory-practice gap, and promote EBP. This is particularly critical due to the initial argument that radiographers base their practice on their historic DR education,[3] suggesting that radiographer mindlines may strengthen the barriers to new knowledge. However, it could be argued that it is not radiographer mindlines that are rigid, but rather, as stated by Munn,[47] various logistical and organisational barriers which are apparent in the profession, may be inhibiting the advancement of both their mindlines and, as a result, EBP.

Internalisation and accepting new knowledge

Finally, a process of internalisation is used to convert explicit knowledge into tacit knowledge, connected to 'learning by doing'. This is particularly pertinent to DR education as the combination of academic and clinical environments allows DR students to use the theory that they have learnt in the classroom, in a clinical 'real-world' environment. This area of knowledge creation has been widely explored, through simulation-based education (SBE).[41,48–50] SBE is particularly useful for DR students to develop tacit knowledge of what to expect in the CLE by carrying out clinical activities in a secure academic setting. Gabbay and Le May[18] also show that it is within this domain that individuals determine whether to accept or reject new explicit knowledge into their clinical practice. Although these SBE studies state that DR students appreciate the opportunity to prepare for the clinical environment, it is unclear how CLEs enable this process of internalisation, not only for students but clinical staff. In addition, with the upsurge of SBE in UgDR curriculum, there is a clear argument for a better understanding of knowledge use in practice, to better simulate this environment for students.

Conclusion

In UgDR education, little has been done to explore how students and radiographers innately develop and subsequently share their professional knowledge in the CLE. Mindlines is a useful theory to both study and define the holistic knowledge we personally hold and use to practice effectively. Historically the terminology we have used to embed EBP, and teach students, has limited our perceptions of knowledge and subsequently how we access new knowledge. If we consider that we all hold mindlines, developed from our experiences, education, and social interactions, we can begin to appreciate that there is valuable knowledge to be accessed from everyone, students, patients, radiographers, researchers, and educators. The challenges we face in radiography, and our endeavours to improve EBP, demand a new level of innovation, which requires us to think differently about where we access new knowledge and how we subsequently embed this into our mindlines. To do this effectively we must first understand the current processes by which we do this, harness these, and adapt them appropriately.

Further empirical research which considers these themes is needed in the radiography profession and wider health education sector. The body of knowledge on mindline development and subsequent application is growing, and researchers are finding new ways to apply this theory to their own professions. Despite this diversity, the commonality throughout mindline research is the focus on specific contexts and the experiences and perceptions of stakeholders. In addition, we must explore the organisational and cultural

dynamics inherent to our own profession if we are to develop strategies for adapting and advancing our professional knowledge.

Conflict of interest statement

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