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Helping Clinical Educators Provide Effective Feedback to Medical Trainees on Their Diagnostic Decision Making: An Educational Design Research Approach

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The candidate confirms that the work submitted is her own and that appropriate credit has been given where reference has been made to the work of others.

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ABSTRACT

An educational design research approach (EDR) was adopted to understand what type of feedback is most effective to enhance medical trainees' diagnostic decision making (DDM) in authentic clinical settings and how this understanding can be used to improve the feedback provided by clinical educators. Research was conducted within the three phases of EDR: 1) preliminary, 2) developmental and 3) assessment. Findings from the preliminary research phase indicated that more structured and specific feedback which focused on self-regulated learning (SRL) and contextual factors would be advantageous for medical trainees. A conceptual model of feedback that incorporated these findings was developed to inform a Personalised Model of Feedback (PFM) intervention in the development phase. Despite a positive response to the PFM intervention, recruitment was poor which highlighted barriers to involving clinical educators in research and training. Six clinical educators used the PFM intervention to provide feedback to their medical trainees after DDM in the authentic clinical setting. Using a mixed methods approach, the assessment phase evaluated participants' perceptions of the PFM intervention. Participants found the PFM intervention useful, usable and effective for providing feedback on DDM. After participation more feedback was provided on SRL, confidence and the influence of contextual factors on DDM. Clinical educators and medical trainees also had an increased awareness of the influence of contextual factors on DDM. Medical trainees viewed SRL focused feedback as effective and useful for improving DDM and used more SRL skills on hypothetical reasoning cases. This research has added to current research on the use of SRL to provide feedback. It is the first research to specifically address how feedback after DDM can be better provided to medical trainees and shows that the PFM feedback can be given as an add on to feedback usually provided. Further research is necessary to modify the conceptual model and the PFM intervention to improve its ease of use in the authentic clinical setting, its receptivity by clinical educators and to determine whether it leads to an improvement in medical trainees' DDM.

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ABBREVIATIONS

Diagnostic Decision Making- DDM

Personalised Feedback Model- PFM

Educational Design Research- EDR

SECTION A: INTRODUCTION TO THE RESEARCH

The purpose of this section is to introduce the reader to the research conducted for this thesis. This section consists of an overview of the structure of the thesis, including a summary of the background to the research problem and how this research aimed to address this. This research was conducted using an approach known as educational design research. This is not a new approach within educational research; however, it is relatively unknown in medical education research. Consequently, this section also provides a thorough description of what educational design research is, its strengths and characteristics and why its use was appropriate in this research.

CHAPTER A1: INTRODUCTION

In this chapter the reader is provided with a brief overview of the background of this work, the problem the research addressed and the methodology used to conduct it. The key terms are defined and a brief description of each chapter is given.

A1.1 My Background

The focus of this thesis is the culmination of my interest into research in medical education over the past five years. I joined the School of Medicine at the University of Leeds, as a research assistant in 2010 after completing a Masters in Clinical and Health Psychology at the University of Manchester. This work fostered my interest in medical education, on feedback in particular and my awareness of the importance of training future doctors effectively. Effective feedback provision within the medical curriculum is crucial in improving performance before remediation becomes necessary. An element of clinical medical education with specific importance in professional practice is making clinical diagnoses in authentic contexts. As such, this thesis is the culmination of my educational design research (EDR) into developing and implementing a conceptual model of how clinical educators can provide medical trainees with more effective feedback on their diagnostic decision making (DDM). My approach to this research was from an epistemological, pragmatist perspective, focusing on the role of beliefs in guiding this research in its focus, structure and the work undertaken. My theoretical perspective is one of interpretivism. However, my perspective is also positivist in that I believe in the value of making predictions or assumptions and testing these. Roth and Mehta (2002) discuss the importance of using interpretivist and positivist research to inform one another. They claim that this use is iterative since interpretivism can provide information regarding the significance of the research problem and how it can be addressed; positivism can then investigate and test these suggestions, leading to more discussion and development (Roth & Mehta, 2002). EDR could be viewed as aligning these two perspectives since it focuses on understanding the needs and viewpoints of the participants,and uses these to develop and test new approaches or solutions to the need that was addressed. This current research problem was investigated in the authentic clinical setting where medical trainees are observed and provided with feedback on their DDM. EDR was used to understand and explore how medical trainees are provided with feedback on their DDM and how this could be improved. EDR has been defined as a "systematic study of designing, developing and evaluating educational interventions such as programs, teaching-learning strategies and materials, products and systems " (Plomp, 2009. p.9).

A1.2 Context and Rationale

The focus of this research stems from the importance of the skill of making a diagnosis, coupled with the seemingly lack of attention this receives in medical education. Diagnostic decisions begin the cascade of patient management, and consequently, errors here can lead to patient harm. Diagnostic errors have been found to be more common than medication errors (14% vs. 9%) (Leape et al., 1991). They are the leading type of error that gives rise to malpractice claims (28.6%) (Tehrani et al., 2013) and are associated with being likely to cause serious harm or death (Gehring et al., 2012; Tehrani et al., 2013). Consequently, it is important to understand how diagnostic decisions are made and how this is taught to medical trainees. There appear to be an array of factors which may influence DDM but there is a lack of consensus regarding how it should be taught (Mehdizadeh, 2011; Norman, 2005). However, research suggests that it is likely that feedback on DDM is imperative for aiding development of this important skill. Feedback on any task performance is necessary to assist learners in understanding where they may have gone wrong and how they can improve for future performance (Hattie & Timperley, 2007). As discussed in Chapter B2 there is a wealth of research which identifies effective and ineffective feedback strategies, however there is contradiction and uncertainty within the findings and it is not clear what feedback should entail to be effective. Consequently, the research conducted in this thesis undertook a review of the literature to determine how to improve the effectiveness of feedback on DDM. Building on this, research focused on the feedback provided in medical education after DDM. The literature on feedback after DDM is limited and further investigations were conducted in order to develop a new conceptual model of effective feedback and an intervention to implement this.

This research problem was investigated in the authentic clinical setting where medical trainees are observed and provided with feedback on their DDM. In line with the EDR approach this research was conducted in three interrelated phases; each phase informed my knowledge and understanding and subsequently influenced the next step in the investigation. Each phase aimed to achieve objectives which would further the progression of the research. The aims of each phase were:

Preliminary research phase (phase 1)- in Section B of thesis:

To understand how medical trainees are provided with feedback on their DDM, how useful they perceive this to be and how they think this could be improved.

Development phase (phase 2)- in Section C of thesis:

To determine the best method by which clinical educators can provide their trainees with more effective feedback on DDM in authentic clinical settings, to develop a conceptual model of feedback and an intervention to implement this.

Assessment phase (phase 3)- in Section D of thesis:

To assess how useful, usable and effective this was considered to be by the clinical educators and the medical trainees and how this can be improved with future research.

The structure of the three research phases is shown below in Figure A1.1 and is expanded on at the beginning of each section. Each phase was made up of multiple research processes and each phase contributed to the next. EDR is explained in greater depth in Chapter A2 with detailed reasoning as to why its use was appropriate.

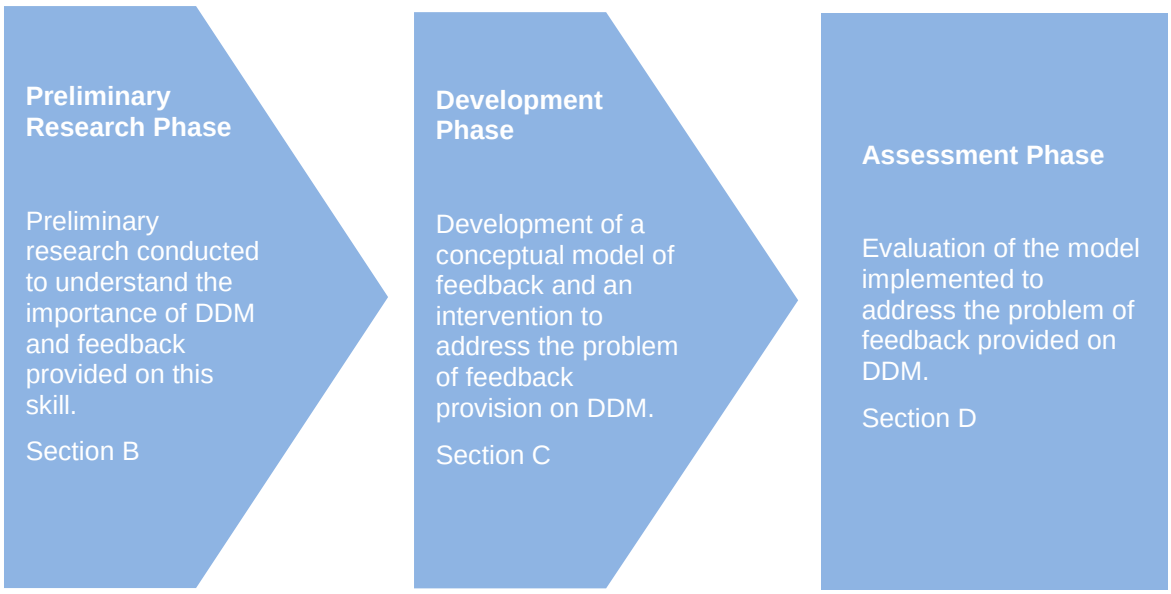

Figure A1.1. A diagram to show the three interrelated phases of educational design research

A1.3 Structure of the Thesis

The thesis is structured as four overall sections. Section A consists of two introduction chapters and sections B, C and D refer to the EDR phases. In each section the chapters are numbered in sequence. For example each chapter in section A is prefaced with an 'A'.

Section A: Introduction to the research

Chapter A1. Introduces the area of the research, provides an overview of the problem and the research approach used, and provides definitions of key terms used.

Chapter A2. Discusses in more detail the methodology used in this research. A history of EDR and an in depth discussion of its affordances and characteristics are provided. The use of EDR within medical education is discussed and the specific use of EDR in this research is outlined, describing the work conducted in each phase.

Section B: Preliminary Research Phase

Chapter B1. Discusses the significance of decision making in doctors' professional practice and the importance of DDM. Two theories of decision making are outlined and the influence of contextual factors on decision making is discussed.

Chapter B2. Provides a detailed overview of the role of feedback. A narrative review is conducted to determine the most effective and ineffective ways of providing feedback. Important theories and models of feedback are introduced along with key features of feedback which need to be addressed. Lastly, feedback in relation to clinical education is discussed.

Chapter B3. Outlines and explains the aims and objectives of this research

Chapter B4. Describes a systematic review conducted to critically synthesize evidence on the nature of the feedback provided to medical trainees on their DDM in authentic clinical settings

Chapter B5. Describes a questionnaire-based study which aimed to understand clinical educators' perceptions (how often provided) and medical students' perceptions (how often received and how useful) of feedback on DDM.

Section C: Development Phase

Chapter C1. Describes the final development of a conceptual model of feedback provision and an intervention developed to implement this. The development is discussed with explicit reference to what influenced each design decision and what this means for the design of the conceptual model and the intervention.

Chapter C2. Describes a pilot study which was conducted to trial the intervention. The pilot study used interviews with clinical educators; these were analysed and modifications were made.

Chapter C3. Describes the implementation of the intervention, including the development of the assessment methods and a detailed description of the design and procedure.

Section D: Assessment Phase

Chapter D1. Outlines the results and analyses the findings. The research is evaluated in terms of whether it led to improved feedback in accordance with the intervention, whether it led to any changes in the participants, and whether it was perceived as useful, usable and effective.

Chapter D2. Discusses and evaluates the findings in light of previous research, and evaluates the implementation of the intervention and its impact. The findings are discussed in terms of their practical and theoretical contribution.

Chapter D3. Reflects on the use of EDR and the progression through the design and implementation processes of this research. The strengths and potential limitations of the research and the implications of this work for future research are discussed. Suggested modifications for a third iteration of the conceptual model and intervention are also outlined.

Chapter D4. Provides an overview summary of the research reported in this thesis. Key findings and lessons learnt are also reiterated and the contribution of this research to the wider field of medical education and education is summarised.

A1.4 Definition of Terms

It is necessary to clarify key terms used in this research:

Authentic clinical setting is a setting where the medical trainee interacts with real patients

Clinical educators are the individuals who teach the medical trainees. In this research the clinical educators are those who teach medical students at the University of Leeds or GP registrars training in practices within the Yorkshire and Humber Commissioning Support (YHCS) and in the Leeds Clinical Commissioning Groups (CCG). Secondary care locations included central Leeds Teaching Hospitals NHS Trust, Bradford Teaching Hospitals NHS Foundation Trust and Harrogate and District NHS Foundation Trust. GPs were recruited from the YHCS and the Leeds CCGs.

Diagnostic Decision Making (DDM) is defined as:

> *The processes of problem-solving and decision-making undertaken by health professionals to make a diagnosis following a clinical presentation within the context of an authentic clinical enquiry. The outcome is a decision to do something.*

The clinical presentation refers to the patient presenting with symptoms and involves the learner conducting an appropriate history and examination. The term *authentic clinical enquiry* refers to the setting being a real life authentic setting with real patients and diagnoses. Diagnostic decisions are also made in training settings, however in this research the focus is on DDM in authentic settings.

Effectiveness has been defined as "*achieving the intended result*" (The Oxford Popular English Dictionary, 1999, p. 160). Effectiveness has two meanings in the evaluation of this research. Firstly, in relation to the effectiveness of the conceptual model in providing feedback perceived to be useful and effective by medical trainees for improving their DDM. The second meaning is in relation to the effectiveness of the intervention in encouraging feedback provision in line with the conceptual model.

Feedback enables the recipient to assess their performance in a given task and promotes desirable and positive development to allow them to understand how to improve their performance for future tasks. My working definition of feedback can be viewed as a focused, operative definition and is based on the literature review and narrative review conducted in Chapter B2:

> *Feedback is information provided by an internal or external source regarding current performance. Feedback can be a positive reaffirmation of success as well as highlighting any discrepancies between goal level and current level of decision making ability. The feedback process is an active reciprocal relationship between the learner and educator and should recognise the influence of goal setting and planning, contextual factors and self-monitoring of one's performance on diagnostic decision making. Feedback should then take these factors into account and aid the learner in reducing this discrepancy in order to improve their ability to make a diagnosis.*

Learners are those who are still learning. This term is used to refer to medical students and GP registrars. It is also used more generally when a learner in any educational context is being discussed not solely medical education.

Medical student is used here to refer solely to medical students.

Medical trainees or Trainees are those who are training to become doctors. The term is used throughout the thesis to refer to any doctor in training.

The Personalised Feedback Model (PFM) is the name given to the conceptual model developed in Chapter C1. The model was developed to demonstrate key elements which influence performance as the learner works through a task, how these interact with performance and how feedback can be provided on these. The name, Personalised Feedback Model is given since the model encourages a focus on elements which are highly personalised and specific to each individual and provides feedback on these. This model is referred to throughout the thesis as the 'conceptual model' or the 'PFM'.

The PFM intervention refers to the intervention developed in Chapter C1 to implement the theoretical conceptual model (PFM). The intervention includes the method used to apply the PFM in authentic clinical settings and the evaluation of the participants' perceptions of this.

CHAPTER A2: METHODOLOGY- EDUCATIONAL DESIGN RESEARCH

This research adopted an educational design research (EDR) approach. In this chapter a brief history and overview of EDR will be given along with a comparison with other research approaches. The characteristics of EDR as well as how it can be used in practice will be outlined. The use of EDR in medical education is discussed and its relevance of use in this research will be made evident.

A2.1 Educational Design Research

Educational Design Research (EDR) recognises that the design of educational interventions need to fit into the complexity of authentic situations in order to be used practically by the intended users (Reeves, 2006). A general overview of EDR and its use in the authentic setting will be further explained and justified throughout this chapter. Subsequently I will clarify how each element of my research fits in with the EDR process and describe my EDR.

A2.2 Clarifying the Terminology

The family of EDR approaches is referred to under a number of guises such as d*esign experiments* (cf Brown 1992; Collins, 1992), *design research* (cf Kelly et al., 2008; Newman, 1990), d*esign-based research* (cf Barab & Squire, 2004; DBRC, 2003; Kelly, 2003) and e*ducational design research* (cf. McKenney & Reeves, 2014; McKenney & Reeves, 2012; van den Akker et al., 2006). These terms are often used interchangeably; however they may be used slightly differently by researchers opting for different meanings of their use (McKenney & Reeves, 2012). The development of numerous terms suggests that EDR is an emerging trend (van den Akker, 1999). I will use the term *educational design research* (EDR) since including the word 'educational' serves to avoid confusion with design research conducted in other fields (McKenney & Reeves, 2012). This term has previously been employed in other EDR texts (see McKenney & Reeves, 2012; Plomp 2013; van den Akker, et al., 2006).

A2.3. A Brief History of EDR

In its early development this approach was known as '*design experiments'* or '*design research'*. It was developed to address several issues within the study of learning, including: the need to address theoretical questions about the nature of learning in real contexts, the need for learning phenomena to be studied in the real world, the need to go beyond the narrow context of learning and the need to derive research findings from formative evaluation (Collins et al., 2004). There are a number of reported motivations behind the emergence of EDR as an approach to research. The first is educational researchers' desire to produce empirical findings and advance theories to address real concerns within educational practice (McKenney & Reeves, 2014). The second stems from the idea

that scientific understanding should be used to provide 'usable knowledge' and an insight into solving practical problems (McKenney & Reeves, 2014; Lagemann, 2002). The third motivation is the desire to increase the robustness of design practice (van den Akker et al., 2006). With these motivations, the emergence of '*design research'* began in the early 1990s (Collins et al., 2004). Ann Brown (1992) and Alan Collins (1992) are often credited as its developers; they aimed to develop an approach which would allow for the design and implementation of educational interventions to conduct formative research to test, evaluate, and modify educational designs based on findings and principles derived from previous research (Collins et al., 2004). They anticipated that researchers would systematically adjust various aspects of the design so that each adjustment became an experiment in itself (Brown, 1992). This process is now referred to as an iterative process of design and development. EDR aims to advance both practice and theory. Here, practice relates to the way in which something or someone works in the educational setting and theory relates to the set of principles or ideas used to describe or explain a phenomenon or activity. EDR is not a research method; it is an approach to conducting research which often employs the use of multiple qualitative and quantitative research methods.

A2.4 EDR Compared with other Forms of Research

EDR is similar to action research as they both identify real world problems and involve those who have an investment in the problem within the research process (Barab & Squire, 2004). Both approaches have a high degree of flexibility within their research deigns and allow for the complexity of variables (Barab & Squire, 2004). In addition, both approaches often use mixed methods and an interactive design process (Anderson & Shattuck, 2012). However, EDR differs from action research in a number of ways. Firstly, EDR relies more heavily on theory to solve real world problems (Reeves et al., 2005). Action research often involves theory, but has a greater focus on reflection compared to EDR (Anderson & Shattuck, 2012). Secondly, although EDR heavily involves participants to develop, evaluate and refine the research process, the researcher develops the overall design and acts as both researcher and designer (Wang & Hannafin 2005). In action research, it is often the users or participants who initiate the research. Researchers may then be involved to aid the research process

(Wang & Hannafin, 2005) or the participants themselves become the researchers. Therefore, action research is not always collaborative, although it is collaboratively-oriented (Munn-Giddings, 2012). Thirdly, EDR places a greater emphasis on designing aims to advance theories and to explore theoretical relationships rather than solely aiming to fulfil participants' needs (Barab & Squire 2004). EDR aims to connect design interventions with current theory and additionally must show what it can contribute above the local level and into the general field of learning and teaching (Barab & Squire, 2004). In EDR a link must be made between theory and practice (McKenney & Reeves, 2012). It is important therefore that EDR explores the contribution of the research findings above and beyond the local context. This is not to say that this does not occur in action research, however a greater emphasis is placed on this in EDR.

There are many differences between EDR and controlled experimental research; the main being control over extraneous variables. Controlled experiments are concerned with controlling the influence of extraneous variables, whereas EDR affords the researchers less control over these. This is because EDR conducted in real world settings will be influenced by extraneous variables. EDR views these variables as contributing to the overall findings of the research and how the intervention works in the authentic setting (Collins et al., 2004). EDR employs an iterative approach to design and implementation which consists of multiple revisions of the intervention, whereas experimental research usually involves a single iteration of the intervention (Collins et al., 2004). Furthermore, in EDR, multiple dependent variables often exist whereas laboratory research usually focuses on only one dependent variable. Consequently, EDR incorporates and welcomes social interaction and the influence of participants on the research. This contrasts with controlled experimental research which aims to prevent participants' interaction with the outside world from influencing the results (Collins et al., 2004). Resultantly, in controlled experimental research the researchers are the sole designers and decision makers whereas in EDR the participants play an active role in the decision making processes in the research.

EDR draws on more uncontrolled methods since it allows for participant interaction in the development and implementation of an intervention. This enables an intervention to be developed that is perceived as usable and potentially effective by the research participants. However, EDR also draws on more controlled research methods since it is led by the researcher and allows for the semi-controlled implementation and evaluation of the intervention. In this sense EDR could be viewed as employing some strengths of both controlled and participant-led designs.

A2.5 Characteristics and Advantages of EDR

The EDR process is most often characterised as being: interventionist, iterative, process-oriented, utility-oriented, theory-oriented, collaborative and responsively grounded (McKenney & Reeves 2012; Walker 2006). Table A2.1 outlines these characteristics and provides examples of how they apply to my research. The two main contributions of EDR are that it contributes to both practice and theory. Practical contributions refer primarily to the intervention developed to address the problem and the solution they offer. The development of insight or expertise into the problem for the participant is also an important practical outcome for EDR. During each phase of EDR different practical and theoretical contributions will be made. The practical contribution of the intervention and the EDR as a whole can have a number of different foci. These include: educational products, educational processes which support teaching and learning, educational programs- which combine products and processes and finally educational policies such as guidelines and rules (McKenney & Reeves, 2012). EDR contributes to existing theories or begins the building blocks of new theory. A definition of theories in relation to EDR is: "Theories describe or explain things that happen and can be used to steer future occurrences" (McKenney & Reeves, 2012, p. 31). Theoretical understanding can take the form of (1) propositions thought to be true but are not proven, (2) evidence which supports an assertion and (3) theoretical principles from existing theories (McKenney & Reeves, 2012). These three forms, through the support of reasoning and reflection, allow new theoretical understanding to be developed.

The theory developed in EDR has a number of purposes: to describe, explain, predict or prescribe (McKenney & Reeves, 2012). Often EDR will produce theoretical contributions which meet more than one of these purposes. Prescriptive understanding is often referred to as design principles, which are used to describe features or things the intervention must do to be effective. Using theory to develop design principles integrates descriptive, explanatory and prescriptive understanding to guide the development and design of interventions. Theories offer explanatory and predictive power which is desirable for designing interventions which will work in authentic settings to solve real world problems, whereas the prescriptive power of theory is required to further refine interventions (McKenney & Reeves, 2012). The contribution of theory to describe, explain, predict or prescribe can occur at three different levels. These levels exist on a continuum ranging from local theoretical contributions, to high-level theoretical contributions (McKenney & Reeves, 2012). Local theory refers to the contribution of the theory that is directly tied to the specifics of the investigation and is typically used to design, explain or predict. These findings usually refer to understanding developed from testing an intervention in one specific context and thus may not be applicable across a range of contexts (McKenney & Reeves, 2012). Design principles can be seen as a form of local theory since they are often derived from the findings in a small number of contexts and are related to the design of one specific intervention. Middle-range theoretical contributions refer to the linking of lower-level interpretations of research findings with higher level theories which unify the two together (Merton, 1957). High-level theories relate to the integration of multiple middle-range theories from numerous contexts and are usually based on assumptions and epistemologies (McKenney & Reeves, 2012). High-level theoretical contribution is less common in EDR. EDR is likely to contribute to theoretical understanding by providing the building blocks of theory rather than providing new rich and detailed theory. This is since it is unlikely for a theory to be based solely on one or two studies.

Characteristic	Explanation	How this Applies to my Research
Interventionist	EDR is aimed at designing an intervention which will positively impact and be utilised in a real world setting. It aims to identify a real life problem which requires an innovative solution. EDR then clarifies their causes and develops solutions informed by existing scientific knowledge, empirical testing and the input of the participants.	My research aims to develop a model of feedback to be used in daily supervision of medical trainees in clinical practice.
Iterative	The research process is made up of multiple cycles of analysis, design, development, evaluation and revision leading to further analysis, design and development.	The precise design and focus of the model of feedback will undergo numerous iterations to improve its effectiveness, usability and usefulness.
Process-oriented	The research focuses on understanding and further improving interventions rather than adopting rigid input-output measurement.	Prototyping will ensure that the model of feedback is relevant and perceived as effective, usable and useful by the participants. Initial iterations will focus more on the reception of the model rather than its impact on performance.
Utility-oriented	Successful design is assessed in part by its practicality in real world settings for the users.	The research will focus on ensuring the model of feedback can be used in a practical and useful way by the clinical educators and medical trainees in daily practice.
Theory-oriented	The design has theoretical underpinnings and is based on a conceptual model or framework. The iterative cycles of design, develop, revision etc contribute to the theory on which the research is based.	The research employs previous theory, scientific research and knowledge to understand current problems, develop a conceptual model of feedback to improve feedback provision to medical trainees on their diagnostic decision making. Testing the model using an intervention will then contribute to the development of theories within medical education and feedback.
Collaborative	The research is conducted in collaboration with rather than for or on those connected with the problem being addressed. The participants are actively involved in solving the problem being addressed.	The model of feedback will be developed in line with and modified in response to the opinions, needs and desires of the clinical educators and medical trainees.
Responsively grounded	EDR explores (rather than ignores) the complexities of real life teaching and learning contexts. Via its iterative process the design and intervention is then moulded around these complexities.	The research will respond to and develop around complications or irregularities in how medical trainees on placements are supervised.

Table A2.1. Characteristics of EDR and how these apply to my research

A2.6 Conducting EDR

A2.6.1 Who Does EDR Involve?

EDR closely involves the participants, whom the research is focused upon. The participants in this EDR were included in the research and design process from an early stage to ensure that the phenomenon of feedback on DDM is meaningful to them, and that the intervention developed is viewed as useful and usable in authentic practice. The importance of this is revealed when looking at research which has not taken this into consideration. For example, Grant et al, (2011) attempted to integrate an online learning package into the existing medical curriculum. The package failed due to a lack of time for students to use the package, students being unaware the package existed and not finding it useful at that point of their course (Grant et al., 2011). Had an EDR approach been adopted to implement this package it is likely that the researchers would have been better able to meet the needs of the students and provide a more useful learning tool.

A2.6.2 Where Does EDR Take Place?

EDR takes place in real-world settings where the phenomenon the research is interested in is situated; my EDR took place in an authentic clinical setting where the learner had to make diagnostic decisions based on an interaction with a real patient. This setting best allowed me as the researcher to evaluate the intervention designed and to closely portray the environment for which the intervention was created (McKenney et al., 2006). These settings are often quite complex, changing and unpredictable. However, this is usually the most effective way to test the use of interventions involving participants in real world settings (McKenney et al., 2006).

A2.6.3 When is it Appropriate to Conduct EDR?

EDR is not appropriate for all research and it is important that researchers can recognise when this is the case. Table A2.2 outlines three conditions highlighted by Kelly (2013) where EDR is most appropriate. These criteria are explained by demonstrating how they apply to my research.

Criteria	How this Applies to my Research
Little agreement over how to solve the issue	Researchers are agreed that not all feedback is effective for all students and that there is a discrepancy between the feedback teachers report providing and that which learners report receiving. However, there is little agreement about how to solve the issues surrounding feedback on DDM
Little research which successfully improves this	There is very little research within medical education which attempts, successfully or otherwise, to improve feedback provided on DDM
The initial goal and goal factors are unclear	It was not clear originally why feedback is not effective and how it should be provided more effectively.

Table A2.2.Appropriate criteria for conducting EDR

A2.6.4 Methods Used in EDR

Mixed methods are often used as EDR lends itself to the employment of multiple types of measures of evaluation. Mixed methods research can be defined as "the class of research where the research mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study" (Johnson & Onwuegbuzie, 2004, p.17). Advocates of mixed methods research argue that research methods should be employed in a manner that will afford the most useful answer to the research questions. Mixed method designs offer firm frameworks for the collection, analysis, mixing, interpretation and reporting of qualitative and quantitative data (Creswell & Plano Clark, 2011; Johnson & Onwuegbuzie, 2004). The breadth and depth afforded by using a mixture of qualitative and quantitative research methods is aided by the different paradigms adopted by the two approaches. Qualitative research adopts an interpretivist paradigm, whereas quantitative research is more likely to adopt a positivist paradigm. The mixed methods approach therefore strives to integrate both qualitative and quantitative research. This approach does not sit well within solely interpretivism or positivism (Cresswell & Plano Clark 2011). There are a number of paradigms which have been put forward to account for mixed methods. One of these is pragmatism, which views itself as offering the chance to acknowledge the value of both qualitative and quantitative research methods in order to produce knowledge which will advance our understanding of a given research area (Feilzer, 2010; Morgan 2007). Thus pragmatism aims to answer a research question, problem or theory using the most appropriate research method available and offers logic to justify its use of research methods

(Feilzer, 2010). I have therefore, adopted a pragmatic world view in the undertaking of this research. However, within this I hold an interpretive stance since I attempt to focus on the problem of feedback on DDM from the perspective of an insider, through involving the participants and by seeking to ensure that all participants benefit from the research.

A salient strength of using mixed methods for this research is that using both words and numbers provides support for the findings of the other. For example, participants' written opinions can add meaning to numerical responses on a questionnaire and vice versa. Consequently, using qualitative and quantitative research can help to elicit insights and understandings that may have been missed when only a single method is used. This affords the researcher the strengths of each approach and this may help to outweigh the weaknesses of the other. In addition, since I was not confined to a single method or approach, a more complete range of research questions could be answered as shown in Table A2.3. Thus, using qualitative and quantitative methods together can help to produce more complete knowledge necessary to inform theory and practice. Therefore, using mixed methods for the evaluation of the conceptual model and intervention encouraged the convergence and corroboration of research findings and thus helped to provide a stronger evidence base for the conclusion. Furthermore, mixed methods were useful for assessing whether the views from the qualitative and quantitative data collection strategies were diverging or converging (Creswell & Plano Clark, 2007). However, there are a number of drawbacks to conducting mixed methods research. It may have made my research more time consuming due to the time taken to develop, implement and analyse multiple measures of assessment rather than focussing on one. As such, more demands were placed on myself in order for me to be competent in conducting a number of research methodologies. Despite the potential issues surrounding the use of mixed methods their use aided the provision of a richer, more complete understanding of the findings and enabled me to utilise a greater range of methods to best fulfil my objectives. The mixed methods employed are shown in Table A2.3.

	Qualitative	Quantitative
Section B: Preliminary research phase	Narrative literature review (B2) Systematic literature review (B4) Questionnaire responses (B5)	Questionnaire responses (B5)
Section C: Development phase	Pilot study- Semi-structured interviews with GPs (C2) Written evaluation feedback from the trainees or clinical educators regarding the intervention (C2-C3).	
Section D: Assessment phase	Questionnaire responses on feedback given or provided (D1)	Questionnaire responses on feedback given or provided (D1) Medical trainees' DDM (D1) Clinical educators' feedback provision (D1) Barriers to feedback questionnaire (D1)

Table A2.3. Mixed methods used at each phase in this EDR

In this research, quantitative research methods are deemed the best approach to answer questions such as '*what'* in terms of what feedback is provided. This allows for the measurement of independent and dependent variables with limited researcher interference in authentic contexts (Tharenou et al., 2007). The qualitative methods contribute to answering questions regarding the '*why'* and '*how'* of feedback provision after DDM. This can reveal differences in participants' perceptions of feedback, and its use after DDM, their perceived barriers to feedback provision and the influence of contextual factors on DDM.

A2.7 EDR in Education Research

It is apparent from the literature that EDR offers important and useful design characteristics and methodology for conducting research in educational settings. However, it is important to assess to what extent its potential has been realised within the education setting. Anderson and Shattuck's

(2012) systematic review of 47 articles, found that 31 provided results from design-based research and the remaining 16 were of a philosophical or explanatory focus on design-based research. In evidence of EDR gaining momentum and popularity over the last decade the majority of the philosophical papers (88%, n=14) were published between 2002 and 2006 whereas the majority (74%, n=23) of the empirical research papers were conducted between 2007 and 2011. This suggests that EDR is moving from theoretical design to being used in practice (Anderson & Shuttuck, 2012). The review concluded that design-based research is being increasingly employed in educational contexts and the majority of articles reported that their EDR interventions had resulted in improved outcomes or attitudes. The review evidences that EDR is being conducted and is reported as being successful. However, limitations of the review are likely to have resulted in relevant articles being missed (McKenney & Reeves, 2013 give a detailed discussion of this review). Consequently, it is likely that many more successful studies using EDR have been conducted since its emergence in the 1990s. Encouragingly, a number of PhDs have been undertaken within the past decade which employed EDR. Amongst others, PhDs have been conducted within educational fields such as: the Chemistry curriculum (Mafumiko, 2006), the use of games (Kennedy-Clark, 2012; Squire, 2004) and web-conferencing in secondary education (Bower, 2008), Maths education (Mor, 2010) and the assessment in Agriculture (Masole, 2011). This further demonstrates the widespread potential use of EDR methods within education.

A2.8 EDR in Medical Education

As evidenced by the publication of an AMEE guide (Dolmans & Tigelaar, 2012) there has been a push more recently within the field of medical education to employ EDR. Building on Badley's (2003) argument that educational practitioners perceive a significant gap between educational research and practice, their guide argues for the utilisation of EDR within medical education. It is argued that many studies reported in medical education journals are not novel, are not always based on proper theory or method and do not contribute new knowledge or understanding on how to best teach medical

students (Dolmans & Tigelaar, 2012; Albert et al., 2007). The utilisation of EDR offers a method to resolve this.

My search of the medical education literature revealed that there are only a handful of studies within medical education employing EDR. However, these studies show how EDR has been successfully employed within medical education. Fluit et al. (2013) employed EDR to investigate the effectiveness of an evaluation system to provide useful feedback to clinical teachers. Fluit et al. (2013) employed focus group interviews as this approach was perceived to be suited to exploratory research and allowed for the involvement of personal and social constructs (Fluit et al., 2013). Upon completion of the evaluation system (EFFECT-S) Fluit et al. (2013) noted that an advantage of using design-based research was that it allowed them to recognise that the design principles and the characteristics realised in the EFFECT system aided the reflection and learning outcomes for clinical teachers (Fluit et al., 2013).

EDR has also been used to develop a mobile-web learning environment for postgraduate courses for health professionals who are also teachers (Bate & Steketee, 2013). Bate and Steketee (2013) employed this approach since it allowed them to address the requirement for delivery of the course to be flexible and meet the needs of the participants, as well as being robust and aligned with the principles of adult learning theory. For example, the approach required that the participants were exposed to authentic experiences which drew on their past experiences; it also used a wide variety of tools and media to allow for individual learning styles. The authors felt that using design-based research provided them with a systematic framework to "conceptualise, re-think and re-engineer the design of a hybrid mobile-web learning environment" (Bate & Steketee, 2013, p.10). Specifically, it encouraged them to develop a system of learning which was integrated to incorporate the affordances of new learning technologies and made clear their roles and purposes for these. They claim that this process assisted them in re-thinking their modular approach into an approach which aids the practice of building upon ones prior knowledge and experience to construct new knowledge. It also assisted

them in finding a balance between authenticity and generalisability in the health professional education environment. Bate and Steketee (2013) also employed design-based research to guide the development of the course and the iterative cycles of review. The authors considered that employing the design-based methodology "ensured the designers stay true to the objectives and specifications of the course" (Bate & Steketee , 2013, p. 10). Further detailed information, is given in the AMEE guide by Dolmans and Tigelaar (2013) which provides a thorough description and justification of their use of design-based research in medical education.

A common theme amongst these articles was the recognition that EDR allowed for the systematic design, development and evaluation of educational interventions. These interventions were instigated as potential solutions to complex issues in educational practice and the advancement of understanding about the successful characteristics of these interventions. Importantly, the research in these articles allowed for a link between theory and practice, and development in authentic settings. To summarise, EDR focuses on showing why a certain design with its specific aim worked in that specific context and consequently how it adds to the advancement of our understanding of theories and design principles (Dolmans & Tigelaar, 2012). These findings suggest the increasing popularity of EDR and its usefulness (yet still underused) in medical education.

A2.9 Why I am Using EDR

After reviewing the literature I chose to conduct my research using an EDR approach since I felt this was best suited to exploring feedback on DDM in the authentic clinical setting. Using EDR may help to tackle the long-standing criticism of educational research having a weak link with actual practice (McKenney & Reeves, 2012; Herrington, 2007). In many cases, educational research, including curriculum design and interventions, are put into practice without being properly and efficiently trialled in the real life setting. This can be seen in relation to feedback since numerous articles and guides are published which provide the educator with 'top tips' and guidelines on how to provide feedback. Such articles appear to be based on theory or previous research alone and so may not work

as effectively in real life. Consequently, interventions which work well in controlled experimental conditions may be less successful in the uncontrolled environment of medical education and the clinical setting. Furthermore, using EDR gives credence to the involvement of participants in the focus and design of the conceptual model and feedback intervention. Involving the participants and conducting numerous iterations of the intervention in the authentic setting enhances the conceptual model and the interventions' applicability to real world settings. The iterative nature of EDR was desirable in this research as this allowed for the development and trialling of the conceptual model and the PFM intervention so that it could be modified to ensure it was relevant, useful and usable for the participants. Furthermore, EDR is useful when there is limited knowledge in the field of interest as is the case regarding research on feedback on DDM. EDR afforded me the flexibility in research design and implementation to develop new insights and knowledge to construct innovative interventions, and solutions for providing feedback on DDM which will be practicable in the real world.

To summarise, EDR was used for the following reasons:

- There is no research which successfully addresses how to provide more effective feedback to medical students on their DDM in authentic clinical settings.
- The research benefitted from involving the participants from an early stage in order to develop an approach to improving feedback which was relevant to them and their needs.
- Conducting the research in authentic settings helps to ensure that the intervention was useful, usable and perceived as effective in authentic settings.
- The iterative process allowed for the modification and development of the intervention to ensure it was relevant, useful and usable to the participants.
- Conducting the research in an authentic setting helped to link educational research to actual practice. This encouraged my research to have a practical contribution to education since it led to the implementation of an intervention in the authentic educational setting.

- The implementation of the intervention in the authentic clinical setting helped to develop existing theory of feedback provision of DDM in authentic contexts.
- Due to its implementation in the authentic clinical setting, the research was more likely to produce evidence-based claims about learning that stand up in similar authentic contexts.

A2.10 Three Phases of EDR

The implementation of EDR can be seen as having three core phases (Figure A2.1); the precise terminology and specific content of these may differ between researchers and studies. The summary provided by Plomp (2013) provides the simplest approach to understanding these phases and this research has been conducted in line with these: Phase 1. *Preliminary research phase,* Phase 2. *Development phase* and, Phase 3. *Assessment phase.* The three phases will be described below and the work undertaken at each phase of my research will also be outlined.

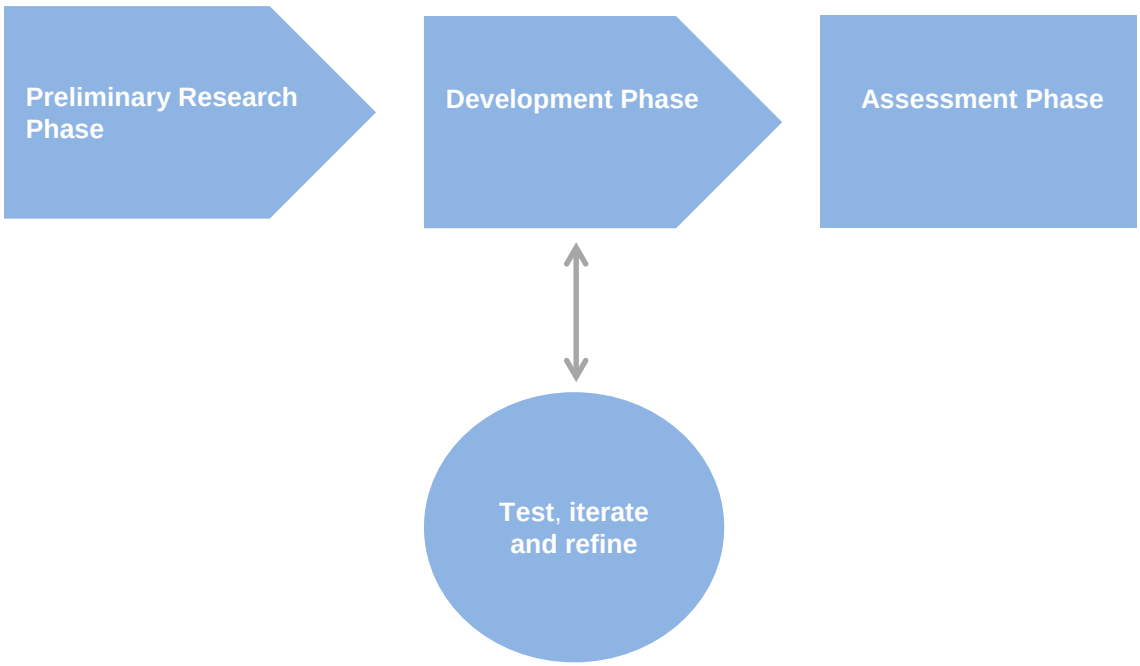

Figure A2.1. The three phases of EDR and the interaction between these

A2.10.1 Preliminary Research Phase

In this phase, I as the researcher aimed to gain insight into the problem to be investigated. In order to achieve this I outlined and explored research on feedback on DDM and accepted the assumption

that existing practices were insufficient or could be improved (Edelson, 2006). I also sought collaboration with those whom the intervention aimed to help, so that the preliminary research could be better identified and understood (McKenney & Reeves, 2012). To better understand how students are taught and provided with feedback in clinical settings I observed medical students in authentic clinical settings. To build on my understanding of the problem to be investigated I explored the literature to define what DDM is, why it is important, and how it is taught (Chapter B1) as well as conducting a narrative review to understand the role of feedback in education (Chapter B2), and a systematic review to understand feedback provided after DDM and the issues surrounding this (Chapter B4). The lack of literature demanded a preliminary field-based investigation to further understand the problem and the needs of the participants involved. To achieve this I conducted a questionnaire study to determine medical students' and clinical educators' perceptions of current feedback provision on DDM (Chapter B5). These tasks provided me with a better understanding of the problem and enabled me to begin outlining design principles and initial design propositions (Chapter C1).

A2.10.2 Development Phase

In my research, this phase began after I had gained more insight into the problem of feedback on DDM and I had a tentative idea for the design of the intervention. Within my research this phase saw the development of the design principles, the development of a conceptual model of feedback, a model of how to implement the feedback and, an intervention to implement this (Chapter C1). These were designed, based on the findings from the research completed in the preliminary phase. Once an initial idea for the model and intervention had been formulated it was discussed with research participants. During this stage I conducted pilot interviews with potential participants (Chapter C2). In these interviews I explained my intentions for the model and ascertained the participants' evaluation of the model based on its effectiveness, usefulness and usability. Evaluation and revision from this stage resulted in continued development of the intervention before it was put into practice by the participants (Chapter C3). This allowed for the development, evaluation and

modification of the conceptual model and the PFM intervention. Each successive version of the model of feedback was informed by the previous cycle of testing. This phase became its own cyclical phase of proposal, design, partial product, evaluation and re-design, and a more completed product.

A2.10.3 Assessment Phase

This phase involved a detailed, summative assessment of the intervention to determine whether it met the desired outcomes. The intervention was developed from the initial problem identification and exploration in the preliminary research phase and from the iterative cycles of design and modification in the development phase. The findings were reflected upon and evaluated with the aim of determining if, how and why features of the intervention worked (McKenney & Reeves, 2012) (Chapter D1 - D2). The effectiveness of the intervention was evaluated in terms of whether it met its goals and the impact of the intervention (as measured by whether it enabled the desired change in the educational context) (McKenney & Reeves, 2012), and the impact of the findings in relation to previous research (Chapter D2). The evaluation involved assessing the soundness and feasibility of the intervention and its underlying design and construct, the local viability of how the intervention worked in the authentic context and how the intervention could be established within the broader educational context.

Reflection is also a vital element of EDR. It is often via reflection that new theories and theoretical understandings arise (McKenney & Reeves, 2012). Reflection involves the active and thoughtful contemplation over what has arisen in terms of the research itself, and the development of the intervention, theory and participants' reactions to the intervention (McKenney & Reeves, 2012). Reflection assisted me in evaluating the EDR method and the research conducted in terms of its contribution: practically, in terms of the practical approach to providing feedback, professionally for the participants, and what it added to existing theory. It was also important to reflect on the use of the PFM intervention, the conceptual model and the design principles to understand the limitations of the research and how it could be modified in future iterations (Chapter D3).

A2.11 An Outline of the Work Conducted For Each Phase

The aim of each phase and the objectives of each research phase are outlined below to make it clear what research was conducted within each phase.

Preliminary research phase (phase 1) in Section B: Understanding current feedback provision on medical trainees' DDM and how this could be improved (Figure A2.2).

a) Why is DDM an important area of medical education and what is the role of feedback in this? (*Chapters B1-B2)*

b) How does the medical literature indicate feedback is provided by clinical educators to medical trainees on their DDM to improve performance? (*Chapter B4*).

c) How are medical students currently provided with feedback to improve their DDM in authentic clinical settings? How useful is this feedback perceived to be by both clinical educators and medical students? *(Chapter B5).*

Development phase (phase 2) in Section C: Development of a conceptual model of feedback and an intervention to provide more effective feedback on DDM (Figure A2.2).

a) How can a more effective model of feedback provision be developed using the information generated from the preliminary research phase? (*Chapters C1-C2*).

b) Implementation of a model aimed at providing more effective feedback to medical trainees on their DDM (*Chapter C3*)

Assessment phase (phase 3) in Section D: Evaluation of the model's usefulness, usability and effectiveness, reflection on the findings and the development of the next iteration of the PFM (Figure 2.2).

a) How useful, usable and effective did the medical trainees and the clinical educators find the model to be? (*Chapter D1*).

b) Evaluation and reflection on the findings from the intervention (*Chapter D*2)

c) Reflections, strengths and limitations of this research and how it could be improved for future iterations of the PFM. (*Chapter D*3)

d) Final conclusions of the intervention and summary of the practical and theoretical contributions (Chapter *D*4).

Figure A2.2. Work conducted at each phase of the educational design process and the corresponding chapters in which these are discussed.

A2.12 Summary of Chapter

To summarise, I chose to conduct this research using an EDR approach as I believed it brought out a number of strengths within my design and in the implementation of my research. Furthermore, I was confident that the focus on real world practice and the iterative process encouraged by EDR would enable me to most efficiently explore and understand the phenomena of feedback provided to medical trainees on their DDM. The three phases of design research: the preliminary phase, the development phase and the assessment phase provided a structured approach to investigate feedback on DDM, develop a method to improve this, and evaluate this approach. This thesis is written in keeping with these phases and is structured into three sections (Section B, C and D) to correspond to each phase of EDR, and the relevant chapters are discussed within each section. At the beginning and end of each section an introductory overview and summary of the phase are given.

SECTION B: PRELIMINARY RESEARCH PHASE

In EDR a researcher's initial investigations into a research topic constitute an important part of the preliminary research phase, since this phase clarifies whether there is a need for the intended research and specifies the issues of interest for the research. As such, Chapters B1-B4 document research undertaken for the preliminary research phase of this thesis; these are diagrammed in Figure B.1. A number of questions (taken from Palalas & Anderson, 2013) were used to guide the research conducted for this phase; illustrated in italics I have highlighted the section of work which answers each question. These are:

1. What information can be gathered from previous research which helps to determine the specific problem? (*Chapters B1-B2)*
2. What is the specific problem and what are the educational needs that require targeting? (*Chapter B3)*
3. What are the specific characteristics of the target population and what are the specific learning and teaching requirements for these individuals? (*Chapter B3)*
4. Have any similar interventions been conducted previously which aim to improve feedback after DDM? (*Chapter B4)*
5. What are the participants' previous experiences of feedback on their DDM and is any improvement needed? (*Chapter B5)*

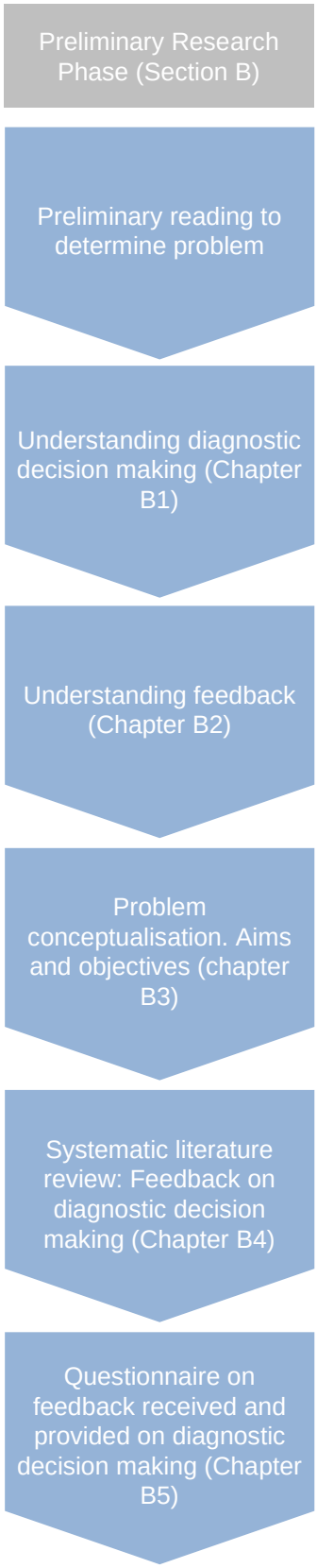

Figure B.1. Research conducted during the preliminary research phase.

CHAPTER B1: THE IMPORTANCE OF DIAGNOSTIC DECISION MAKING

In this chapter I introduce the importance of making a diagnosis in clinical practice, emphasising the role of this in patient safety. I then discuss research on how it is believed a diagnosis is made and the factors which may influence this. Next, this research is discussed in terms of how the process of diagnostic decision making (DDM) is currently learnt by medical trainees and how this skill is assessed. This highlighted the importance of feedback on performance and the need for a greater insight into feedback on DDM.

B1.1 The Importance of Making a Diagnosis

Making a diagnosis is the cornerstone of clinical practice and begins the cascade of patient management (Durning et al., 2010; Cantillon & Sargeant, 2008). The General Medical Council has identified making a diagnosis as one of the key outcomes for what graduate medical students must be capable of as practitioners (General Medical Council, 2009; 2013), and its importance is further highlighted in the Foundation Programme curriculum for newly graduated medical students (General Medical Council, 2015). The process of making a diagnosis however is often not clear-cut, which means clinicians may make mistakes, which could lead to adverse patient outcomes (Graber et al., 2005). Diagnostic error has been shown to be one of the most common, timely, expensive and potentially harmful types of error in the medical out-patient setting (Chandra et al., 2005; Sandars & Esmail, 2003; Twigg et al., 2001).

Diagnostic decision making (DDM), which I defined for the purpose of this research as "the processes of problem-solving and decision-making undertaken by health professionals to make a diagnosis following a clinical presentation" (page 27) is one element in the broader field of clinical reasoning and clinical decision making. However, the terms clinical reasoning and decision making are often used interchangeably. Clinical reasoning can be viewed as a process whereby health professionals think through the various components of patient care in order to arrive at decisions (Higgs & Jones, 2008). It has been defined as the ability to "sort through a cluster of features presented by a patient and accurately assign a diagnostic label, with the development of an appropriate treatment strategy as the end goal" (Eva, 2005, p.98). Clinical decision making may be viewed as the process of making a choice between alternatives for a course of action within the clinical setting (Thomas et al., 1991). It is important to highlight this confusion and overlap in meaning amongst terms that have been used to represent this field of research (Mehdizadeh, 2011). The literature does not establish clear cut distinctions between the terms 'clinical reasoning', 'clinical judgement', 'clinical problem solving', 'diagnostic reasoning' and 'clinical decision making' (Mehdizadeh, 2011). Furthermore, there are often differing definitions of clinical reasoning and decision making and there is no clear consensus of the meaning of clinical reasoning (Schuwirth, 2009). Despite their wide

ranging definitions these terms are often used interchangeably and synonymously with one another (Lin, 2012; Mehdizadeh 2011; Bowen, 2006; Norman, 2005; Thompson & Dowding 2002). This leads to confusion and difficultly in thoroughly researching the literature for information on making a clinical diagnosis. For clarity, where used in this thesis, the notion of 'clinical reasoning' and 'decision making' are discussed for their relationship with DDM, as opposed to a focus specifically on clinical reasoning or decision making.

B1.2 How are Decisions on Making a Diagnosis Made?

When one thinks about the amount of information practitioners have to assimilate when making diagnostic decisions, it is not surprising that errors may be made (MeReC, 2011). Consequently, it may be impossible for individuals to process all the incoming information; this is known as 'bounded rationality' (Simon, 1978). It refers to the premise that an individual's reasoning or decision making is bounded by the extent of the information they possess, the cognitive limitation of their minds and the set amount of time available in that instance (Jones, 1999). When making a diagnostic decision a clinician must possess the relevant knowledge and understand the interaction between numerous areas of clinical information at one time. Evidently, the process of understanding how individuals make diagnostic decisions is not clear cut. Two approaches to understanding how we make diagnostic decisions will be discussed: the dual process theory (Croskerry, 2009) and situativity theory. The dual process theory is an information processing theory; this is currently the most common approach to understanding decision making. Situativity theory is less widely adopted, but it focuses on an important element not explained by other theories, the role of context in influencing decision making.

B1.2.1 The Dual Process Theory

The dual process theory (Croskerry, 2009) has been proposed to explain how clinicians make decisions in the face of the vast amount of diagnostic information, clinical practice guidelines and patient management options available to them in the clinical setting. For the purpose of this research this will be discussed in terms of the decision making aspect of DDM, rather than a focus on clinical practice guidelines and patient management options. The dual process theory proposes that decisions are made using two reasoning systems, one which is fast, automatic, effortless and unconscious (System 1) and the other slower, controlled, effortful and conscious (System 2) (Evans & Frankish, 2009). As the sheer volume of information relating to diagnosis and management is unmanageable, most of the time clinicians will make decisions using a fast and less intensive process. This is known as System 1 processing and refers to the less effortful and quicker approach to decision making which is largely based on pattern recognition (Croskerry, 2009). System 1 processing is often influenced by cognitive biases and mistakes made here are rarely corrected due to the processing being fast, automatic and unconscious (Croskerry, 2012). In contrast, System 2 processing involves more conscious and deliberate effort and is employed if System 1 fails. System 2 employs more reliable processes, however this comes at a cost of being more resource intensive and slower (Croskerry, 2009). In order for System 2 to be used, the clinician needs to be aware that they cannot make a diagnostic decision using only System 1 processes in that situation. They then make a conscious decision to revert to the slower, more deliberate decision making processes employed in System 2. Cognitive forcing strategies such as mindfulness can be used to promote the awareness of a need to switch to System 2 to avoid diagnostic error (Croskerry et al., 2013; Croskerry, 2003a). Errors in DDM are more likely to occur when the clinician is not aware that decisions made using System 1 are not correct, and so do not switch to System 2 processing. Instead they continue using System 1 and potentially make an incorrect diagnosis.

In order to understand how the dual roles of System 1 and System 2 processing work to influence decision making in a clinical setting, an example of a clinician engaged in diagnostic decision making is shown below (Table B1.1).

Stage in the Consultation	Further Explanation	System Used
Female- 28 years old. Two month history of exertional chest pain when pushing a buggy. Past history of type two diabetes, hypothyroidism and a BMI of 34.6	These key clinical features do not fit with a well-recognised pattern.	System 2 is employed as analytical thinking is required to determine a diagnosis
Investigations ordered. Resting ECG- showing ischaemic changes.	Clinician recognises this symptom and is able to diagnose based on it.	System 1 is employed as pattern recognition is employed to diagnose the patient.

Table B1.1. How clinical decisions are made using System 1 and System 2.
Note: Adapted from information in 'How clinical decisions are made' (Bate, Hutchinson, Underhill & Maskrey 2012, pg 616)

In line with the dual processing theory, medical trainees are often taught how to make diagnostic decisions by developing analytical (System 2) and non-analytical decision making (System 1). To assist analytical decision making skills medical trainees are encouraged to use mental rules which consist of linking features of the clinical presentation such as symptoms, with the diagnosis, as well as with mnemonics to prompt the recall of clinical knowledge from memory (Eva, 2005). To assist non-analytical decision making skills, medical trainees are encouraged to use heuristics or pattern recognition.

System 1 and 2 processing can be mapped onto a learner's development from novice to expert. A medical student is likely to rely on the more effortful System 2 processing until they have developed more expertise. As they progress through their medical career the information and skills they learn will become automated and eventually System 2 learning will become embedded into System 1. Despite this, System 2 processes are still employed when System 1 employs patterns that are not reliable or detailed enough to act upon. Training students to use their skills in accordance with the two processing systems has proven effective. Students who are encouraged to trust their feelings of familiarity (System 1) but also to consider all the data available (System 2) actually perform better and with more diagnostic accuracy than those who are encouraged to rely on System 1 or System 2 processes alone (Eva et al., 2007; Ark et al., 2006, 2007).

B1.2.2 Situativity Theory: Situated Cognition

Situativity theory views thinking, learning and knowledge as situated within one's experiences such as the culture, the environment and the participants themselves. It places an emphasis on the interaction between these components and the environment where learning and decision making occur. Situativity theory views knowledge, context, environment and the culture as interdependent on one another; they can be viewed as *situated* (Durning & Artino, 2011).

There are a number of situativity theories: situated cognition (Robbins & Aydede, 2009), ecological psychology (Heft, 2001), distributed cognition (Hutchins & Kluesen, 1996; Hutchins 1995) and situated learning (Lave 1988). However, only situated cognition will be focused on in this thesis. Situated cognition suggests that there are complex interactions between both the individual and the outcome of patient care. Certain factors within the clinical encounter such as physician, patient and environmental will interact to influence diagnostic reasoning (Durning et al., 2012). Situated cognition views all learning as situated within the context of the social and physical environment (Artino, 2013). Thus, knowledge, thinking and learning are situated in the environment in which they are taking place. From this viewpoint, cognition, knowing and learning occur as interactions between individuals and their environment (Wilson & Myers, 1999). Here the focus is shifted from the individual learner to the social setting where the activity is occurring (Durning & Artino, 2011). Knowledge therefore arises from our interactions within the world. This contrasts with information processing theories views of cognition as an internal process, memory in a location and knowledge as an object (Durning & Artino, 2011). Situated cognition views perception as the tool individuals use to learn, to understand how, and what decisions to make (Durning & Artino, 2011). From this perspective, learning involves the individual and the context they are in. Their knowledge and intelligence are conceptualised as the interaction between the individual and the learning context they are in at that precise moment (Artino, 2013). From a teaching perspective all learning interactions should occur in authentic clinical practice. These settings allow medical trainees the opportunity to "construct extensive, flexible knowledge, by integrating information across multiple domains, instead of learning decontextualized facts" (Artino, 2013, p. 178). The focus here is on the interaction between the

educator, learner, patients and the environment they are in, with recognition that both the learner and the environment may be changed by this interaction (Durning & Artino, 2011). Such a view places greater emphasis on what is taught, how it is taught, and when the information is taught; these factors may then influence how that information is used in the future (Durning & Artino, 2011). In practice this accounts for the fact that clinicians will enter a clinical environment not knowing exactly what the outcome will be since it will be influenced by the patient, the clinician themselves and the physical environment. This viewpoint attempts to integrate and understand the influence of the social and physical environment on decision making rather than labelling it as *noise* which distracts from the process of decision making (Durning & Artino, 2011).

B1.3 Factors Influencing Diagnostic Error

Situated cognition views factors influencing diagnostic error as naturally occurring elements within that specific physical and social environment. Rather than viewing these factors as an element of the decision making process, dual processing theory views them as factors which may cause *bias* in decision making or as *errors* which may negatively influence DDM. From a dual processing standpoint, the heuristics and short cuts employed by System 1 may make individuals more prone to error; these errors are known as biases (Kahneman, 2011). There are many cognitive biases which influence our decision making (Jenicek, 2011; Croskerry, 2009; Croskerry & Abbass, 2008) and these often cause diagnostic error. It has been argued that they play a greater role than a lack of medical knowledge does in causing poor decision making (Croskerry, 2009; Graber et al., 2005; Klein, 2005; Redelmeier, 2005). Some common cognitive biases are described in Table B1.2. Croskerry (2003b; 2002) provides a more detailed overview of these and more cognitive biases. One difficulty in tackling the influence of cognitive biases is that individuals may not always be aware of them and their influence. In order to overcome a cognitive bias the individual must be alerted to it and develop specific strategies to counter its influence (Croskerry, 2003b).

Clinician performance has been shown to vary across both clinical presentation and the presenting environment (Eva et al., 1998). The influence of the clinical setting and other contextual factors is

recognised as '*context specificity'* and refers to the phenomenon that the same individual may respond differently to identical clinical cases performed in different contexts (Eva et al., 1998). Context specificity has important implications for how we understand DDM in the real world. In authentic clinical interactions there are numerous factors influencing decision making which are not present in controlled settings. Therefore, DDM in real life can be highly complicated and influenced by the environment in which the consultation takes place, the patient and the clinician. Research has supported the existence of context specificity. One example shows that a group of second year medical students interpreted the same clinical event slightly differently (Durning et al., 2010). Furthermore, Durning et al. (2012) showed that context specificity among participants was induced by the contextual factors manipulated in the study. These included: limited time, low English proficiency and incorrect diagnostic or treatment suggestion from the patient (Durning et al., 2012). There are many easily identifiable contextual based factors which can influence the decisions clinicians make. Situated cognition views these as contextual factors which can include conditions in the environment, characteristics of the patient, or individual characteristics within the clinicians themselves. For ease of understanding these will be referred to as *contextual factors*, consisting of *environment, patient* and *clinician factors*. The contextual factors can be related back to cognitive biases (see Table B1.2) but may be easier for the clinician to recognise as influencing their decision making in DDM and therefore may be easier for them to manage or rectify. For this reason this research will focus on the role of contextual factors rather than cognitive biases. The importance of the situation or environment in DDM although overlooked by some theories (such as behaviourism, information processing theories and psychometric theories) cannot be denied and consequently a focus on contextual factors and their role in DDM may be valuable in bringing together the important influences on DDM.

Heuristics and Biases related to Diagnostic Decision Making		Contextual Factors which may Influence this Bias
Anchoring Bias	To be unable to adjust the initial diagnostic hypothesis when further information (e.g. test results) becomes available.	Clinician factors
Availability Bias	To consider a diagnosis more likely because it readily comes to mind. For example a recent and striking experience with a rare disease may make the physician overestimate the frequency of this disease for the next patient.	Environment factors
Confirmation Bias	To look only for symptoms or signs that may confirm a diagnostic hypothesis, or to interpret clinical findings only to support this hypothesis, without looking for, or even disregarding, disconfirming evidence.	Environment factors Clinical factors
Diagnosis Momentum Bias	To consider a diagnosis as definite because a diagnostic label attached to a patient is transmitted again and again by all persons taking care of this patient.	Patient factors
Framing Effect	To be influenced by the way the problem is framed. For example, a survival rate of 60% may be perceived differently from a mortality rate of 40%.	Patient factors
Gambler's Fallacy	To believe that if the same diagnosis occurs in several successive patients, it has less probability to occur with the following one. Thus, the pre-test probability that a patient will have a particular diagnosis may be influenced by the diagnosis of previous patients	Clinical factors
Multiple Alternatives Bias	When multiple diagnostic options are possible, to simplify the differential diagnosis by reverting to a smaller subset with which the physician is familiar; this may result in inadequate consideration of other possibilities.	Clinical factors
Outcome Bias	To opt for a diagnosis with better outcome for the patient, rather than for those associated with bad outcomes. To value more what the physician hopes rather than what the clinical data suggest, leading to minimise serious diagnoses.	Patient factors
Posterior Probability Error	When a particular diagnosis has occurred several times for a patient, to assume that it will be again the case with the same presenting symptoms. For example, to assume that dyspnea is due to cardiac insufficiency because a patient has already suffered of acute cardiac failure several times, while it may be pulmonary embolism.	Patient factors
Representativeness Bias	To consider only prototypical manifestations of diseases, thus missing atypical variants	

Search Satisfying Bias	To stop considering other simultaneous diagnoses once a main diagnosis is made, thus leading to miss comorbidities, complications, or additional diagnoses.	Environment factors Clinical factors
Sunk Costs Bias	To have difficulty to consider alternatives when a clinician has invested time, efforts, and resources to look for a particular diagnosis. Confirmation bias may be a manifestation of this unwillingness to discard a failing hypothesis	Environment factors
Visceral Bias	To favour a diagnosis or to discard other ones because of excessive emotional involvement with the patient. Positive or negative feelings towards a patient, as well as feelings related to these, for example addiction or risky behaviours, may influence the diagnostic process.	Patient factors

Table B1.2. Descriptions of common cognitive biases and the contextual factors which may cause these.
Note. From 'Diagnostic errors and flaws in clinical reasoning: mechanisms and prevention in practice' (Nendaz & Perrier 2012, p.4)

Figure B1.1 depicts the influence of contextual factors on DDM. The figure shows that clinician and patient factors influence each other and the clinicians' use of System 1 or System 2 processes. This is encompassed within the environment itself and thus, this further interacts with the decision making process. As a whole, these interactions will influence DDM. With this in mind it is important to explore the role of environment, patient and clinician focused factors within the authentic clinical setting, and their influence on DDM. Various factors relating to the environment, patient and the clinician are likely to influence the clinicians' approach to the consultation, how they might respond to the patient, and ultimately how they arrive at diagnostic decisions for patient care. Furthermore, it is likely that the influence of these factors can interact and that the clinician may not always be aware of their impact.

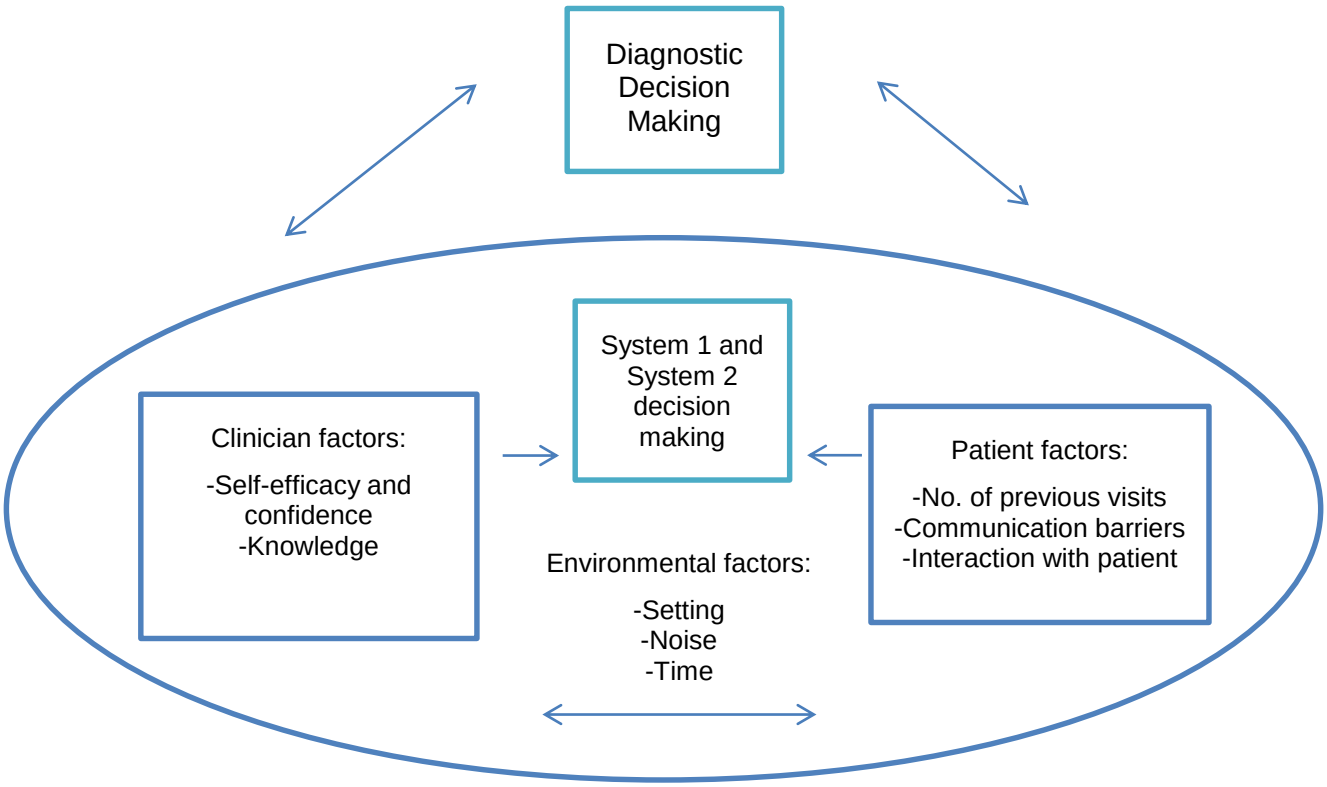

Figure B1.1. Contextual factors which can influence the clinical encounter and how these interact to influence DDM.
Adapted from Durning and Artino (2011).

B1.3.1 Clinician

Self-efficacy and Confidence

Individuals who possess higher self-efficacy are likely to be more confident in their decision making (Smith, 2006). Additionally, it is likely that novices will have lower levels of self-efficacy as they are less experienced. Previous research suggests that those with more experience are likely to have greater self-efficacy (Smith, 2006; Ewing & Smith, 2001). Confidence can also influence positive emotions; confident individuals are more likely to experience positive emotions rather than negative emotions such as fear and anxiety (Smith, 2006).

Knowledge

A lack of knowledge can negatively impact decision making. A greater knowledge base can provide the individual with more certainty in their decision making (Smith, 2006). Individuals with a greater

knowledge base are also more likely to have a more accurate idea of the limits of their knowledge (Smith et al., 2008; Smith, 2006).

B1.3.2 Environment

Setting

Specific characteristics of the setting as well as interruptions can negatively impact decision making. Nurses' decision making has been shown to be disrupted by interruptions in the workplace setting (Hedburg & Sätterlund Larsson, 2004). Furthermore Speier et al. (1999) showed that distractions within the environment could have detrimental effects on complex decision making. Additionally, if the interruptions were dissimilar in content to the task itself then the effect on decision making was exacerbated (Speier et al., 1999).

Noise

External noise is likely to negatively impact the clinicians' DDM by distracting them. This makes it harder for them to understand and assimilate the pertinent information in the consultation to arrive at an accurate diagnostic decision. Whilst no previous research was found regarding the influence of noise in the clinical setting, Zhao et al., (2010) found that factory workers exposed to higher levels of noise experienced more stress and had poorer decision making skills.

Time

Time constraints can have negative influences on DDM due to their negative impact on rapport building with the patient (Smith et al., 2008) and since time constraints place more pressure on the individual to arrive at a decision quickly.

B1.3.3 Patient

Familiarity of the patient and number of previous visits

The familiarity of diagnostic information may influence diagnostic decisions. Symptoms which clinicians have commonly seen in practice tend to have a greater influence on diagnosis than do novel symptoms (Dore et al., 2012). This could be seen as a form of bias and a reliance on System 1 according to the dual process theory. Furthermore, the familiarity of non-diagnostic patient information also influences decision making. Young et al. (2011) showed that psychology students were greatly influenced by familiar non-diagnostic patient information when assigning diagnostic probability.

Communication Barriers

Communication barriers between the patient and clinician can influence the diagnosis made and the patients' understanding of the diagnosis (Burbano et al., 2003). These are most likely to be with children, the infirm or those who do not speak the same language. This may influence DDM since the clinician may struggle to take an accurate history from the patient or identify all the symptoms of the current presenting problem. An inadequate or inaccurate history and understanding of the presenting problem will negatively impact the information on which a decision is made. Research has shown that in consultations where a language barrier was present in an emergency setting, the patient was sent for significantly more diagnostic tests and spent longer in the emergency department (Hampers et al., 1999).

Factors which influence the interaction with the patient

A number of factors may influence how the clinician interacts with the patient; these may include the patients' age, gender or attitude and behaviours. Age may influence DDM as clinicians may interpret presenting problems differently depending on the age of the patient (Hajjaj et al. 2010). This could cause error if a symptom is overlooked due to it being uncommon in that age of patient. According to research, clinicians often perceive women's problems to be more likely influenced by emotional

factors (Bernstein & Kane, 1981); they are likely to receive more tests, checks, return appointments and examinations (Verbrugge & Steiner, 1981). However, in terms of DDM, women may be disadvantaged in terms of the attention paid to signs and symptoms of disease (Lerner & Kannel, 1986). For example myocardial infarction is less likely to be recognised in women compared to men (Lerner & Kannel, 1986).

Regarding patient attitude and behaviours, it is estimated that 10-20% of consultations in general practice deal with patients who are rude, aggressive, demanding or those who are seeking a secondary gain from the outcome of the consultation (Hahn, 2001). Hajjaj et al. (2010) postulate that clinicians may employ different diagnostic and management strategies in order to placate these patients and to reduce further contact with them, e.g by prescribing unnecessary medication or tests. The tendency for patients to suggest incorrect diagnoses or treatment has been shown to negatively impact the clinician's differential diagnosis (Durning et al., 2012). Patients' desires can also influence the clinicians' decision to admit the patient (Escher et al., 2009). The growing ease of access to the internet and other media resources is increasing the tendency for patients to research their symptoms and visit their GP with often incorrect assumptions regarding their diagnosis. This influences the diagnosis, treatment and care they desire.

B1.3.4 The Contextual Factors

These contextual factors are likely to be external and internal, conscious and unconscious, the effects of these will be different for each individual and can significantly influence how diagnoses and decisions are made, especially in those still in training (Bowie et al., 2012). Contextual factors may influence DDM by acting as distractors to the clinician or by evoking an emotional reaction, leading to potential decision making errors (Croskerry, 2002). Table B1.3 shows the contextual factors and how these might influence DDM. These factors may further interact with one another (Durning et al., 2011). Unless there are too many contextual factors, experts can recognise when these factors may be influencing their DDM (Durning et al., 2011). However, novice medical students are less likely to be aware of the impact of these factors on their DDM. This is because the presence of contextual factors such as fatigue, mood or setting may increase cognitive load, leading to the

individual being unaware of the influence of them and subsequently missing important information which is informative of their own difficulties (Durning et al., 2011). Multiple contextual factors cause increased cognitive load and resultantly the factors are viewed as having a negative impact.

Contextual Factors	Specific Factors	How these affect Diagnostic Decision Making
Patient These factors evoke an affective response within the clinician, influencing how they react, respond and treat the patient	• Communication barriers • Number of previous visits • Stereotype of the patient – influenced by age, gender, attitude or behaviour	These are likely to influence the DDM in terms of the diagnoses the clinician considers and the management plan developed. These factors may lead to visceral bias, diagnosis momentum bias, framing effect, outcome bias, posterior probability error (see Table B1.2)
Environment Contextual factors within the working conditions may influence how the clinician feels, thinks and acts in the consultation.	• Noise • Time • Privacy	These are likely to act as distractors when the clinician is making diagnostic decisions. They may influence what information the clinician attends to and thus may affect the information the clinician uses to develop their diagnosis. These distractions may lead to availability bias, confirmation bias, search satisfying or sunk costs bias (see Table B1.2).
Clinician These factors may influence the clinicians' affective state and their affective response to the patient	• Confidence in their abilities • Knowledge.	These are likely to influence the clinicians DDM in terms of their exploration' of the history and development of a differential diagnosis. A clinician who has low confidence or knowledge is more likely to make anchoring bias, confirmation bias, search satisfying bias or multiple alternatives bias. Gamblers fallacy may also occur if the clinician has limited previous knowledge (see Table B1.2).

Table B1.3. Contextual factors associated biases.

Different contextual factors will be more important and more influential depending on the circumstances at the time (Smith et al., 2008). Furthermore, the role and influence of contextual factors is not always straight forward. Individuals will hold views and opinions of contextual factors

and consequently, the same contextual factor may be viewed as beneficial or problematic depending on the situation. Experts' views of contextual factors are specific to each situation and are further influenced by the patient, the setting and their own goals (Durning et al., 2011). This further supports the notion that DDM is influenced by contextual factors and that context plays a significant role in patient care (Durning et al., 2012). In agreement on the influencing role of contextual factors, Essers et al. (2013) state that they should be considered as signals relevant to the consultation rather than as noise. The complex yet significant role of contextual factors suggests that clinicians may benefit from being provided with effective strategies which help them to identify and manage the influence of these factors on their DDM (Durning et al., 2012).

B1.4 How are Medical Trainees Taught the Skill of Making a Diagnosis?

Whilst how decision making is taught is not the focus of this research, it is important to understand the process by which it is taught to and learnt by medical trainees since this will influence how and what feedback is given. Medical trainees are likely to be taught DDM via classroom based learning or workplace learning. Learning in the classroom is likely to include paper-based methods or computer aided instruction using hypothetical medical scenarios. Such an approach loses the complexity of consulting with patients and making a diagnosis in real-life situations where making a diagnosis is less straightforward. Important aspects of authentic consultations such as contextual factors, managing their own anxiety, managing the patients' expectations and the impact of their decisions are lost in classroom based teaching. These settings envelop the individual in an isolated training bubble where they are free to focus solely on making a diagnosis. Such a luxury is not possible in real practice. Iterating this point, medical academics claim that an individual's true DDM is only revealed during real action (Brailosvky et al., 2011; Durning et al., 2011).

Learning also takes place in the workplace. This often involves the learner role modelling the clinicians' decision making as well as practising it themselves. As learners' expertise grows they move from observing experts perform DDM in authentic settings, to performing their own DDM on cases away from the bedside, to consulting patients with a supervisor and eventually independently.

Throughout this process the aim is that the learner develops sufficient medical knowledge and decision making skills to be competent in DDM. Experience in the authentic clinical setting is necessary therefore for the student to apply their medical knowledge to real clinical presentations (Eva, 2005). Importantly, both clinical education and clinical experience are viewed as being significant in influencing good clinical decision making (Bakr et al., 2013). Learning in the workplace reflects the complex nature of real life DDM and facilitates the learners' true DDM (Brailovsky et al., 2011). One criticism of workplace learning is that practice here may be too unstructured and unfocused to assist learners in developing their DDM. As such, the influence of contextual factors may not be taken into account in authentic clinical settings. A balance must be reached therefore, between formal (classroom based) and informal (workplace learning) teaching.

A systematic review has not yet been conducted which analyses how medical trainees are taught the skill of making a diagnosis in authentic contexts. However, an unpublished systematic review on formal training interventions to enhance doctors' clinical decision making was completed in 2010 as part of a PhD thesis at Leeds University (Mehdizadeh, 2011). This review revealed that interventions have been implemented to improve learners' clinical reasoning and clinical decision making (Mehdizadeh, 2011). Thus, aside from implemented interventions it is not clear to what extent workplace learning and classroom based learning occurs in daily teaching. Whilst this research is informative, interventions implemented to enhance clinical decision making are unlikely to be representative of how clinical decision making is taught on a daily basis by busy clinicians in authentic clinical settings. The review also revealed disagreement amongst medical educators regarding how training interventions can improve clinical decision making. The majority of interventions reviewed appeared to be effective to some degree, however no single method emerged as superior (Mehdizadeh, 2011). Despite this, certain elements appear to be important: the provision of feedback on performance, including training in how to utilise specific expert strategies to improve DDM, as well as the use of established theories of decision making in teaching and the use of appropriate assessment methods. A large proportion of the interventions highlighted in the review by Mehdizadeh (2011) involved practice within non-authentic clinical settings such as questionnaires,

clinical vignettes and computer or paper-based assessments. As stated previously, a limitation of this is that such approaches are not always applicable to clinical reasoning and DDM in authentic clinical settings which may weaken the generalisability of the skills learnt.

Mehdizadeh (2011) concludes that there is no best way to teach decision making, nor is there one best way to solve a clinical problem. This view supports that of Norman's (2005) decade old discussion of trends in clinical reasoning. No research has been conducted which highlights a more superior way by which medical trainees should be taught how to reason clinically. Despite its recognised importance there appears to be a lack of research which documents the formal training on making diagnoses within the medical undergraduate curriculum (Kempainen et al., 2003; Mehdizadeh, 2011). Despite its centrality to clinical practice, diagnostic decision making remains a conundrum to those who teach and assess it (Charlin, 2012).

B1.4.1 How Could it be Improved?

By asking medical trainees to voice their thoughts during problem solving or making a diagnosis, their DDM can be assessed and feedback can be given on this (Pinnock & Welch, 2014). Furthermore, teaching learners in this manner may alleviate some of the issues highlighted by Kempainen et al. (2003) that, despite noticing they have made a mistake, learners may not understand the causes behind their error. Kassirer (2010) supports the active role of the learner and places emphasis on asking the learner why they performed the DDM the way they did and what they learnt from the experience. From their review of the literature on diagnostic reasoning errors and reflective practice, Mamede et al. (2007) suggest that enhancing reflective practice may lead to reductions in diagnostic error. Transferred to a learning context, this could promote the approaches identified by both Pinnock and Welch (2014) and Kassirer (2010). Furthermore, Boud (2012) also identifies with the need for learners to be involved in the feedback process rather than playing a passive role.

B1.4.2 Feedback

In support of the role of feedback in teaching and helping to improve DDM, Graber and colleagues investigated interventions which aimed to reduce the likelihood of cognitive errors in DDM (Graber et al., 2012). Feedback was a large component within interventions aiming to increase knowledge and experience. Furthermore, feedback was utilised in studies aiming to increase decision making and encouraging individuals to get help (Graber et al., 2012). As such, it is evident that feedback plays a large role in interventions aiming to reduce diagnostic error. In her review, Mehdizadeh (2011) revealed that despite the lack of consensus on the best way to teach clinical decision making, feedback was deemed universally important. It has also been suggested that recognising and discussing learner's errors in judgement, information and reasoning immediately will strengthen their clinical memory and reasoning strategy (Kassirer, 2010). Despite the lack of consensus regarding how best to teach making a diagnosis there is general agreement that immediate, specific and constructive feedback is a key strategy in teaching DDM and is essential in aiding the remediation of diagnostic errors (Lin, 2012; Croskerry & Nimmo, 2011; Rencic, 2011; Elstein et al., 1993; Bowen, 2006). This is important since repeated errors may occur in trainees' decision making if they are not provided with effective feedback during the acquisition of this skill (Croskerry, 2002).

Research into DDM suggests that medical students struggle with making a diagnosis and asking for help (McGregor et al., 2012). Indeed, remediation strategies to improve clinical reasoning have used feedback amongst other techniques to effectively improve (Chou et al., 2008; Faustinella et al., 2004). However, despite the emphasis on workplace learning, reports suggest that trainees are rarely provided with feedback which is based on actual observation of their interactions with patients (Hauer et al., 2008; Dudek et al., 2005; Howley & Wilson, 2004). Such findings reiterate the importance of providing trainees with effective feedback on their decision making in authentic clinical settings. It is likely that supervised practice with effective feedback will assist medical trainees in becoming competent diagnostic decision makers (Pinnock & Welch, 2014). Thus, it appears that a greater focus on feedback on learners' DDM is required to assist their acquisition and improvement. There is a lack of research which addresses the complexity of decision making and the influence of

contextual factors, and how these are addressed in training. It is possible that feedback on these factors may help the medical trainee learn how to deal with these elements when making diagnostic decisions in authentic clinical settings.

B1.5 Conclusion

It is evident that DDM is an important skill used daily by clinicians. Consequently, it is important that medical trainees are taught how to make effective diagnostic decisions and to recognise when their DDM is not optimal. The literature paints a bewildering picture of different terms used to represent DDM, notably decision making and clinical reasoning and how these skills are taught in medical schools. For ease of reading and relevance, the research presented here has only focused on a small section of the clinical reasoning and decision making literature. A review which investigated doctors clinical decision making using theory to assess how it is taught, found that there is no clear 'gold standard' method of teaching students how to make diagnostic decisions, especially in authentic contexts (Mehdizadeh, 2011). Despite this, it is apparent that feedback on DDM is a key strategy for both teaching and improving performance. Furthermore, it is likely that learners are influenced by contextual factors within authentic clinical settings and that these are unlikely to be taken into account in training or feedback provision. Building on this, the next phase of my EDR will explore in greater detail, the role of feedback in improving performance and how feedback is given in clinical medical education after DDM.

CHAPTER B2: FEEDBACK

Feedback appears to be vital in teaching the skill of DDM. Feedback on DDM is important since it helps the learner to understand where they may have gone wrong and how they can improve for the future. In this chapter, the discussion around feedback is contextualised in relation to the importance of feedback within general education. A narrative review was conducted to investigate what constitutes effective feedback and the importance of feedback within education. The most salient theories and models of feedback are described in more detail and important characteristics of feedback provision are outlined. The importance of feedback as an element of teaching within medical education is then discussed. This review of the literature has strengthened my understanding of the importance and role of feedback and aided the formulisation of the problem for my EDR.

B2.1 Defining Feedback

What is feedback? The term 'feedback' possesses multiple definitions. Importantly, feedback given to a learner should be non-judgemental, non-evaluative, reinforce positive actions, guide future learning and identify and correct areas for improvement (Gigante, et al., 2011; Wood 2000). The main function of feedback has been viewed as reducing the discrepancy between an individual's current level and an ideal or goal level of understanding or performance (Hattie & Timperley, 2007). A similar definition exists specifically to define feedback in clinical education: "specific information about the comparison between a trainee's observed performance and a standard, given with the intent to improve the trainee's performance" (van de Ridder et al., 2008, p.189). In addition, definitions such as that adopted by Butler and Winne (1995) have also incorporated the role of the learner and their cognition. Furthermore, more recent research places emphasis on the role of the student in the feedback they receive (Murdoch Eaton, 2012; Murdoch Eaton & Sargeant, 2012) and as an elicitor of feedback for improvement rather than as a passive recipient of feedback. From this viewpoint, feedback is a process which involves the student rather than something *done* to them (Boud & Molloy, 2013).

A number of seminal articles conclude that feedback in education is a crucial factor in facilitating improved performance, knowledge and skill acquisition and is a motivational factor for learning (Hattie & Timperly 2007; Narciss, 2004; Robins et al., 1997; Kluger & DeNisi, 1996; Azevedo & Bernard 1995; Bangert-Drowns et al., 1991). Unsurprisingly, feedback is viewed as "one of the more instructionally powerful and least understood features in instructional design" (Cohen, 1985, p.33). Despite its importance there is little consensus regarding what constitutes the most 'effective' feedback. Studies show great variability in the effectiveness of feedback on subsequent performance, suggesting that certain forms of feedback are more powerful than others (Hattie & Timperley, 2007). Effective feedback is seen as that which assists students in developing their own insights into their learning and helping them to become self-critical and self-directed (Wiliam, 2011; Gipps et al., 2000). A narrative review was conducted in order to better understand what constitutes effective feedback

within general education. The background and results from the narrative review are discussed in Chapter B2.2, but the method and analysis section can be found in Appendix 1.1 and 1.2.

B2.2 Effective Methods of Giving Feedback

A preliminary search of relevant databases for research on feedback has revealed the vastness of the literature. There have been thousands of articles published across numerous research domains which range from assessing how effective feedback is to what specific elements of the feedback are effective. The studies range in diversity from language acquisition, to teaching disabled children, to training teachers. Furthermore, many of the articles are systematic or meta-analytic reviews and have thus already made an attempt to synthesize the literature. Consequently, I completed a narrative synthesis of the main meta-analyses and systematic reviews in order to understand what the most effective methods are for providing learners with feedback on their performance within education generally. The narrative review allowed for the compilation of information from the vast number of reports on feedback in general education (Green et al., 2006). Due to disparities between the studies it was not feasible to conduct a systematic review on this literature. There are no rigid published guidelines stating what should be included in a narrative review (Green et al., 2006) and consequently, they may be criticised for being biased and unsystematic in their selection and analysis of the literature (Green et al., 2006; Slavin, 1995). However, to overcome these issues and in line with Green and colleagues' (Green et al., 2006) suggestions for a successful narrative review, it was well structured and adopted a systematic search strategy in order to synthesise the evidence. This synthesis was undertaken with the aim of providing a basis for my understanding of the role of feedback within education, to elucidate what feedback is effective and help me to develop my conceptual model of more effective feedback provision after DDM.

B2.2.1 Aims and Objectives of the Review

This review aimed to examine the feedback literature to gain an understanding of what constitutes effective feedback within education, based upon findings from previous meta-analyses and systematic reviews. The review had the following objectives:

- To gain a preliminary understanding of the most and least effective characteristics of feedback.
- To identify contexts and areas of learning where feedback has been shown to be effective.
- To highlight the major reviews into feedback

B2.2.2 Findings: Identifying the Most Effective and Least Effective Characteristics of Feedback.

The data from the reviews fell into four distinct areas of feedback, with more specific characteristics of feedback within each area also being identified. The main themes drawn from the 62 articles retrieved were: (1) the focus of the feedback, (2) the style of the feedback, (3) the feedback providers' approach to feedback provision and (4) factors within the learner that need to be taken into account. Additionally, throughout the retrieved articles a number of key messages and findings stood out:

- Key features of effective feedback are often described in slightly different ways and sometimes the findings appear to be contradictory.
- There is an apparent trend in more recent years for feedback to actively involve the learner rather than them being a passive receiver of the feedback.

The most and least effective characteristics of feedback extracted from the studies for each of the four themes are outlined below and can be found in more detail in Appendix 1.3.

Feedback Focus

The reviews suggest that the most effective feedback will be corrective, have a specific focus, elaborate on the point the feedback is making, focus on the task itself and focus on the learners' use of processes and goal setting. The feedback focus should also demonstrate the gap between the current level of performance and their desired level, and strike a balance between positive and negative feedback. Feedback should avoid focusing on solely positive or solely negative comments, comparing the learner with a norm value (comparison with others), providing grades, not informing the learner why they were or were not successful, and using extrinsic rewards.

The Style of the Feedback

The reviews suggest that to be most effective the style of the feedback should be individualised, detailed and clear, it should be of a high quality and be provided as soon as possible. It could be written, verbal or videotaped, and should include advice for improvement which can be utilised in the near future. The feedback should be provided as a standalone feedback session rather than as part of another intervention or strategy. The feedback style should not be discouraging, personal or evaluative.

Approach to how Feedback is Provided

The reviews suggest that to be most effective the approach to providing feedback should be on directly observed behaviour (if appropriate), actively involve the learner, promote learning goal orientation, encourage learner self-assessment, self-monitoring and self-reflection. The feedback should be provided often and from a credible source, it should be referenced to the task and used in situations where the learner can use the feedback to improve future performance.

Factors within the Individual

According to the reviews, effective feedback should take various factors within the learner into account such as their emotional state, their self-efficacy, self-concept, motivation and calibration accuracy as well as the learners' attributions of success and failure. The timing of the feedback may be influenced by the task type and learner style. For example, immediate feedback is better for difficult tasks and delayed feedback after more simple tasks. That the feedback fits in with the learners' learning orientation (learner or performance) and that they also perceive a change is necessary will influence how well the feedback is received. In contrast, feedback which does not take learner individual differences into account or allows the learner to play a passive role is likely to be less effective. Feedback is also less effective if it focuses on the learner's self-concept or threatens their ego.

B2.2.3 Findings: Feedback in Different Areas of Learning

A number of the articles retrieved in the narrative review provided data on the effectiveness of feedback on various disciplines (Appendix 1.3.5). Amongst others, these included: general academic performance (Pehlps, 2012; Beesley & Apthorp, 2010; Smither et al., 2005; Skiba, 1986), specific areas of academic performance (Hatala, et al., 2014; McGaghie et al., 2009; Smith et al., 2007; Baker et al., 2002; Huebusch & Lloyd, 1998), language acquisition (Kao, 2013; Li, 2010; Lyster & Saito, 2010) and children's behavioural problems (Getsie et al., 1985). These wide-ranging effects of feedback further demonstrate its' usefulness in education and other settings.

B2.2.4 Findings: Major Reviews into Feedback

It is important to note that a number of the publications retrieved were major articles on feedback. These articles have been seminal in paving the way for the recognised importance of feedback after performance and the proposed characteristics of this feedback. A number of these reviews used their findings to develop preliminary theories or models of feedback. These models either explain the process of learning and feedback or which feedback strategies are most effective (for example, Hattie & Timperley, 2007; Kluger & DeNisi, 1996; Turnstall & Gipps, 1996; Bangret-Drowns et al., 1991). Other articles provide suggestions for how feedback should be provided (Sadler, 1989). These

theories and models offer separate propositions for feedback provision. However, they can be seen to be interrelated since some models and theories employ the findings of previous articles and other theories. The most informative theories and models are summarised in Table B2.1. Two approaches to feedback provision appeared to be more salient for this current research in determining how to provide effective feedback and are discussed in greater detail. These were Butler and Winne's (1995) focus on the role of self-regulated learning in feedback and Hattie and Timperley's (1997) focus on four proposed levels of feedback.

Authors	Summary of Model, Theory or Research
Kulhavy (1977)	Viewed feedbacks main role to be in correcting errors. Concluded that feedback is likely to be effective if it confirms correct responses or identifies and corrects errors. Feedback is likely to be less effective if the learner has access to the feedback material (correct answer) before they respond (as they may copy) or if the material is hard as they are likely to spend more time guessing the answer than associating the feedback with the answer (Kulhavy, 1977).
Kulhavy and Stock (1989)	Believed that feedback would be most effective if the individual was very confident they were correct but later found out that they were wrong. This is since learners are more likely to study the incorrect item for longer to correct their error. Feedback is less likely to be effective if the individual was not confident in their response and the response is wrong. This is since in these situations the low confidence means the student is more likely to require instruction in new strategies and learning structures rather than integrating new information into their existing structure and use of strategies (Kulhavy, 1977).
Schimmel (1983)	Compared correct feedback and confirmation feedback. The amount of information in the feedback (eg. the complexity of the feedback) did not influence how effective the feedback was. Any feedback was more effective than no feedback at all. Immediate feedback was more effective than delayed feedback. Concluded that feedbacks effectiveness is more likely to be caused by the characteristics of the instructional content within the feedback, rather than the feedback itself.
Kulik and Kulik (1988)	Investigated the timing of feedback. Delayed feedback was effective in situations where the learners were required to learn test content or lists and were then provided with feedback which would repeat the stimulus word. These tasks were more likely to encourage memorization and the delayed feedback acted as a second stimulus exposure. In contrast, for tasks with a higher cognitive demand such as list learning where the feedback did not repeat the stimulus word or in more authentic applied learning, immediate feedback was superior.
Sadler (1989)	Suggested that students must be involved in their own feedback. Students should be taught or helped to develop skills to enable them to evaluate the quality of their performance, in particular during the task itself. This involves a focus on student self-monitoring rather than a sole reliance on external teacher feedback. This skill requires students to be able to meet three conditions: (1) to understand what constitutes the high quality work being aimed for (ideal level of performance), (2) be able to compare their own work against this level and (3) employ action or strategies to close the gap between the desired level of performance and their current level. Students must be provided with the opportunities to acquire their own evaluative expertise via direct and authentic evaluative experience to achieve the three conditions.

Bangert-Drowns, Kulik, Kulik and Morgan (1991)	In order to be effective, feedback must be received mindfully by the learner. Feedback which encourages mindlessness it is more likely to inhibit learning; this is more likely if the feedback does not meet the learners' cognitive needs or if the information or correct answer is made available before or during performance Learners must be able to monitor and adapt to changes brought about by their behaviour; they must adapt to new information in order to match the results of their performance to their performance expectations. A five stage model describes the learner as they move through a cycle of feedback: (1) their current state (degree of interest, goal orientation, self-efficacy and prior knowledge), (2) search and retrieval strategies are then activated by the question or task to be performed, (3) a response is made to the question or performance, (4) the learner evaluates their response or performance in view of the feedback. This evaluation is influenced by the learner's expectations of their performance and the feedback and (5) the learner makes adjustments to their goals, interest in the task, self-efficacy and relevant knowledge based upon the feedback. These adjustments then lead into the next cycle beginning at 1.
Kluger and DeNisi (1996)	Developed the preliminary Feedback Intervention Theory (FIT) based on their meta-analysis on the reported effects of feedback interventions on performance. Numerous moderators such as task novelty and complexity, verbal or written feedback, praise, time constraints and the types of the tasks themselves. FIT is based on the proposition that feedback interventions work to change the leaners' locus of attention between three different levels of control: task-learning, task-motivation and meta-task processes (Kluger & DeNisi, 1996). The lower down the hierarchy the learner is induced to focus their attention there is an increased benefit for the feedback intervention on performance.A focus on the task itself and aspects of the task will promote greater learning and subsequent achievement than feedback which focuses on the self. FIT contains five basic premises: (a) behaviour is regulated by comparisons of feedback to goals or standards, (b) goals or standards are organized hierarchically, (c) attention is limited and therefore the learner can only actively participate in behaviour regulation for discrepancies between actual and desired performance that receive attention, (d) attention is normally directed to a moderate level of the hierarchy and (e) Feedback interventions (FI) change the locus of attention and therefore affect behaviour . Variables which enhance the FIs include: (1), correct response feedback, (2), FIs which include goal-setting, (3) FIs have a greater impact on performance in cognitive tasks compared to physical tasks, (4) feedback which tells the learner how they have changed from previous assessments (velocity feedback), (5) the provision of frequent messages or information, (6) FIs have a greater effect on memory tasks compared to procedural tasks, (7) computerized FIs showed stronger effects than non-computerised FIs and (8) FIs for simple tasks are more effective than for complex tasks. Variables which attenuate the effect of the FI include: (9) feedback which is discouraging, (10) praise, (11), feedback which threatens the leaners' self-esteem and (12) verbally provided feedback. Of 607 effect sizes studied, over a third of these showed that the feedback intervention decreased performance.

Turnstall and Gipps (1996)	Identified and developed a typology of feedback that was given to children under 10 years old. Identified four types of feedback which could be used for positive or negative feedback, each of which were used by every teacher at some point. These types include: (A) rewarding/punishments, (B) approving/disapproving, (C) specifying attainment/improvement and (D) constructing achievement/the way forward. Types A and B can be viewed as self-focused feedback and could lead to a performance goal-orientation. Turnstall and Gipps (1996) viewed type C as leading to mastery goal orientation and type D as being learning-oriented and encouraging self-regulating strategies. Feedback which specified attainment/improvement and constructed achievement, or showed the learner the way forward were viewed as being the most useful and effective.
Black and Wiliam (1998)	Answered yes to these three questions: (1) Is there evidence that standards can be raised by improving formative assessment? (2) Is there evidence that these can be improved? (3) Is there evidence about how formative assessment can be improved? Showing that formative assessment can lead to improved performance and that the assessments themselves can be improved. Suggest that formative assessment could be improved with a focus on learner self-assessment, using meaningful assessments and involving the learner in a dialogue focused around their performance in order to evoke and explore their understanding. Students should be given guidance on how to improve and given opportunities to work on the improvement.
Mason and Bruning (2001)	Developed a theoretical framework to aid others in developing their own computer-based feedback tools. Suggested that the effectiveness of computer based feedback is dependent on the timing of the feedback and the level of the learner. Struggling students benefit more from immediate feedback where and more competent students benefit from delayed feedback. Prior knowledge influences the type of feedback provided: Low level of prior knowledge elicits feedback which is correct response and response contingent- this provides a focus on the learner's specific response and may describe why it is correct or incorrect (Shute, 2008). High level of prior knowledge elicits feedback which is correct response (but not for high achieving students) and topic contingent – this provides the learner with information that relates to the topic or information currently under study (Shute, 2008).
Narciss and Huth (2004)	Designed a conceptual model of formative feedback (feedback provided after formative testing). Three factors interact with feedback and influence learning. Within each of these three factors there are three main elements: (1) Feedback; the content of the feedback, how the feedback is presented and the level of function of the feedback: (2) Instruction; the learning tasks, the errors made and the objectives of the instruction: (3) The learner; the learner's prior knowledge, skills and abilities, the learner's objectives and goals and the learner's motivation to do well. Suggest that these three factors of the feedback message should be adapted to fit in with the instructional goals and learner characteristics. To generate effective formative feedback the educator should: identify learning tasks, match the feedback to learning outcomes, select and specify learning objectives and provide specific information which addresses the learners' mistakes or errors.

Nicol and Macfarlane-Dick (2006)	Propose a model of good feedback practice which builds on Butler and Winne's (1995) focus on building a close relationship between self-regulation and feedback. They consider all learners to be self-regulated to an extent and that good feedback will aid learners' self-regulatory approach and empower them to become more self-regulated learners. Approach to using feedback to address self-regulation focuses more on using feedback to aid the learner's self-regulation of their own performance in terms of motivation, knowing how good performance is, self-reflection and further practice. This contrasts with a focus on feedback on the learner's self-regulatory strategies themselves e.g. the learner's goal setting and planning, their self-observation and their confidence. List seven principles of good feedback practice which support learner's self-regulation: (1) clarify what good performance is, (2) facilitate self-assessment, (3) deliver high quality feedback information, (4) encourage teacher and peer dialogue, (5) encourage positive motivation and self-esteem, (6) provide opportunities to close the gap and (7) use feedback to improve teaching. This requires the redevelopment and redesign of educational modules, how they are taught and how learners are assessed rather than simply adapting the feedback provided. This supports the view of the learner becoming more proactive in generating and using feedback to improve performance intends to aid the learner in developing their own skills without a reliance on external feedback.

Table B2.1. A summary of the main theories and models of feedback.

Hattie and Timperley's (2007) meta-analysis outlines the importance of the focus (or level) of the feedback provided to learners. Hattie and Timperley (2007) claim that feedback is focused at four different levels: the self, the task, the processes employed and learners' self-regulated learning. A detailed synthesis of 74 meta-analyses from an earlier database (Hattie, 2009) showed that the most effective feedback provides cues or reinforcement to the learner and focuses on their goals. Feedback related to rewards, punishment and praise were least effective for improving performance. They postulate that self-level feedback is the least useful style of feedback; a claim which is largely supported by the literature (Hattie & Timperley, 2007; Kluger & DeNisi, 1998; Wilkinson, 1982). Feedback at the level of the self is feedback which praises or criticises the individual (Hattie & Timperley, 2007). It provides little information about what the individual did right or wrong or how they can improve. It may also encourage learners to view task performance as fixed, with improvement beyond their control. Such a view is less likely to motivate the learner for future performance. However, positive self-level feedback when provided in addition to higher levels of feedback may be advantageous for improving the learners' motivation and self-efficacy (Manzone et al., 2014). Hattie and Timperley (2007) advise that to be most effective, feedback must focus on the processes associated with the task and/or the learner's self-regulated learning. Feedback at the level of the task focuses on informing the learner of what they did right, or wrong in that task or performance. Task level feedback is most effective if it corrects misconceptions about the task rather than just focusing on incorrect knowledge (Hattie & Timperley, 2007). Feedback at the task level may include a focus on telling the learner what they need to improve in simple terms but is limited in its transfer to other learning situations since it is specific to that task (Brookhart, 2008). Feedback at the level of the processes employed provides the learner with specific information regarding how they approached the task, which highlights the relationship between what they did and how well they performed. As well as information about what different processes or techniques they could employ to improve (Brookhart, 2008; Hattie & Timperley, 2007). Specifically, it encourages a focus on using processes and techniques to check their work, recognise mistakes, and to correct their own errors (Brookhart, 2008). Feedback at the level of self-regulation provides the learner with feedback about their self-regulation and use of self-regulated learning strategies. Learners employ self-regulation strategies to help them set effective goals, adopt task-specific processes to achieve strategic plans and

self-monitor their performance through the task. This feedback encourages the learner to self-monitor their performance and develop the skill of creating their own accurate internal feedback. It also assists them in integrating external feedback into their internal feedback and using it to guide future task completion or performance (Brookhart, 2008; Hattie & Timperley, 2007; Butler & Winne, 1995). Individuals who are self-regulated are more comfortable in creating internal feedback, assessing when they need external feedback and employing techniques to get this feedback (Butler & Winne, 1995). These learners are likely to be more confident and have high self-efficacy (Brookhart, 2008). Feedback on one's self-regulation should also encourage task success or failure to be attributed to a specific cause or reason that can be rectified (Brookhart, 2008). Self-regulated feedback is effective if it can encourage self-regulated behaviours and enhance self-efficacy.

B2.2.5 Self-regulated learning and feedback

Self-regulated feedback focused on learners' self-regulated learning (SRL) is a three-phase cyclical process during which individuals proactively plan and use feedback to ensure that their chosen goals are met (Zimmerman, 2000). From a social-cognitive perspective, SRL involves the cyclical adaption of one's thoughts, feelings and behaviours to achieve their goals (Zimmerman, 1989). Self-regulation can be broadly defined as the processes used by learners to guide their goal-driven activities by managing and controlling their behaviour, affect and cognition (Sitzmann & Ely, 2011). Learner's thoughts, feelings and actions are regulated in order to achieve their goals. The cyclical feedback loop consists of three phases: forethought phase (processes before any efforts to learn or perform: goal setting, strategic planning, self-efficacy), performance phase (processes during learning or performance: self-monitoring, employ task strategies and attention focusing) and a self-reflection phase (processes after learning or performance: self-evaluation, self-reflection) (Zimmerman, 2000). The SRL perspective suggests that there are differences in the components of the cyclical phases of SRL between high and low performers. Poor performers will tend to have low levels of interest in the topic or task, low levels of self-confidence, maladaptive motivational beliefs (such as blaming poor performance on factors out of their control) and various SRL deficits such as poor strategic planning, goal setting, ineffective self-monitoring, poor self-reflection and infrequent use of

appropriate strategies or techniques (Cleary & Zimmerman, 2001; Butler, 1998). In contrast, experts and high performers are more likely to report engaging in SRL processes in each phase of the cyclical model (Cleary & Sandars, 2011; Kitsantas & Zimmerman, 2002; Cleary & Zimmerman, 2001). Self-regulated individuals are more likely to focus and set goals pertaining to the specific processes they need to follow or employ to achieve an end goal. In contrast, poor self-regulated learners are less likely to be as strategic in their planning and goal setting, and are more likely to focus on task general approaches to achieving their goal, and set goals focused on achieving an end outcome of performance. An important aspect is that training participants to use these specific SRL processes has been shown to increase athletic and academic performance (Cleary & Zimmerman, 2006; Cleary & Zimmerman, 2004). If improving SRL has led to improved performance it stands to reason that providing feedback on a learner's SRL would help to improve their self-regulation and performance.

Research which has used SRL to assess and improve performance has successfully utilised a microanalytic framework to distinguish between high and low performers (Cleary & Zimmerman, 2001). This procedure involves asking the learner questions about specific SRL processes as they engage in the task or activity of interest (Cleary, 2011). An advantage of using these measures is that they are customized to particular tasks or activities and involve the use of context specific questions to target the various processes at each phase of the cyclical SRL model. The approach attempts to assess how the learner approaches, executes and reflects during specific tasks or events and does this by using a variant of 'think-aloud protocols'. Here, learners are asked open-ended questions before, during and after their performance. This process directly targets the key SRL cyclical processes (goal setting, strategic planning, self-monitoring, strategy use, self-evaluation and causal attributions) (Cleary & Zimmerman, 2004). This approach would be useful for giving feedback on SRL but may not be feasible in all learning environments. There is little research which has actively investigated how feedback can be provided on SRL in authentic learning environments. Educators desire training in SRL processes and agree that such processes are significant determinants of learner success; however, they often do not receive training with this focus (Cleary & Zimmerman, 2006; Wehmeyer et al., 2000). Educators are often not equipped to determine how students approach and perform

learning tasks in authentic settings. They are also likely to lack the appropriate skills and knowledge to provide effective SRL feedback and instruction (Peters-Burton et al., 2015). According to Peters-Burton et al. (2015) few professional development courses focus on the SRL and motivation of the teachers themselves.

Butler and Winne (1995) have also focused on the relationship between self-regulated learning and feedback. Their detailed review of the role of self-regulated learning concludes that research on effective feedback should be tightly coupled with learners' self-regulated learning processes. Butler and Winne (1995) believe that viewing feedback solely in terms of the information it provides to learners is too simplistic. Rather, they adopt a more learner-centred approach by stating that a learner's pre-existing belief systems influence how they generate their own internal feedback and process externally provided feedback. Here, feedback provided by a teacher or supervisor is received as additional feedback to the learner's internally provided feedback. Thus, this feedback may add to, confirm or conflict with that internal feedback. How external feedback is received will evidently influence its use. Performance therefore is likely to be influenced by the quality of the internal feedback the learner generates and the external feedback they are provided with. Butler and Winne (1995), argue that, "self-regulated learning is inherent in knowledge construction-learning" (Butler & Winne, 1995, p. 275), however it may not always be carried out well. Self-monitoring is key to effective self-regulation during a task and refers to the individual self-observing their behaviours or performance throughout a task. Self-monitoring creates internal feedback which is vital to influencing the learner's engagement with a task. In addition to this, Butler and Winne (1995) recognise that feedback interacts with other information to influence learner's belief and knowledge about the learning tasks, processes and their performance. Consequently, feedback information is not received in a vacuum, rather feedback is information which the learner can add to, reject, confirm or restructure to ultimately decide if and how they will use that information (Butler & Winne, 1995). This is influenced by a learner's knowledge, beliefs and thinking. Ultimately, Butler and Winne (1995) are stepping away from the idea of the passive learner in receiving feedback and are recognising the role the learner plays in receiving and acting upon the feedback. Externally provided feedback is seen

as essential to self-regulation since it provides the learner with information required to make adaptive changes to the key self-regulation processes they employed (Butler & Winne, 1995). Feedback assists the learner in developing the processes required for effective self-regulation such as goal setting, task selection, self-monitoring and the employment of strategies to progress learning. In support of the role of self-monitoring in performance improvement, learning tends to improve when the feedback informs the learner about their own monitoring of their learning needs and assists them in how to reach their learning goals (Butler & Winne, 1995).

B2.3 Factors to Address When Providing Feedback

The literature on feedback identified a number of key factors that need to be taken into consideration when providing the learner with feedback. A number of these factors refer to how feedback should be provided (and why this is important) whereas others discuss how the environment, learning task, or the learner themselves may influence what style or focus of feedback is most effective.

B2.3.1 Confidence, Self-Efficacy and Calibration Accuracy

Confidence and self-efficacy are integral to performing everyday skills and tasks (Maddux, 2002). Such perceptions of one's self can influence performance, the desire to learn and the receptiveness to improve. Self-efficacy is defined as "beliefs in one's capabilities to organize and execute the courses of action required to provide given attainments" (Bandura, 1997, p.3). Self-efficacy has been shown to be a significant predictor of ones' behaviour and actions. If an individual has low self-efficacy they are likely to have less belief in their ability to achieve a task, are more likely to approach a task with apprehension and are less likely to attempt harder tasks (Maddux, 2000). Individuals with higher levels of self-efficacy perceive successful task completion as dependent on their effort and persistence with a task, and frequently choose more difficult tasks (VandeWalle et al., 1999; Dweck & Leggett, 1988).

Confidence in one's knowledge and beliefs can influence the decisions that are made (Griffin & Tversky, 1992). Indeed, overconfidence has been suggested as one of the main causes of diagnostic

error in the clinical setting (Berner & Graber, 2008). Overconfident learners are more likely to fail to identify when they are incorrect and should be employing new strategies to achieve their goals (Hadwin & Webster, 2013). To date, it appears that learner's confidence and self-efficacy play a small to non-existent role in influencing the feedback they receive.

Learners' ability to accurately predict their level of performance in relation to their confidence is referred to as calibration accuracy (Nietfield et al., 2006). Learner's ratings of their confidence judgements are compared to their actual performance to measure their calibration accuracy (Nietfield et al., 2006). Individuals who are highly calibrated will have a strong correlation between their perception of their performance and their actual level of performance, whereas those who are poorly calibrated will have a weaker correlation (Nietfield et al., 2006). Poorly calibrated learners may struggle to recognise when they have underperformed and the impact of their confidence on performance.

In terms of confidence of their performance, higher performing students tend to underestimate their abilities whereas poorer performing students are more likely to over-estimate their abilities (Edwards et al., 2003; Haun et al., 2000). Thus, poorer performing students are likely to be more confident that they are performing at a higher standard. This is known as the Dunning-Kruger effect (Kruger & Dunning, 1999) and postulates that those who are less skilled are more likely to over-estimate their own abilities. These individuals do not know what they do not know (Kruger & Dunning, 1999) and consequently lack the ability to accurately judge their own skilled performance and level of knowledge (Kruger & Dunning, 1999).

Confidence can be central to performance in clinical settings. A student with adequate knowledge may underperform in certain situations solely due to a lack of self-confidence and self-efficacy in their abilities (Pajares & Kranzler, 1995; Bandura, 1986). Consequently, it appears imperative that feedback takes confidence, calibration, and self-efficacy into consideration when assessing performance and providing effective and relevant feedback. Interestingly, research has demonstrated

that receiving more elaborative feedback can promote self-efficacy and receiving correct response feedback improved performance (Wang & Wu, 2008). Most often feedback provision to medical students does not appear to take these factors into account, however Wang and Wu (2008) provides some confidence that it can be addressed. More recent research (Eva et al., 2012) is beginning to focus on such individual learner characteristics in feedback. However, it is not evident that this focus has translated into practice in clinical education.

B2.3.2 Verbal vs. Written Feedback

The prevalence of verbal and written feedback is likely to depend on the focus of the feedback and the setting in which it is provided. With regards to clinical medical education, feedback in authentic clinical settings is more likely to be verbal. Audit and feedback in medical practice is effective in both verbal and written formats (Jamtvedt et al., 2012). Furthermore, research demonstrated that there was no difference between the effectiveness of verbal or written feedback to internal medical residents on their community clinic performance (Elnicki et al., 1998). Other research suggests that there is a difference in the effectiveness of verbal and written feedback. Specifically, verbal feedback may be more detailed, clear and informative compared to written feedback (Nesbitt et al.,2014). This seems valid given the time commitment required to produce detailed written feedback. Furthermore, some concepts or inaccuracies are better explained verbally rather than written. There is a dispute within the literature over the effectiveness of written feedback. It is possible that this is influenced by the work or performance the feedback is referring too. One important issue is that students may be less likely to recognise verbal feedback as feedback (Gibbs et al., 2003) as it is more likely to occur as part of the student-teacher interaction, rather than be signposted as feedback.

B2.3.3 Immediate vs. Delayed Feedback

Feedback can be provided immediately after a task, or after a delay. Delayed feedback can be hours, weeks or months after the task (Keiding & Qvortrup, 2014). Delayed feedback runs the risk of the learner forgetting crucial task information and thus failing to link the feedback to their performance.

However, immediate feedback does not allow the learner time to reflect on their performance and analyse what they may need to do to improve. There is a wealth of contradictory research which provides support for the advantages of both immediate and delayed feedback (Kluger & DeNisi, 1996; Azevedo & Bernard, 1995; Kulik & Kulik, 1988). In support of delayed feedback, learners receiving delayed feedback had superior final assessment performance compared to learners who had read a passage, answered questions and were given immediate feedback (Butler et al., 2007). In support of immediate feedback Kulik and Kulik (1988) found that it was more effective than delayed feedback in applied studies set in classrooms. Additionally, a meta-analysis by van der Kleij et al. (2015) showed a negative effect of delaying feedback on students' learning outcomes. Furthermore, Papa et al. (1999) also showed that medical students benefited from immediate feedback after DDM on a computer program.

Such findings lead to the conclusion that the effectiveness of the timing of feedback is likely to be influenced by the learner and the task. Shute (2008) provides the most recent synthesis of research on timing and learner factors. From the literature she concludes that immediate feedback is more effective for low-achieving learners (Mason & Bruning, 2001; Gaynor, 1981; Roper, 1977), after difficult tasks (Clariana, 1990; Knoblauch & Brannon, 1981) and when the educator wants to encourage the retention of conceptual or procedural knowledge (Dihoff et al., 2003; Azevedo & Bernard, 1995; Corbett & Anderson, 2001). Delayed feedback is more effective for high achieving students (Gaynor, 1981; Roper, 1977), after simple tasks (Clariana, 1990; Corno & Snow, 1986) and when the educator wishes to encourage the transfer of learning (Schroth , 1992 Kulhavy et al., 1985). Interestingly, Keiding and Qvortrup (2014) argue that it does not matter whether the feedback is immediate or delayed. What is relevant is that the learner "has access to the relevant information at a time that fits the learning process" (Keiding & Qvortrup, 2014, p. 200).

B2.3.4 Norm vs. Self-referenced Feedback

Research has debated the influence of the focus of feedback. Norm-referenced feedback refers to comparing the learner's score or performance with their peers, ie. they are rated against other peers

and are not provided with any information about how to improve (Brookhart, 2008). It is generally recognised that norm-referenced feedback is the least effective at improving performance. Norm-referenced feedback is particularly detrimental for under-performing students who are compared to higher achievers. These individuals are likely to attribute their poor performance to a lack of ability and may be less motivated in the task in the future (Kluger & DeNisi, 1996). Self-referenced feedback refers to feedback which compares the learner with their own level of ability as assessed by another measure (McColskey & Leary, 1985). McColskey and Leary (1985) found that learners who were provided with self-referenced feedback were more likely to attribute any success to their effort and had higher expectancies of their own future performance, compared to those who were provided with norm-referenced feedback. Feedback can also influence the learners' learning orientation. Norm-referenced feedback was more likely to encourage the learners to become more performance orientated (a desire to show improved performance in order to show off superior skills to peers), whereas self-referenced feedback was more likely to increase the learners' interest in the course (Shin & Dickson, 2010). Not all research however supports this assertion. However, as suggested by Natriello (1987) all students can improve some aspect of their performance in relation to previous accomplishments but some students will always perform more poorly than others. Consequently, all students can benefit from self-referenced feedback whereas the top performers are more likely to benefit from norm-referenced feedback (Natriello, 1987). Feedback therefore, should avoid comparing a learner's performance with their peers and employ self-referenced feedback instead.

B2.3.5 Positive vs. Negative Feedback

The reference to feedback as positive or negative relates back to research conducted in the 1950s and 1960s on feedback from a behavioural standpoint which viewed behaviour as eliciting either a positive or negative reward (Deci et al., 1999). Positive rewards would encourage the same behaviour to occur again whereas negative rewards (punishments) would reduce the chances of the reoccurrence of the behaviours. In relation to feedback, positive feedback is often viewed as feedback which praises the learner or informs them what they did well and why, and is generally received after good performance.

Negative feedback in contrast can be viewed as feedback which informs the learner that they are not doing as well as they should be doing and is likely to be received after poor performance.

Negative feedback may be detrimental to future performance since it can be threatening to a learner's self-perception, self-confidence and their self-efficacy. It is often proposed that positive feedback leads to a positive emotion and negative feedback leads to a negative emotion. Jarrell et al. (2015) found that those who reported positive emotions after receiving performance feedback had higher performance on diagnostic reasoning cases, where as those who reported negative emotions had the lowest performance. However, only providing the learner with positive feedback leaves them with no information about how to improve. What is required therefore is feedback after poor performance which is constructive in assisting the learner in understanding what they did wrong, why this was wrong and how it can be improved. Constructive feedback is less likely to cause a negative emotional response from the learner. Consequently, it is likely that a balance of both negative and positive feedback, provided in a manner that provides useful information to the learner on how to improve for future performance will be the most effective. This seems practical since no good performance will be without faults and no poor performance will be without something that was done well.

In support of the importance of determining what constitutes useful negative feedback, Cleary et al. (2014) found that if learners are given negative outcome-focused corrective feedback after a first attempt at a task they will tend to employ less strategic or process orientated thinking on their second attempt (this mirrored reductions in self-efficacy). Specifically, the learners were less likely to report effective plans or refer to specific diagnostic reasoning processes. These findings suggest that negative outcome-focused corrective feedback (or task level feedback according to Hattie & Timperley's levels) alone may be detrimental to the strategic planning and thinking of learners. This could have important consequences for how feedback is received, used and its influence on future performance after poor performance. The feedback provided here was simple and outcome focused which did not provide the learner with any information on their use of strategies, planning or self-regulation. Consequently, the findings may lend weight to the argument that, to be effective, negative feedback

should provide a focus on the learner's use of strategies, goals setting, planning and their self-monitoring. Under such circumstances, negative feedback is more likely to be seen as constructive criticism which will assist them in future improvement. Furthermore, Boehler et al. (2006) witnessed improved knot tying skills in learners provided with constructive criticism (negative feedback) compared to general compliments (praise). This feedback was constructive, individualised and specific, and thus it is likely that it was effective since the learners were provided with constructive information they could use to improve.

In general, positive or negative feedback which is not constructive is less likely to lead to improved performance. Kannappan et al. (2012) found no difference in time to task completion on a surgical skills task between those receiving positive feedback and those receiving negative feedback which was nonspecific, judgemental and unhelpful. These findings reiterate the importance of providing learners with feedback which is both positive and negative, and is provided in a constructive, clear manner.

B2.3.6 Reflection

Reflection is the process of giving meaningful thought or consideration, with reference to an event that has occurred or one's performance in a situation or task. "Reflection allows the elements of the experience to be revisited, analysed and integrated into one's existing base of knowledge and understanding, as a basis for further experience" (Sargeant et al., 2009, p. 400). Reflection aids the integration or re-organisation of skills, knowledge, understanding and concepts into existing knowledge or information structures (Branch & Paranjape, 2002). The process of reflection is viewed as enabling learners to evaluate the progress they are making toward their goals and as vital in aiding them to learn effectively from their previous experiences (Bandura, 1986). Reflection can lead to various outcomes such as making plans to change behaviour for future action or preparing the learner for a readiness to act differently in future situations (Sargeant et al., 2008a). Reflection on performance has been shown to have some impact on performance across a variety of educational and work settings (Di Stefano et al., 2014; Carr & Johnson, 2013; Lew & Schmidt, 2011). In the last

decade reflection has begun to be widely used in the medical curricula. Since Branch and Paranjape's (2002) article which postulated that reflection is rarely used in the clinical setting, reflection is a skill now more widely promoted on clinical placements and medical trainees' are asked to keep reflective logs to reflect on their experiences in each placement.

Reflection on performance can provide the learner with important information about their strengths and weaknesses. It can be viewed as a form of internal feedback as learners self-monitor their performance (Archer, 2010; Butler & Winne; Mann et al., 2009; Hattie & Timperley, 2007); this also forms an important element of self-regulated learning (Zimmerman, 1990). A self-regulated individual is more likely to understand why they may have underperformed, thus making them more aware of and more attentive to ways to improve in the future. It is possible that self-reflection on performance before feedback is provided improves how well that feedback is received by the student. Pelgrim and Kramer (2013) suggest that this indicates that students need time to process the feedback before they can assimilate its beneficial factors for learning and future performance.

In addition to reflection on their own performance learners may also reflect on the feedback they are provided with. Reflection on external feedback from a tutor or peer can help the learner to assess, assimilate, accept and ultimately use that feedback in future performance (Sargeant et al., 2009). Learners report a desire for assistance in reflection on their feedback in order to help them interpret the feedback and use it to recognise areas for improvement (Sargeant et al., 2008a). Reflection may be particularly useful after receiving feedback after poor performance (Sargeant et al., 2009) and in difficult consultations (Kjaer et al., 2006) in order to better understand the performance and the feedback given. To promote the usefulness of reflection, Pelgrim et al. (2013) suggests that clinical educators should be trained in utilising learners' reflections in developing an action plan that can then be translated into action in future performance.

B2.3.7 Goal Setting and Planning and Self-Monitoring

Goal setting, strategic planning (using task-specific processes) and self-monitoring are key for effective self-regulated learning, and feedback on these can be viewed as SRL feedback. Providing feedback on these should assist the learner in becoming more self-regulated. In contrast, feedback on the learner as an individual (self-feedback) and feedback on whether or not they performed the task correctly are seen to be less effective forms of feedback, and are less likely to lead to great improvements in performance.

In support of the importance of self-regulation in improved performance, previous research suggests that less able medical students engage in fewer self-regulatory strategies (Cleary & Sandars, 2011). Specifically, this small-scale pilot study suggested that students who were more competent at venepuncture were more strategic in their thinking before, during and after the task. In contrast, poorer performers were more likely to focus solely on the end outcomes they wanted to achieve (Cleary & Sandars, 2011). Building on this, Artino et al. (2014) have more recently explored novice medical students' use of self-regulatory processes during a clinical reasoning task. Their findings suggest that when engaged in a clinical reasoning task, novices are less likely to set themselves goals or develop plans for their reasoning which incorporate key diagnostic reasoning processes or strategies to solve the clinical case. Furthermore, potential support for the importance of employing self-regulatory strategies in clinical reasoning is evidenced since those who developed strategic plans and goals accomplished better outcomes in terms of their clinical reasoning (Artino et al., 2014). This is in line with previous novice versus expert studies which showed that novices were less likely to use SRL processes (DiBenedetto & Zimmerman, 2010; Anders Ericsson, 2008; Bransford et al., 2000; Cleary & Zimmerman, 2001). Consequently, feedback should focus on encouraging the learner to set task-specific goals and plans, rather than focusing on a general outcome, and on the general method and procedure they will follow to achieve their goal.

Goal setting can positively influence performance since a set goal can direct the learners' attention, increase their persistence and effort with the task and encourage strategy development (Locke et al.,

1981). Goals which are specific, challenging and agreed as important by the learner are more likely to improve task performance (Locke et al., 1981). Furthermore, feedback which demonstrates the learner's progression in relation to the goal is also likely to further improve performance (Locke et al., 1981). In support for the importance of feedback with a goal and planning focus Fuch's et al. (1997) found that task focused goals with feedback on their improvement increased the amount of effort low achieving maths students put into their maths learning. This feedback is useful to students as self-regulated feedback may influence how learners cognitively engage with successive tasks which subsequently affect their learning. Such feedback is also likely to increase their self-efficacy and encourage them to invest more effort in future similar tasks (Hattie & Timperley, 2007).

Self-monitoring is also a useful tool when learning from performance since it aids the learner in monitoring their progress towards their goal. This monitoring assists the learner in recognising whether they are on track or not, which then enables them to adapt or modify their goals and plans accordingly. Richman et al. (1988) showed that self-monitoring led to some increase in on-task behaviour and adherence to scheduled activities. They found that the participants sometimes struggled with self-monitoring which led to a reduction in on-task behaviour and adherence to scheduled activities. However, this was improved when feedback was given in addition to the self-monitoring. In addition, Donaldson and Normand (2009) showed that goal setting, self-monitoring and feedback on progress was effective in increasing the calorie expenditure in obese adults. Previous research has demonstrated that feedback which informs students of, or highlights their attention to monitoring their learning needs (based on previous goal setting) aids them in achieving their learning objectives and helps them to do better in future tasks (Butler & Winne, 1995).

Feedback should focus on the learner's goal setting, planning and self-monitoring to encourage them to become more self-regulated learners. Specifically, the feedback should focus on the goals and plans the learner set, encouraging them to set task-specific goals which focus on specific processes and steps they need to take in the clinical interaction. This is in contrast to having an outcome focused goal such as "to diagnose the patient". Learner's should receive feedback on their planning and be

encouraged to employ task-specific strategies to plan how the goal will be achieved. Feedback should also focus on assessing whether the learner is self-monitoring their progression through the task, inform the learner of their competency in this skill and their ability to use this self-monitoring to adapt their approach to the task.

B2.4 Feedback in Clinical Medical Education

Thus far, the majority of the research discussed surrounding feedback has focused on feedback provided in general within education with just some reference to medical education. This next section discusses research more specifically related to feedback within medical education and feedback within the clinical medical setting. In particular, issues surrounding feedback within medical education will be discussed as well as barriers influencing effective feedback provision. Furthermore, the recognition of the role of the learner within feedback provision will also be highlighted.

B2.4.1 Feedback in Clinical Medical Education

By encouraging medical trainees to review their performance with the aim of improving it, feedback plays a vital role in learning in the clinical workplace (Veloski et al., 2006; Rolfe & Sanson-Fisher, 2002, Irby, 1995). Indeed, one of the characteristics of a good clinical trainer is that they provide positive and negative feedback (Alsultan, 2011). High quality feedback provision may seem easy to provide, however feedback is often reported as being of an inadequate quality to guide learning and improve performance (Clynes & Raftery, 2008; Sargeant et al., 2008a).

B2.4.2 How Much Feedback is Provided?

Feedback, when provided effectively is reported by medical trainees to be helpful in assisting them to gauge their level of performance, make plans and set goals for future improvement (Bing-You & Trowbridge, 2009; Hewson & Little, 1998; Bing-You et al., 1997). Medical trainees recognise the importance of receiving feedback on their learning and professional development and desire regular feedback (AlHaqwi, 2012). However, within medical education there is an apparent gulf between the

useful and frequent feedback that clinical educators believe they have provided and the ineffective and infrequent feedback that medical trainees report receiving (Jensen et al., 2012; van de Ridder et al., 2008; Sender-Liberman et al., 2005; Hewson & Little, 1998). Faculty often report covering more points in their feedback in comparison to medical trainees' reports of what was covered (Sostok et al., 2002). Faculty also disagree with trainees on the exact content of the feedback (Sostok et al., 2002). This is concerning since the trainee is expected to use the feedback to improve. Use of the feedback and improvement will be limited if there is a discrepancy between learners' and educators' perceptions of what that feedback was. Specifically, Jensen et al. (2012) found that faculty members in general surgery training had higher perceptions of how frequently feedback was provided compared to the residents who received the feedback. Furthermore, residents were less satisfied with the quality of the feedback compared with the satisfaction of the faculty members. The residents believed that there was not enough feedback and that it was not specific enough (Jensen et al., 2012). Similarly, further research in the area of general medicine demonstrated that residents believed that compared to the faculty's perceptions they do not get enough feedback on the steps of a procedure, intraoperative feedback on their surgical skills, instrument handling, or on their surgical technique (Rose et al., 2011). They were also less likely to view the feedback during the case as constructive, and reported receiving less positive and negative feedback (Rose et al., 2011).

One explanation for this discrepancy could be that clinical educators provide less feedback than they think they do. A second explanation is that the medical trainees do not always recognise the feedback as feedback. Feedback which is not recognised as such is less likely to be effective (Kogan et al., 2012). Clinical educators may experience barriers in providing feedback, such as not understanding what constitutes effective feedback or lacking the confidence in their ability to provide it (Cantillon & Sargeant, 2008; Brukner et al., 1999). The clinical educator may also provide less negatively critical feedback in case they upset the student and harm their relationship with them (Hesketh & Laidlaw, 2002). Busy clinical schedules often result in little contact time for observing students (Hanson et al., 2010) or for providing feedback (Milan et al., 2011; Sachdeva, 1996; Schum & Yindra 1996). In addition, the feedback itself may not give the student guidance on how to improve, it may be too

generalised and not be specifically focused on pertinent information and observations (Hesketh & Laidlaw, 2002). Feedback which is inconsistent is also less likely to be viewed as effective (Hesketh & Laidlaw, 2002), and trainees prefer feedback which helps them to maintain their confidence (Eva et al., 2012).

B2.4.3 What Influences Perceptions of the Feedback?

Many factors influence whether a medical trainee accepts and ultimately uses the feedback they are provided with (Sargeant et al., 2008a; Atwater et al., 2002; Kluger & DeNisi, 1996). This is important since feedback needs to be interpreted, constructed and internalised by the trainee in order for it to influence their subsequent learning (Ivanic et al., 2000). Medical trainees appear to be apprehensive about receiving feedback on their performance (Pelgrim, et al., 2012). Pelgrim and Kramer (2013) suggest that these fears may be overcome if the trainee realises the essential need of feedback for effective learning and development. Medical trainees' initial reactions to the feedback they are provided with will influence whether they use that feedback in their future performance (Smither et al., 2005). Clearly, if a trainee rejects the feedback they are provided with they are unlikely to use it (Ilgen et al., 1979) and are unlikely to improve their performance. Medical trainees must at least accept their feedback in order for it to lead to improved performance.

A variety of factors may influence medical trainees' recognition of the feedback and reception of the feedback message (Murdoch-Eaton, 2012). Individual differences including confidence, emotion, learning styles, motivation, reasoning processes and performance attributions are also likely to play an important role in what type of feedback individuals prefer (e.g. positive or negative, verbal or written, immediate vs. delayed) (Eva et al., 2012; Murchdoch-Eaton, 2012; Murdoch-Eaton & Sargeant, 2012; Van Dijk & Kluger, 2011; Norcini & Burch, 2007). According to Jonsson (2013) a learner might not use the feedback if the information is not authoritative, specific, detailed, individualised or useful to them. One explanation for trainees not using the feedback they are given could be explained by the 'ostrich problem' (Webb et al., 2013). This refers to individuals' tendency to sometimes avoid, ignore or reject information which would assist them in evaluating their goal

progress (Webb et al., 2013). In particular, learners may avoid or reject information which goes against their views of themselves, or how they want to be viewed (Webb et al., 2013). The learners therefore may have to weigh up the balance between receiving and using information which may help them improve but is psychologically unpleasant, with avoiding receiving this information in order to feel better about themselves (Webb et al., 2013). The ostrich problem can also occur in terms of the learner self-monitoring their performance. Again, they may choose to avoid monitoring their performance in a task, or perhaps monitor their performance but ignore the resulting information. It is not clear whether this is a conscious choice or whether learners are subconsciously protecting their self-esteem and self-integrity (Webb et al., 2013). It is possible therefore that learners may be ignoring and not acting upon useful performance information without realising they are doing so.

It is reasonable to assume that medical trainees are less likely to use feedback if they do not understand it, or if they lack the strategies needed to employ the suggested changes. Furthermore, as discussed in Chapter B1.3 the impact of contextual factors such as the patient and the environment may affect the trainee's mood, confidence and concentration, and their subsequent DDM. This may influence what feedback is necessary and how effective it is. Eva et al. (2012) suggest that there is a complex interplay between fear, reasoning processes and confidence which will influence how a trainee will respond to feedback. This suggests that these factors should be taken into account when the clinical educator is assessing the trainee's performance and providing feedback. Based on this, Eva et al. (2012) posit that educators must take the trainee's self-perceptions into account to provide feedback which is useful and effective. Feedback appears to be deemed '*most credible*' when it is delivered to the trainee from a position of gain to them and allows them to maintain their self-concept (Eva et al., 2012). Viewing the feedback provider as a credible individual in an authoritative position also improves receptivity of the feedback (Ivers et al., 2012). Furthermore, a strong, positive relationship between the feedback provider and the receiver fosters receptivity of the feedback as well as feedback seeking behaviour (Bok et al., 2013; Crommelinck & Anseel, 2013). Additionally, trainees are more likely to be receptive to and accepting of negative feedback if it is provided by a mentor (Seargeant

et al., 2008) and view it as useful if it is provided by a trusted, respected and credible individual (Ivers et al., 2012; Hesketh & Laidlaw, 2002;).

B2.4.4 The Role of the Trainee in Feedback Provision

Until recently, the emphasis of feedback research has mostly been on effective delivery and consequently has largely ignored factors such as the role of the trainee in seeking feedback, the external factors and the different preferences of the feedback recipient (Boud & Molloy, 2013; Eva, 2013). However, more recent research places an emphasis on these feedback characteristics and is bringing to the fore their importance in providing effective, individualised feedback (Pelgrim & Kramer, 2013; Eva et al., 2012; Teunissen et al., 2009). It is likely that this interest has come about with the increasing focus on the medical trainees' active role in their own learning and in the feedback process itself (Pelgrim & Kramer, 2013). Recent research has suggested the importance of explicitly highlighting to trainees the gap between their current performance and an ideal standard, as well as giving them specific learning action plans (Gauthier et al., 2015) in making feedback more effective. Despite this, feedback still appears to be something medical trainees feel is done to them rather than with them (Urqhart et al., 2014).

B2.4.5 Helping Clinical Educators Improve Feedback

Brukner et al. (1999) have queried what guidelines exist for clinical educators attempting to improve their skills in providing feedback in the clinical setting. With regards to feedback, generic ways to improve general clinical performance and clinical skills have been discussed within medical education, with most papers outlining 'how to' and 'top tip' guides for feedback provision (Ramani & Krackov, 2012; Cantillon & Sargeant, 2008; Bienstock et al., 2007; Nicol & Macfarlane-Dick, 2006; Vickery & Lake, 2005; Hesketh & Laidlaw, 2002; Sachdeva, 1996). A number of feedback training interventions have been conducted within medical education with varied effectiveness in improving the quality and quantity of feedback (Junod Perron et al., 2013; Steinert et al., 2006; Stone et al., 2003; Paukert et al., 2002; Holmboe et al., 2001; Turnbull et al., 2000; Brukner et al., 1999). However, these interventions

provide little reference to specific practical guidelines with regards to making a diagnosis or a step-by-step guide of how the feedback can be implemented. In general, most teaching and feedback within the clinical setting on DDM is undertaken by clinicians not by trained educators. Consequently, the lack of large scale translation from feedback theory to practice in the clinical setting does not seem surprising (Anderson, 2012). The lack of structured and systematic feedback on clinical skills in general is likely to be a function of the absence of a framework for clinicians to use to provide feedback (Anderson, 2012). Furthermore, in professional development courses in general there appears to be a paucity of a focus on the students' learning processes (Loucks-Horsley et al., 2003) and in particular their self-regulated learning (Peters-Burton et al., 2015).

Methods of feedback need to overcome the barriers to effective feedback discussed above by ensuring that clinicians are confident in their ability to provide feedback and are given a structured framework around which to provide feedback. It is also important that the feedback recognises the influence of contextual factors on trainees' DDM, is accommodating to trainee individual differences, encourages self-assessment, enhances trainee ownership of the feedback and is focused on the trainee's goal setting, planning and their self-monitoring of their performance.

B2.5 Conclusion

The research into effective feedback provision has highlighted a number of key strategies which influence how feedback is given and various factors which the feedback should focus on. In particular the feedback should focus on medical trainees' goal setting, planning and self-monitoring, and encourage their involvement in the feedback, as well as taking into consideration individual differences and the influence of contextual factors on their DDM. The medical trainee's response to feedback should also be considered. From the background research undertaken, it appears that research has not solely focused on providing feedback on trainees' DDM. Furthermore, a clear conceptual model of how to provide effective feedback to improve DDM does not exist but warrants further investigation and development. The research conducted for the preliminary research phase thus far has led to the conceptualisation of the problem and mapped out an approach to address this

(outlined in Chapter B3). Based on these findings the next step in the preliminary research phase is to further investigate how and what feedback medical trainees are given on their DDM in the authentic clinical setting (Chapters B4-B5).

CHAPTER B3: PROBLEM CONCEPTUALISATION AND AIMS AND OBJECTIVES

The problem to be investigated is conceptualised based on the review of the literature up to this point. Based on this conceptualisation, the aims and objectives are formulated in line with the three phases of EDR.

B3.1 Summary of the Problem

The literature illustrates the importance of DDM in medical education (Chapter B1). Indeed, errors in DDM can, and do lead to patient harm. Despite this recognised importance, the literature does not suggest one best method by which to teach medical students how to make a diagnosis. However, there is overall agreement that feedback is a vital component. Furthermore, there is an absence of research which recognises the importance of the influence of contextual factors on decision making and feedback provision on these despite their evident role. This directed the focus of the investigation toward the importance of feedback to improve performance. There is a wealth of literature within publications on general education which demonstrate the effectiveness of feedback in improving performance (Chapter B2). There are also a number of key characteristics of feedback that improve or contribute to its effectiveness. There is some contradictory evidence however regarding the impact of these and the effectiveness of such characteristics are further influenced by various factors within the trainee. Despite the agreed importance and effectiveness of feedback, there appears to be few hands-on training programmes for clinical educators wishing to improve their feedback. Many theoretical guidelines exist but there appears to be a gap in the link between theory and real practice in authentic clinical settings. Furthermore, there appears to be a large and mostly unexplained discrepancy between the feedback providers report providing and the feedback trainees report receiving. Clinical educators may experience barriers in providing effective feedback, including a lack of training. Factors relating to the feedback provider, the task itself and the feedback receiver, will influence whether that feedback is recognised, valued, assimilated into existing knowledge and used for future performance. Consequently, the act of feedback provision appears to be less simple than merely providing feedback on DDM.

B3.2 Where Do We Go From Here?

Based on these findings this research sought to address the issue of providing more effective feedback to medical trainees on their DDM in authentic clinical settings. In particular, it was apparent that further investigation was necessary to understand the types of feedback medical trainees' desire after DDM and what feedback they receive. A greater understanding of how they view contextual factors

as influencing their DDM and whether they are provided with feedback on this was also investigated. Lastly, further investigation was required into the current role of feedback on self-regulated learning in DDM.

B3.3 Aims and Objectives

Overall, this research aimed to understand what type of feedback is most effective to enhance medical trainees' DDM and how this understanding can be used to improve the feedback clinical educators give to medical trainees on their DDM. This aim had three objectives which align with the three phases of EDR: (Phase 1) to investigate how medical trainees are provided with feedback on their DDM, how useful they perceive this to be and how they perceive this could be improved: (Phase 2) to develop a conceptual model of feedback and an intervention to implement the feedback model for clinical educators to use, to provide more effective feedback to medical trainees on their DDM and (Phase 3) to evaluate this model in terms of the medical trainees' and clinical educators' perceptions of whether the model and the intervention were useful, usable and effective in improving feedback on DDM. The following chapters of this thesis present this research and explain the development of the endeavours to meet these objectives and the overall aims.

CHAPTER B4: SYSTEMATIC LITERATURE REVIEW TO INVESTIGATE FEEDBACK ON DIAGNOSTIC DECISION MAKING

Chapters B1 and B2 highlighted the importance of feedback on DDM. Building on this understanding, I describe a systematic review which critically evaluates and synthesizes evidence of how medical trainees are provided with feedback on their DDM. This review is part of the preliminary research phase in my educational design research as it is further informing my understanding of feedback provision on DDM. The review is introduced and its needs, aims and objectives are summarised. The search strategy is outlined followed by a discussion of the findings. The strengths and limitations of the review are considered along with the implications of the findings and how this influences the next phase of my EDR.

B4.1 Background

For those wishing to improve feedback provision to their students there is not a clear cut set of guidelines to follow regarding how to provide feedback after DDM. A narrative review on feedback provision (Chapter B2.2) within the general education literature does allow for the identification of the main "dos and don'ts" of what constitutes effective feedback; however one concrete method of effective feedback provision cannot be identified. Perhaps this is to be expected since, as discussed previously what is 'effective' is highly influenced by the setting, the task and the learner themselves (Chapter B2.3-B2.4). Furthermore, not all the research in the narrative review was based on feedback in medical education, or based on actual feedback provided, nor was it all set within authentic settings. Consequently, it is not clear how feedback is actually provided to medical students on their DDM in authentic clinical settings. The systematic review conducted here aims to further investigate the strategies and methods by which medical trainees are provided with feedback on their DDM in authentic clinical settings. To date, to my knowledge, there is no systematic review which has investigated this. Such a review could be valuable in synthesising the feedback methods utilised in current studies to determine how feedback is provided on DDM and whether this is effective. This review is valuable to the preliminary research phase and provides a theoretical contribution to our understanding of feedback on DDM since it will highlight how and what feedback is provided and whether this is effective for medical students needing to improve their DDM.

B4.2 Aims and Objectives

This review aimed to critically synthesize evidence of the feedback that is provided to medical students and postgraduate medical students on their DDM in authentic clinical settings. It was anticipated that the findings would provide effective ways of providing feedback after DDM or highlight the absence of reported feedback provision on this important skill. The review had the following objectives:

- To identify the settings within which DDM is assessed and feedback provided
- To identify how feedback on DDM is provided

- To identify whether external influences and individual differences are taken into account when feedback on DDM is provided
- To identify the impact of providing feedback on DDM using Kirkpatrick's four level model of evaluation

B4.3 Method

B4.3.1 Design

A systematic literature review was carried out to critically synthesize evidence on the nature of the feedback provided to medical trainees on their DDM in authentic clinical settings. Systematic reviews are often conducted to answer specific, narrow questions at depth. They are usually formulated around variables including: a specific population and setting, a specific area of interest or intervention and one or more outcomes (Cook et al., 1997). This review was a cross sectional survey of primary empirical research which included providing feedback to medical students and postgraduate medical students on their DDM, clinical decision making or clinical reasoning in authentic clinical settings. The review employed the BEME methodology (Best Evidence Medical Education see BEME website www.bemecollaboration.org; Harden et al., 1999) to ensure it was robust and systematic. Robustly conducted systematic reviews offer a number of advantages over more traditional reviews and commentaries. Firstly, it allows for the identification of relevant studies to my research area; followed by the summarisation of their results and evaluation of their overall quality using scientific methodology (Khan et al., 2011). An advantage of this is that any recommendations made by my systematic review will be, in principle, based on unbiased, balanced conclusions from the evidence collected. A second advantage of systematic reviews is that the findings should assist me in clarifying what is understood about feedback after DDM and ultimately identify gaps in the research conducted in this area (Cook et al., 1997), and will help identify avenues for improving the provision of feedback after DDM. A third advantage is that the review can be viewed as a scientific investigation in itself since it employs pre-planned methods and collated and synthesised original studies using strategies that reduced bias and random error (Cook et al., 1997; Cook et al.,1995; Mulrow, 1987). Specifically,

these strategies comprised a thorough search of the literature, the utilisation of specific reproducible criteria for the selection of articles to be reviewed and the subsequent analysis of these articles. Conducting the systematic review gave me the opportunity to investigate what the most appropriate methods are to provide and investigate feedback provision.

B4.3.2 Search Strategy and Selection Criteria

To ensure all the relevant articles were retrieved a search strategy was developed as a process of iteration over a number of preliminary searches in the Medline (OVID) database. The research question was divided into three main topic areas around which the search was based: feedback, trainees and diagnostic decision making. Under each topic area a list of synonyms was searched for in order to maintain breadth in the search (Table B4.1). The review is centred around feedback provided on DDM but the search was broadened to include studies on clinical decision making, or clinical reasoning that included a focus on diagnosis since the term 'diagnostic decision making' returned few results.

The study selection criteria therefore were as follows:

The population: Medical trainees, medical students, postgraduate medical students or postgraduate training doctors.

The interventions: Must describe the feedback provided, feedback must be provided on decision making, reasoning or problem solving, must be set in an authentic clinical setting.

The outcome: The description of feedback, including its focus, timing and delivery. Whether the opinions regarding the usefulness of the feedback by those who received it, or the impact of the feedback were assessed.

The study designs: Experimental intervention (with or without randomisation), implementation of a change in the curriculum, assessing a previous change in the curriculum or an investigation to assess current teaching or feedback provision.

The study selection exclusion criteria were as follows:

The population: Practising clinicians; trainees or practising clinicians from any other health profession such as veterinary, dentistry or nursing.

The interventions: Feedback provided by peers only, diagnostic decision making assessed using virtual patients, computer systems or virtual haptic (touch) simulations. Feedback where making a diagnosis was not mentioned.

The outcome: No mention of feedback.

It is important to note that although the review focused on research in authentic clinical settings, studies which involved simulated patients also were included. This was due in part to the paucity of research but also because it was determined that for trainees, a simulated patient setting would stimulate an effective response to the situation in terms of the influence of relevant contextual factors.

The following databases were searched from their start date (all years) until the week ending April 13th, 2014 using relevant key words and MeSH terms: Medline, Embase, Cinahl, PsychINFO, Web of Science, Global Health, Educational Research Information Centre (ERIC), British Education Index (BEI), Australian Education Index (AEI) and Applied Social Sciences Index and Abstracts (ASSIA). To obtain a manageable and relevant set of results the Cochrane Library was searched using only three keywords: feedback, medical education and diagnostic decision making.

Topic 1: Feedback	Topic 2: Medical Education	Topic 3: Decision Making
Feedback, Psychological	Medical Education: continuing: graduate: undergraduate	Clinical Reasoning
Feedback	Internship and Residency	Making a diagnosis
Evaluation Studies	Clinical clerkship	Decision Making
Evaluat*	Medical Student*	Clinical Decision Making
	In-service training	Diagnostic Decision Making
		Problem solving
		Clinical competence
Combined with OR	Combined with OR	Combined with OR

Searches for topic 1. 2 and 3 above were combined with AND.

*denotes truncation where that word with was searched for with different endings also being searched for

Table B4.1. Table to show the synonyms used in the search and how these were combined

B4.4 Results and Interpretation

The search retrieved 3667 articles. When the inclusion criteria were applied most studies did not involve making a diagnosis, did not provide feedback, or were not in the authentic clinical or simulated patient setting. The Prisma diagram in Figure B4.1 shows the iterations of the revision process (Liberati et al., 2009), which resulted in the final inclusion of 19 studies for the review. A summary of the feedback provided in each of the 19 studies is shown in Appendix 2.1. A data extraction template was developed to extract the relevant information from each study. The data extraction template was developed using the BEME guidelines and by viewing and modifying previous data extraction templates used by studies which employed the BEME guidelines. The development of the data extraction template was also a process of iteration as more specific criteria were added as the review process continued and the data were extracted from each record.

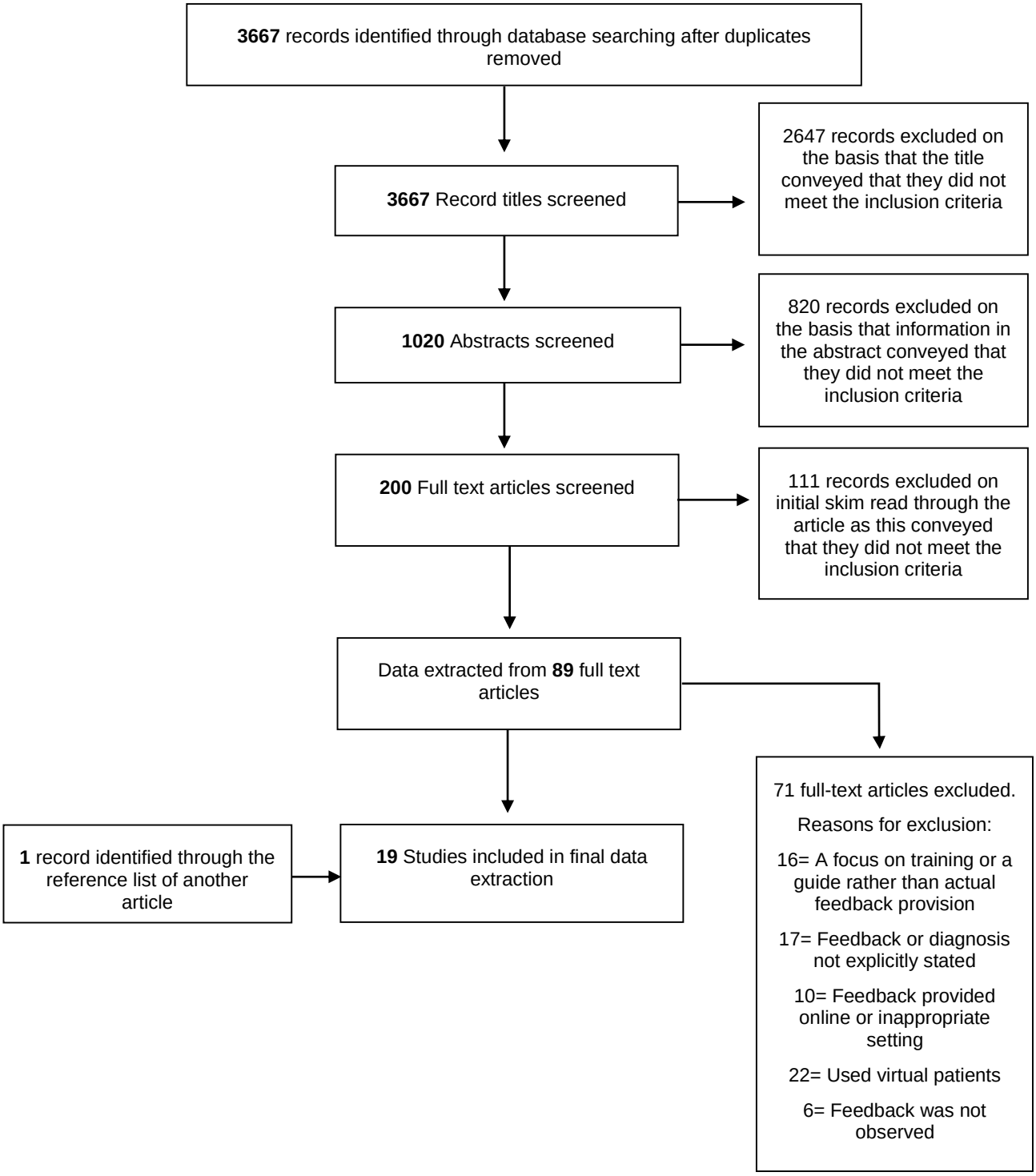

Figure B4.1.Prisma diagram to illustrate selection process for the articles retrieved after searching the literature

B4.4.1 Within What Setting is DDM Assessed and Feedback Provided?

The majority of research has been conducted in the USA (n=8); a small number of studies were conducted in Australia (n=3) or in northern Europe (n=3). One study was conducted in Canada and only one was conducted in the UK. The majority of the studies were conducted on undergraduate medical students (n=12), the rest were conducted on post-graduate medical students (n=5) and two studies involved GPs in training. The studies mainly employed relatively small samples of fewer than 50 participants (n= 8); only three studies employed samples sizes over 200 (Table B4.2). In the majority of the studies (n=15) the feedback provided was based on observations of the trainee whilst they interacted with patients in real clinical practice (Table B4.3). In the other four studies, feedback was provided based on performance with a simulated patient. It is possible that the setting is related to the sample population since studies using simulated patients were more likely to involve medical students (n= 4), rather than post-graduate medical students (n=1).

The 19 studies were conducted for a variety of reasons (Table B4.4). Feedback on DDM tends to be investigated as part of an intervention to determine whether providing feedback in that manner improves DDM (n= 8). Additionally, in a number of studies a curricular program change had previously been implemented and was being assessed (n=6). Another two studies looked at DDM through the implementation of a change to the curricular programme. In only three studies feedback was provided on DDM to determine how it was currently being given in everyday clinical practice

Table B4.2. Sample characteristics of the studies in the review

Sample Characteristics		Study Number
Country of study	USA	4,10, 11, 12, 13, 14, 15, 19
	Kuwait	6
	Taiwan	7
	Australia	3, 5, 8
	UK	9
	Brazil	18
	EU- Sweden, Netherlands, Norway	1, 2, 17
	Canada	16
Level of training	Medical students	2, 3, 4, 8, 9, 12, 13, 14, 16, 17, 18, 19
	Post-graduate medical students	6, 7, 10, 11, 15
	GP in training	1, 5
Sample size	1- 50 participants	3, 5, 6, 8, 11, 15, 18, 19
	51-100 participants	1,12, 13, 16
	101-200 participants	2, 9, 10, 14
	200 + participants	4, 7, 17

Context in which DDM was Assessed	Study Number
Real clinical practice	1, 2, 4, 5, 6, 7, 8, 9, 10,11, 12, 15, 16, 17, 19
Simulated patients	3, 13, 14, 18

Table B4.3. Context within which DDM was assessed with corresponding study number

Design of the Research	Study Number
Intervention	3, 4, 8, 12, 13, 14, 16, 18
Assessing previous curriculum change	1, 2, 6, 7, 10, 17
Implementation of a program change	5, 11
Investigation into how feedback is given	9, 15, 19

Table B4.4. Design employed by the studies with corresponding study number

It was important to determine whether the studies were focused solely on feedback provision or whether feedback was one element that was investigated alongside others (Table B4.5). Half of the studies (n= 10) investigated feedback as the sole focus of the research. The other studies investigated feedback provision in addition to assessing clinical skills as well as other performance measures (n=9). These studies investigated feedback in addition to an overall evaluation of an assessment tool or a new teaching method.

Focus of the Research	Study Number
Feedback was the main focus of the research	1, 2, 3, 4, 5, 7, 9, 10, 12, 15
Feedback was one element investigated within a larger focus	6, 8, 11, 13, 14, 16, 17, 18, 19
Clinical reasoning, Decision making or Diagnostic accuracy were the sole focus of the research	13, 14, 19
Diagnostic decision making was a one element in the focus of the study	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 17, 18

Table B4.5. Focus of the studies in terms of feedback and DDM and the corresponding study number

Similarly important was the focus of the studies in relation to what the feedback was provided on (Table B4.5). Upon reviewing the literature it became evident that research has not solely addressed or investigated feedback on DDM. This was apparent since in only three of the studies, making a diagnosis was the sole focus of the research (Yudkowsky et al., 2009; Windish et al., 2005; Goss 1996). The studies, more commonly investigated performance in general clinical skills in which making decisions surrounding the diagnosis was one component. Furthermore, none of the studies used the term DDM; the terms clinical reasoning, decision making or diagnostic accuracy were used instead.

These findings demonstrate that there is little research which specifically investigates feedback on DDM in truly authentic clinical settings. Feedback and DDM tend to be assessed as elements within the overarching field of assessing clinical skills (Al-Jarallah et al., 2005), clinical decision making (Windish et al., 2005), evaluating a new assessment tool (Haffling et al., 2011; Yudkowsky, et al., 2009), or a new teaching method (Dorfsman & Wolfson 2009; Troncon et al., 2000; Turnbull et al.,

2000; Goss 1996). This is surprising given the recognised importance of making correct diagnoses and of providing feedback within medical education and practice.

Clarity of the Research	Definition of Each Level of Clarity	Study Number
Unclear	It could not be replicated	13, 14, 15, 18
Slightly clear	Some of the main elements of the intervention could be replicated	2, 4, 5, 6, 7, 8, 9, 10, 12, 16, 17
Clear	The most salient aspects of the intervention could be replicated	1, 3, 11, 19
Very clear	The description enabled the exact same, detailed intervention to be copied	None

Table B4.6. Clarity of the feedback with the corresponding study number.

The majority of studies produced research which was classed as slightly clear (n=11) and four of the studies were classed as clear since they gave some indication as to what feedback was provided (Table B4.6). Four of the articles were unclear in that no attempt at replication could be made. The feedback classifications were defined by the researcher and were checked with an independent reviewer (this individual was a lay person and did not have an investment in this research).

B4.4.2 How is Feedback Provided?

Given the extensive literature on the importance of providing feedback it was surprising to find that only a third of the studies (n=7) provided reference to a theory or model as a basis for their feedback provision (Table B4.7). These models and theories included the Pendleton rules (Lin et al., 2011; Fernando et al., 2008; Fraser, 2007), the Leicester assessment package (Haffling et al., 2011), the RIME model (DeWitt et al., 2008) and direct observation (Hamburger et al., 2011; Dorsfman & Wolsman 2009). Just over a third of the studies (n=9) provided some form of justification or reasoning for feedback provision and three of the studies (n=3) did not provide a clear rationale or

theory to justify why feedback was important. Consequently, it was often not obvious why feedback was given in the manner it was, or whether it was simply provided ad hoc.

Justification, Rationale and Theory for Feedback Provision	Study Number
Justification for use of feedback	1, 2, 4, 6, 8, 12, 13, 15, 19
Based on a theory or model	3, 5, 7, 9, 10, 11, 17
No explanation or not clear.	14, 16, 18

Table B4.7. Underlying theory of feedback and explanation or justification for feedback provision in the studies

With regards to the feedback itself, verbal feedback was the most common (n=16) (Table B4.8). Where written feedback was provided it was mostly in addition to verbal feedback (n=9). Written feedback alone was provided in only three studies. Six of the studies appear to have promoted independent self-reflection and internal assessment of performance by the participants. Here, the participants' self-assessments of their own performance formed part of the feedback process that was provided (Pelgrim et al., 2012; Haffling et al., 2011; Braend et al., 2010; Holmboe et al., 2004; Windish et al., 2005; Sanson-Fisher et al., 2002).

Feedback is largely provided in a one-to-one setting (n= 18) rather than to a group as a whole (n= 2). In the majority of studies feedback was given immediately after the DDM (n=15) (Table B4.8). Six studies reported delaying giving feedback, but this was likely to be due to the environments in which they were conducted (Haffling et al., 2011; Braend et al., 2010; Dorsfman & Wolfson, 2009; Holmboe et al., 2004; Turnbull et al., 2000; Goss, 1996). In authentic clinical settings with patients, immediate feedback is not always feasible and instead must wait until the end of the day or shift.

How Feedback Is Provided	Study Number
Verbal	1, 5, 6, 7, 8, 9, 10,11, 12, 13, 14, 15, 16, 17, 18, 19
Written	1, 2, 4, 5, 6, 7, 8, 11, 12, 13, 16, 17
Use of participant self-reflection and self-assessment	1, 2, 8, 14, 15, 17
Immediately after performance	1, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19
Delay after performance	2, 11, 15, 16, 17, 19
Unclear	3
Feedback provided to individual	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19
Feedback provided within a group	14, 19

Table B4.8. The delivery of the feedback in the studies with the corresponding study number

In summary, participants are most often provided with individual, verbal feedback on their DDM immediately after decision making. However, although not rated in detail in this review, the quality of the description of the feedback provided in the studies was relatively poor (see list of studies in Appendix 2.1). Beyond reporting the timing, delivery model and setting, most of the studies were quite ambiguous when it came to understanding how feedback was provided, what it focused on and how this could aid the participants in improving their DDM.

B4.4.3 Was the influence of Contextual Factors on DDM Taken into Account?

As discussed previously, it is important that contextual factors are recognised and that feedback is provided on these since they may affect DDM. Twelve studies did not focus on any contextual factor. A minority of the nineteen studies explicitly identified or provided feedback on patient (n= 3) or environmental (n=6) factors that may have influenced decision making (Table B4.9). In particular, these usually focused on time management within the environment and the trainee's ability to take account of various patient factors within the consultation. Only one study explicitly stated recognising or providing explicit feedback on the influence of clinician factors such as confidence, knowledge or cognitive biases and meta-cognition on DDM. This is worrying given the recognised impact of these on decision making (Durning et al., 2012; Croskerry, 2003b; Kempainen et al., 2003; Croskerry, 2002).

It is possible that such factors were recognised and fed back on, but were not reported by the individuals providing feedback or by the authors of the studies.

Contextual Factors Taken into Account	Study Number
Environment	7, 11, 17
Patient	2, 10, 11, 14, 16, 17
Clinician	10

Table B4.9. Contextual factors taken into account in the studies with the corresponding study number

B4.4.4 Impact of the Feedback using Kirkpatrick's Four-Level Evaluation Model

Kirkpatrick's four-level model of evaluation (Kirkpatrick, 1994) was used to assess the impact of the feedback provided on DDM (Table B4.10). Kirkpatrick's model (Kirkpatrick, 1994) provides a framework for evaluating the effectiveness of training on four increasingly sophisticated levels: individuals' reactions to the training, learning as a result of the training, transfer of the learning to everyday practice and benefits to the organisation (or in this case patients), as a result of the training. It is important to assess participants' reaction to the feedback. Negative perceptions of feedback are unlikely to lead to behavioural changes or improvement in performance, rendering the feedback ineffective. Eight studies did not achieve any of the four Kirkpatrick levels. Nine studies reached a level 1 impact as they assessed participants' reactions or opinions of the feedback; here, reaction to the feedback was overtly positive and well received. Four studies reached a level 2 impact as they demonstrated that the feedback had an impact on the participants' learning. Two studies reached level 3 as they showed how the effect on learning had impacted subsequent behaviour. None of the studies reached impact at level 4 where the effect on the environment in general as a function of the participants' learning is assessed.

No. of Kirkpatrick Level of Impact	Study Number
Level 1- Reaction	3, 5, 10, 11, 12, 14, 16, 17, 19
Level 2- Learning	8, 12, 13, 14,
Level 3- Behaviour	8, 13
Level 4- Results	none

Table B4.10. The location of the studies on Kirkpatrick's four-level model of evaluation

With regard to assessing the Kirkpatrick level of impact it is difficult to determine the impact specifically on DDM from these studies, since this was not usually the only focus. Of the four studies which reached impact at level 2 (assessing learning) the feedback provided was mainly verbal (n=4) and written (n=3), delivered immediately (n=4) in an individual (n=2), or group setting (n=1), and included trainee self-assessment (n=2). The feedback provided was more likely to be based on a supported rationale (n=3). Two of these studies focused specifically on DDM. These four studies implemented the feedback provision as an intervention, involved medical students (n=4), and used either authentic clinical encounters (n=2), or simulated patients (n=2), and relatively small sample sizes. These studies tended to evaluate the impact in terms of the students confidence in future consultations and diagnosing (Paukert et al., 2011), as well as performing various elements of the consultation better than a control group (Windish et al., 2005), making more independent judgements, an increase in perceptions of their learning (Sanson-Fisher et al., 2002) and showing improvement in their consultation performance (Yudkowsky et al., 2009).

With regard to the nine studies which reported favourable participant assessment of the feedback (level 1) the feedback was verbal (n=9), immediately after their performance (n=7) and was observed in an individual setting (n=8). The research was most likely to be an intervention design (n=5), rather than assessment of previous curriculum change (n=2) or the implementation of a curriculum change (n=2). Justification for feedback provision was most likely to have some form of theoretical basis (n=5) and occur after observation in authentic clinical settings (n=7). Two studies reached impact level three- behaviour change. In these two studies the participants' showed an improvement when

they performed cases they had received feedback on the previous year (Yudkowsky et al., 2009) and set more learning goals as a consequence of the intervention (Sanson-Fisher et al., 2002).

B4.4.5 Assessing the Quality of the Studies.

It is important to assess the quality of the studies employed in the review. Broadly, quality is assessed to ascertain how near the truth a study's findings are and whether these are relevant to the setting or group of individuals of interest (CRD, 2009). However, to view quality in terms of assessing the truth of the study could be argued to be too simplistic, for there are likely to be many confounding factors influencing a study's quality regardless of whether it is near the truth. One important feature in quality assessment is assessing a study's risk of bias (Higgins et al., 2011; CRD, 2009). Bias is the systematic error in results or in the inferences the researchers make (Higgins et al., 2011). As this systematic review investigated how feedback is provided on DDM it is also important to assess the quality of the methodology employed by the studies to determine how reliable and valid they are.

It was challenging to find a tool of quality assessment that was applicable to this research; many of the quality assessment tools and guidelines are used for assessing the quality of systematic reviews conducted on clinical trials. The criteria therefore were not always applicable to my articles such as in the GRADE working group (http://www.gradeworkinggroup.org/intro.htm), the Jadad scale (Jadad et al., 1996), or the Newcastle- Ottawa Scale (Wells et al., 2000). In order to assess the quality of the studies the Quality assessment element of the QUESTS outlined by Harden et al. (1999) was used. Harden et al. (1999) provide a table of questions to determine quality in both research based and theory based medical education studies. One limitation of the QUESTS criteria is that it is left to the reviewer's judgement whether a study has acceptable quality or not. Although there are evidently limitations of this in terms of the subjective judgements made by the reviewer there are also limitations of using a number scale to provide a cut-off point to determine whether a study has quality or not. Indeed, the Cochrane Handbook for Systematic Reviews of Interventions advises against

using scales or check lists to determine bias in studies (Higgins et al., 2011). The Cochrane Handbook suggests using domain based judgements and they provide six areas of bias to focus on. However, half of the domains the handbook focuses on were not relevant to the style of studies in this review which is why this tool was not used. This made it difficult to soundly assess the quality of the studies and consequently may have influenced the quality of those assessments. Importantly, it might have negatively impacted the reliability and validity of the quality assessments made. More research is required therefore in how best to assess the quality of different types of studies so that a meaningful assessment can be made.

To remove the focus from a scale or checklist approach to determining quality, the responses to the questions used to assess study quality were not quantified to provide an overall quality score. Rather, the responses to the questions were used to provide an overall view of the quality of the study in terms of its sample, methodology, reliability, validity and appropriateness of the conclusions. Overall, none of the studies were viewed as devoid of all quality, however seven of the studies (2, 4, 5, 7, 8, 12, 19) were viewed as being considerably lower in quality than the remaining twelve. One general methodological weakness evident in most studies was the potential bias of the sample or the lack of generalizability of the findings. Participants who opted in to the research or who returned assessment and feedback related documentation required for the study may have represented a certain type of learner. There may have been certain characteristics of this sample that made them unrepresentative of the entire population. Additionally, due to the specifics of each medical speciality, the methodology or the findings in one setting may not be applicable to other specialities. Most studies however, did recognise this. Another main issue was that the research was not assessed for its' reliability and validity. It was more common for this not to be addressed at all rather than the researchers reporting a lack of reliability or validity. It was harder to assess the studies in terms of their data collection and analysis as feedback and DDM tended to be one element within a broader focus. For the large part, the data collection and analysis as a whole was well explained. What was lacking (as noted above) was explicit detail regarding the feedback provided. Another area in which quality was lacking was regarding whether they had been properly developed or piloted. Two of the studies were described

as pilots for a main instrument or intervention (3, 18). Twelve of the studies (1,2,5,7,9,10,11,12,13,15,16,17) mentioned some form of previous testing, development or piloting of the instrument of intervention and five did not (4, 6, 8, 14, 19).

In summary, it appears that the studies were of an acceptable quality. This is important as a review's strength can be limited by weaknesses in the studies' methodologies. Conclusions drawn by low quality research are less likely to be reliable representations of true findings. Importantly, despite a number of methodological weaknesses it is unlikely that the methodological quality of the studies has influenced the conclusions of the review.

B4.5 Discussion

To summarise, the systematic review retrieved 19 studies which revealed that most feedback on DDM is given after real patient-learner clinical interactions. However, DDM and feedback were not always the main focus of the intervention. Most of the feedback is provided verbally, immediately after the interaction and on an individual basis. However, very few studies used participant self-reflection or self-assessment. In addition, studies rarely took into account the effect of contextual factors in the environment on DDM. Those that did were most likely to focus on patient-centred factors.

In terms of assessing researchers' approach to feedback provision, only a third of the studies provided a model or a theory as evidence for the way in which they were providing feedback. Most studies did provide at least some form of justification for their use of feedback. Most of the published articles were either interventions put in place or were assessments of changes to the medical curriculum. Within these designs, feedback provision and a focus on DDM were more likely to be one of a number of variables investigated rather than the sole focus. Most articles provided slightly clear descriptions of the feedback provided. The findings in relation to the delivery of feedback support the suggestions of the narrative review in Chapter B2.2 (i.e timing, verbal or written, individual feedback). I had intended to assess feedback provision in relation to more of the effective feedback

characteristics suggested by the narrative review. However, there was not enough detail regarding the feedback for this to be analysed. It is not clear whether this information is lacking from the articles due to its level of detail or whether feedback was not provided in this manner.

The small number of articles which matched the inclusion criteria reveals a number of issues regarding the state of research into DDM. Firstly, there is limited research which aims to investigate feedback provision on DDM. Secondly, most research which does investigate feedback provision on DDM does not assess the recipients' perceptions of the feedback or whether it led to any improved performance. Thirdly, DDM receives little direct attention with regards to feedback in the literature. This is interesting given its recognised importance within the field of medical practice and the vast literature published surrounding how diagnostic decisions are made. In most of the articles DDM was one of a number of elements on which feedback was provided; this is probably because this reflects real life teaching of students in authentic clinical settings. Despite its importance, DDM is only one skill required of medical practitioners. Medical students must also learn the knowledge required to make effective diagnostic decisions as well as appropriate consultation and communication skills and so they also require feedback on these skills.

Despite the increasing emphasis on active feedback and the learner as an equal partner in the feedback 'conversation' it is concerning to see how few studies reported employing the use of learner self-reflection or self-assessment. However, the six studies which did include learner self-assessment or self-reflection were all conducted within the last 10 years. Since the increased emphasis on employing self-reflection and self-assessment is a relatively recent occurrence it is possible that current and future research may demonstrate a greater use of self-reflection and self-assessment.

B4.5.1 Strengths and Limitations

In this review an extensive search strategy was employed. Using the broader terms of 'diagnosis', 'decision making' and 'reasoning' ensured that relevant literature was not missed. A further strength of this review is the methodology review process employed to analyse the findings. This was conducted in line with the BEME methodology (Harden et al., 1999). The main weakness of the review is also its main strength in that there is little thorough research investigating feedback provision on DDM. This finding supports the need for further investigation and ensures that my EDR is novel and unique. However, the lack of research and the poor reporting makes it difficult to reliably assess how feedback is currently given on DDM in authentic clinical situations. There is no evidence to explain the dearth of literature on feedback on DDM. It could be influenced by the nature of the medical curriculum since those most likely to be involved in research are often not those responsible for medical students in the clinical setting. As such, effective feedback may be being given but is not reported via published studies. This supposition could be explored by speaking to experts in this field. Additionally, the difficulty in finding research solely on DDM may suggest that it is likely to be taught and assessed as part of clinical skills, communication skills, or clinical decision making and reasoning, and therefore has not been addressed as an isolated performance condition (Croskerry & Norman, 2008). Consequently, it is not clear whether the lack of information is due to researchers not realising the importance of feedback on DDM, or due to the importance placed on other skills. It could be that the lack of information reflects a lack of publication in this field rather than a lack of feedback focusing on DDM. Regardless of this however, the findings from the literature still highlight the lack of emphasis of research on feedback on DDM. This is surprising given the wealth of literature independently stressing the importance of both effective DDM and feedback on performance.

B4.6 Conclusion

Taking into consideration the strengths and limitations, the review draws together results from a rather disparate but related field of research and exposes how feedback on DDM is under-researched. Despite a plethora of research on feedback, there is little which goes as far as implementing interventions specifically to improve feedback on DDM as very few studies are solely focused on feedback on making diagnostic decisions. Furthermore, they do not describe the feedback in enough detail to ascertain what feedback was provided and which specific elements were effective. Resultantly, it is difficult to determine what was actually done and how feedback on DDM is given. The synthesis of feedback provision allowed by the limited literature suggests that feedback is often verbal and is provided on an individual basis immediately after the DDM has occurred. The current literature does not allow for a substantial conclusion to be made regarding the effectiveness of this feedback. It does show that more research is warranted specifically on DDM to determine what feedback is specifically provided and which particular elements are effective. Based on these conclusions, and given the importance of DDM and feedback's role in improving performance, further research in the preliminary research phase is essential in understanding how medical students are currently provided with feedback on their DDM, whether there is a need for its improvement and if so, how it can be improved. Specifically, the following research focus is necessary:

- Understanding whether feedback on DDM currently focuses on the trainee's self-regulated learning and the influence of contextual factors.
- A focus on employing trainee's self-assessment and self-reflection in feedback provision as the studies investigated here rarely used this approach.
- A focus on feedback provision surrounding the influence that context may have on DDM.
- A focus on what feedback was given and a focus on the trainee's self-regulated learning.
- Research which specifically investigates feedback provision on DDM rather than incorporating this as a by-product of a more general formative assessment style focus as was the case in the majority of the papers reviewed.

- Research is needed which investigates trainee's perceptions of the feedback, to determine why it was (or was not) effective or perceived as useful, as well as whether the feedback led to improved DDM in the short and long term.

These will be addressed in the next steps taken in the preliminary research and by the intervention developed in the development phase:

B4.7 Summary of Chapter

This chapter aimed to critically review and synthesise the literature on feedback provided on medical trainees DDM. This was attempted as thoroughly as possible given the literature available. Conclusions were drawn which ratify the need for further, more specific research which investigates how feedback is provided on DDM and how it could be improved. The lack of literature, gives support to my research as a novel area of research that warrants further investigation. Based on these limited findings it is important to investigate in more detail how medical trainees are provided with feedback on their DDM and whether they perceive this to be useful for further improvement. The next stage of the preliminary research phase is based on the conclusions summarised above and aims to explore medical trainees' and clinical educators' experiences of feedback after DDM in the authentic clinical setting.

CHAPTER B5: INVESTIGATING FEEDBACK ON DIAGNOSTIC DECISION MAKING

Findings from the preliminary research phase suggest that feedback is vital for DDM improvement but that it is not clear what this feedback should consist of, how it should be given, or what feedback medical trainees currently receive on their DDM. Therefore, in this chapter I describe a study which used questionnaires to investigate medical students' and clinical educators' perceptions of how often they receive or provide various styles of feedback after diagnostic decision making (DDM), in addition to how useful the medical students perceive this feedback to be. As shown in the systematic review (Chapter B4), despite the vast quantity and wide variety of research on feedback there is little with a focus on feedback after DDM or on implementing interventions to improve feedback on DDM. Consequently, as part of the preliminary research phase of my EDR, this questionnaire study was undertaken with the intention of understanding in greater detail how feedback is provided after DDM. The research was conducted to understand any limitations in provision and areas for improvement. The discussion section of this chapter explores the meaning of these findings, how they influence my overall research design and what they mean for the key facets in the provision of effective feedback. Conclusions are drawn in terms of their implications for the feedback model. Strengths and possible limitations of the study are also addressed.

B5.1 Background

To improve feedback provision it is imperative to understand how clinical educators and medical students perceive the frequency and usefulness of feedback on DDM. Only by understanding current provision can future provision be improved. Furthermore, as demonstrated in Chapter B4, there is a lack of research investigating the provision of feedback on medical students' DDM from the perspective of those receiving and providing the feedback and how useful medical students find this feedback. This questionnaire study therefore, is novel in its specific focus on DDM and its sample of both medical students and clinical educators. Following on from literature discussed in Chapters B1 and B2 it appears that there is increasing recognition of the importance of providing detailed and specific feedback which incorporates learners' self-regulation and an awareness of the important influence of contextual factors on DDM. However, there are few reports of, or research into feedback provision which focuses on these aspects. As such, there is limited insight into how often feedback is provided which places an emphasis on these elements. Consequently, it is not clear how feedback is provided and how useful this is to those receiving the feedback; in order to determine whether there is a need for this feedback to be improved and how it could be improved it is necessary to ascertain how feedback on DDM is provided to medical students.

The study therefore aimed to understand how medical students are provided with feedback on their DDM and how useful they find this to be. To achieve this aim the study had the following five objectives. To determine:

(1) How often different types of feedback are provided and received after poor and good performance

(2) How useful medical students perceive the different types of feedback to be after poor and good performance

(3) The setting in which feedback is usually provided as perceived by medical students and clinical educators.

(4) Medical students' and clinical educators' perceived influence of contextual factors on DDM and the provision of feedback which takes these into account

(5) Medical students' and clinical educators' opinions of current feedback provision on DDM and how could it be improved

B5.2 Methodology Design

The study employed a cross-sectional survey design using a questionnaire to elicit the data. The objectives of my research lend themselves to the use of a questionnaire as I wanted to obtain relatively simple, yet detailed, data from a large number of participants using as little external resources and time as possible. Questionnaires allowed me to achieve this since they are reasonably simple to carry out and offer an economical way of sourcing and collecting a substantial amount of standardised data (Schutt, 2006). Using questionnaires which required mainly quantitative responses meant that I could obtain simple answers to my questions. The use of questionnaires also allowed for the standardised distribution of questions to the desired sample as a whole (Green & Browne, 2006). This was particularly advantageous since my desired sample comprised two separate groups (medical students and clinical educators). Furthermore, the individual participants within each group were quite dispersed as the medical students have different timetables and the clinical educators work in different locations. Since questionnaires allow simultaneous sampling from a range of geographical locations it was anticipated that this would aid recruitment. The questionnaire also allowed for anonymity; this should have reduced the tendency for participants to provide socially desirable responses (Green & Browne, 2006). Anonymity is also particularly important since some participants may not want other medical students or colleagues knowing their opinions on feedback. Questionnaires are non-threatening and are familiar to most individuals; they are also less obtrusive than interviews and so may allow for more honest and opinionated answers (Green & Browne, 2006).

B5.2.1 Ethical Approval

This study received ethical approval in November 2013 from the University of Leeds Faculty of Medicine and Health Research Ethics committee (Ethics number SOMREC 13004, Appendix 3.3).

B5.2.2 Participants

Clinical educators and medical students were recruited to take part in the questionnaire. The student sample consisted of medical students from the University of Leeds on the MBChB course from years 3, 4 and 5. Those from years 1 and 2 were not recruited because these students do not get as many opportunities to engage in DDM and therefore did not have adequate clinical exposure to complete the questionnaire. The clinical educators were those who teach years 3, 4 and 5 medical students on the University of Leeds MBChB course. The clinical educators were only asked to complete the questionnaire if they observed students make diagnostic decisions. Participants were recruited using opportunity sampling. Opportunity sampling is the sampling of participants who meet the inclusion criteria and are able to take part when you are recruiting (Jupp, 2006). However, it is potentially a source of bias and may threaten the validity of the conclusions made by the research as the sample is not representative of the entire population and runs the risk of not being truly representative of the population of interest.

B5.2.3 Materials

Verbal or Email Invitation and Information Sheet

The paper questionnaire given to the medical students was accompanied with an information sheet to explain what participation would involve. Participants were also informed that participation was voluntary and that their responses would remain confidential and their identity anonymous. The email to the clinical educators was addressed from the researcher; however it was sent out by the respective head of each year group. The email invited them to take part in the study and contained the information sheet and a URL link to the online questionnaires hosted by Bristol Online Surveys (http://www.survey.bris.ac.uk).

Questionnaire Construction

The questionnaire was developed by drawing upon the findings from the narrative review and systematic review conducted in earlier stages of the preliminary research phase (Chapters B2.2 and B4). The questionnaire was designed to aid my understanding of how often and how useful medical students and clinical educators perceived different elements of feedback on DDM. In my reading for this research I found that the proposed viewpoints in Hattie and Timperley (2007) and Butler and Winne's (1995) papers were appropriate and relevant to my research. These papers, as well as the findings from my reviews (Chapters B2.2 and B4), influenced the style and focus of the questionnaire and ultimately the questions themselves.

The questionnaire evaluated how often clinical educators provided and medical students received, self, task, process and SRL level feedback after poor or good DDM. These are the proposed levels of feedback discussed by Hattie and Timperley (2007) (discussed in Chapters B2.2.4-B2.2.5). The medical students were also asked how useful they find feedback at each level after poor or good DDM to be. As there is increasing recognition of the importance of contextual factors negatively influencing DDM (Durning et al., 2012; Durning et al., 2011) the questionnaire asked the medical students how often they felt the contextual factors influenced their DDM and how often they felt they were given feedback on these. The clinical educators were asked how often they felt the contextual factors influenced medical students' DDM and how often they provided feedback on these. The factors included: from the environment- setting, noise, time constraints: from the patient- number of previous visits with the same presentation, communication barriers, attitude toward the patient: from oneself- confidence and knowledge.

The final version of the questionnaires can be found in Appendix 3.1 and 3.2. A 5-point Likert scale (Likert, 1932) was used throughout the questionnaire and included a neutral response of "occasionally" or "not particularly useful or un-useful". This ensured that participants were not forced into having an opinion or an answer which only incorporated extremes, as is often the case with the four-point forced-choice design Likert scale (Polgar & Thomas, 2011). A seven point Likert

scale was not used as the responses could be accurately conveyed across the 5 point scale. Free-text responses were not incorporated into this iteration of the questionnaire design.

Questionnaire Development

A number of versions of the questionnaire were drafted and modified. The initial version of the questionnaire was discussed with my supervisors and Dr Richard Fuller- director of the MBChB programme at the University of Leeds. This discussion was vital to ensure that the questions were appropriate and the feedback examples were true to real life. Their input was valued due to their roles as clinicians and medical educators for undergraduate and postgraduate medical students and for their collective experiences within medical education. The modified version ensured that the questions and examples of feedback in the questionnaire were realistic. This second iteration of the questionnaire was shown to five medical students and four clinical educators who I have worked with in the past, to ensure that participants would be able to understand the questions and that the questions elicited valid responses. No changes were made after this and this iteration of the questionnaire was further piloted (section B5.2.4) with a larger sample of participants to ensure its face validity (Brace, 2008).

B5.2.4 Pilot Study.

A pilot study was conducted to ensure that the participants understood what the questions were asking. This helped to ensure that the questions measured what I intended them to measure (Brace, 2008). This was important since the participants may not have been used to receiving feedback with the specific focus given in the questionnaire. The pilot study was also crucial in ensuring that important features, aspects or areas of feedback provision were not being missed at the expense of the focus on the levels of feedback. The pilot study involved 15 medical students and 10 clinical educators with whom I had worked in the past. These individuals were sent copies of the questionnaire via email as I already had their contact details. The email explained to them that this was a pilot study and that their responses would not be included in any data analysis. The participants were asked whether they had any recommendations or comments on how the questionnaires could

be improved. The participants were also asked whether the examples of feedback were realistic and were asked to summarise what the examples of feedback were conveying. This allowed me to determine whether they understood them.

B5.2.5 Modifications

Based on the participants' responses to the piloted questions and further reading the following modifications (third iteration) were made:

1. The questionnaires evaluated five elements on which feedback is most often provided rather than four. The level of self-regulated learning was spilt into two levels; (1) feedback on goal setting/planning and (2) feedback on self-monitoring/self-evaluation throughout the task. SRL theorists propose the existence of self-regulation strategies throughout three phases in relation to a learner's performance (forethought phase, performance phase and self-reflection phase) (Zimmerman , 2000). Consequently, it appeared more appropriate for the feedback levels to reflect the main strategies in self-regulation. Examples of feedback for these two questions were developed. The examples of feedback for the other three levels (self, task, process) were not modified as responses suggested that the participants found them realistic and understood their meaning.

2. Additional Likert scale questions were included to capture information on how often the students were given feedback individually, in group settings, verbally or in a written format. This was included based on the data collected from the pilot questionnaires and participants' comments regarding the pilot questionnaires.

3. Additional free-text questions were included to provide greater understanding about participants' perceptions of the feedback. It was decided that it would be valuable to also evaluate perceptions on feedback provision in more general terms, the strengths and weaknesses of feedback provision and how this could be improved. Free-text responses were used so as not to influence or limit the participants' responses. These questions asked the participants about current feedback provision, what was wrong with it, how it could be improved and whether level of performance (good or poor DDM) influenced how often feedback was provided.

B5.2.6 Recruitment and Procedure

Using opportunity sampling the participants were recruited into the study in the following ways:

Medical Students

The medical students from years 3, 4 and 5 were recruited during a lecture where they were taught as a whole year group. At the beginning of the lecture the research was introduced using a Power Point presentation. Paper copies of the questionnaires with consent forms and information sheets were then distributed throughout the room and those who wanted to complete a questionnaire took one. The lecturer finished 10 minutes early and the completed questionnaires and consent forms were collected at the end of the lecture.

Clinical Educators

Clinicians who take years 3, 4 or 5 medical students on placement from the University of Leeds were contacted via the heads of year 3 (Dr Virginia Aylett) year 4 (Dr Jonathan Darling) and year 5 (Dr Graham Woodrow). These participants were recruited via an email inviting them to take part in the research described in B5.2.3.

B5.3 Analysis

To analyse the responses from the medical students the paper questionnaires were run through Formic Solutions® software (www.formic.com). This software captures the responses and transforms the ink marks to coded responses which can be exported into Microsoft Excel®. If a respondent had answered slightly outside of the marked response area or their response was not clear enough the software asked for human clarification as to which answer was correct. Twenty forms were cross checked in full to ensure that the coding process was correct. The participants' qualitative questions were typed into Microsoft Excel® and these were analysed and coded separately. The quantitative responses were exported into SPSS™ for analysis.

The clinical educators' responses were captured online in data form on Bristol Online Surveys©. Their responses were coded and imported into Excel. The numerical responses in Excel were exported into SPSS™ for analysis. The qualitative responses were kept in the same data sheet in Microsoft Excel and were analysed and coded separately.

B5.3.1 Demographics:

	Number of Participants			Size of the Sample Population			
	Male	Female	Total	Male	Female	Total	Proportion of Sample Population who Participated %
Medical student Y3	37	31	68	111	156	267	25%
Medical student Y4	48	85	133	112	182	294	45%
Medical student Y5	34	77	111	86	245	331	34%
Medical student Total	119 38%	193 62%	312	309 34%	583 65%	892	35%
Clinical Educator	31	31	62				

Table B5.1. Demographics of the participants

Three hundred and twelve medical students completed the questionnaire; of these, 193 were female and 119 were male; this ratio is similar to the ratio of male to female students in the target population (Table B5.1). The number of male and female medical students who took part from each year group is shown in Table B5.1 as well as the sample size of each year group. Overall, 25% of 3rd years, 45%

of 4th years and 34% of 5th years took part. Sixty-two clinical educators completed the questionnaire; of these, 31 were female and 31 were male.

A note about analysis: Due to the number of participating medical students the results were not analysed by year group. There are important reasons to analyse such results as a function of year of study due to maturational differences across the years as highlighted by Murdoch-Eaton and Sargeant (2012). However, these differences are less likely to be present in these results since the participants were not in their 1st or 2nd years of study. Furthermore, the findings will be used to inform the development of a model to improve feedback on DDM which can be applied across year groups. Consequently, the feedback factors focused on in the model should produce effective feedback irrespective of year of study.

B5.4 Quantitative Analysis and Results

The quantitative results were analysed using t-tests and repeated measures analysis of variance (ANOVA). The same analysis was completed independently for medical students and clinical educators. Independent t-tests and repeated measures ANOVAs were then used to compare the medical students' and clinical educators' responses. Paired samples t-tests were also used to compare participants' responses within each group.

T-tests are used to compare the mean results from two groups. Paired samples t-tests are used when the same participants are tested twice on the same variable (Ho, 2006). Independent samples t-tests are used to compare the same variable across two separate groups (Ho, 2006). T-tests are advantageous as they can provide information regarding whether the difference in the means of the two groups compared are significantly different from one another (Field, 2009). When conducting t-tests a probability value is given which informs the researcher of the likelihood that the difference between the two means was due to chance or not (Field, 2009). ANOVAs were used to analyse the results for questions regarding the levels of feedback provided or received after good and poor

feedback. These questions enquired about whether certain levels of feedback were more commonly provided than others and how useful the medical students found the different levels of feedback to be. Repeated measures ANOVAs were used because they allow for the analysis of how more than two independent variables interact with each other and how they influence the dependent variable (Field, 2009). Conducting multiple t-tests reduces the probability that any findings are not due to chance. The ANOVA design however, compares the means of all the independent variables simultaneously and so controls for this (Field, 2009). It also allows for the control of confounding variables which may influence the results. ANOVAs were used to analyse these results rather than regression since they test the effect of a categorical independent predictor variable (IV)(eg. the level of feedback) on a continuous dependent variable (eg. the 1-5 Likert rating) (Winter, 2014). This analysis is referred to as a 'repeated measures ANOVA' since multiple factors (and therefore multiple observations from the same participants) were being assessed at the same time (eg. the different levels of feedback) against one dependent variable (DV) (eg. perceived usefulness of the feedback) (Winter, 2014). The independent and dependent variables are shown in Table B5.2

	IV: Levels of Feedback	DV: Frequency of Feedback	DV Perception of Feedback
Medical Students 5 IVs, 4DVs = 4 repeated measures ANOVA's conducted	1. Self 2. Task 3. Process 4. Goal setting 5. Self-monitoring	1. After good performance 2. After poor performance	3. After good performance 4. After poor performance
Clinical Educators 5 IVs, 2DVs = 2 repeated measures ANOVA's conducted	1. Self 2. Task 3. Process 4. Goal setting 5. Self-monitoring	1. After good performance 2. After poor performance	-

Table B5.2. The independent (IV) and dependent variables (DV) for the ANOVA's

Partial Eta Squared ($\eta 2$) was used as a measure of effect size to quantify the magnitude of the difference between two groups (eg. clinical educators and medical students (between subjects) or the medical students on two measures (within subjects) (Coe, 2002). This is important, since it addresses the fact that whilst the difference may be statistically significant the difference in the means may not be particularly meaningful. To address this, effect size uses the variation in scores to contextualise the difference between the two groups. A greater spread of scores in each group means that there will be a greater overlap between the scores in each group, showing that the size of the difference between each group is not that great. A small effect size (small difference between each group) is $\eta^2 = 0.01$, medium is $\eta^2 = 0.06$ and large is $\eta^2 = 0.14$ (Cohen, 1988). Measuring the effect size is important since it places an emphasis on the size of the effect, rather than relying solely on the statistical significance (Sullivan & Feinn, 2012). Partial Eta squared was the measure of effect size used since it is often employed for use with ANOVAs (Lakens, 2013).

B5.4.1 Type of Feedback

Independent t-tests revealed that clinical educators report providing feedback on a one-one basis more often than medical students report receiving it ($t(383)=-7.2$, $p<.001$). Clinical educators also report providing feedback both verbally ($t(99)=4.7$, $p<.001$) and in a written format ($t(72)=4.8$, $p<.001$) more often than medical students perceive that they receive it. To summarise, both clinical educators and medical students report that feedback is most often verbal and occurs both one-on-one and in group settings (Table B5.3).

	Mean of how Often Medical Students Receive Feedback:	Mean of how Often Clinical Educators Provide Feedback
One on one	2.9	3.7
Group	3	3.1
Verbal	3.6	4.2
Written	1.9	2.7

Table B5.3. Medical students and clinical educators perceptions of how often feedback is provided
Note: Mean: 1= Never, 5= Always

B5.4.2 The Influence of Contextual Factors on DDM.

Paired samples t-tests (Table B5.4) were conducted to determine whether there were significant differences between how often students perceived their DDM to be influenced by contextual factors and how often they felt they were provided with feedback that took these into account. For each contextual factor, medical students perceived that their DDM was influenced by that factor to a greater extent than they were provided feedback on that factor. These differences were significant at the $p=0.05$ level. The effect size ranged from 0.11 (small/medium) to 0.45 (large). This suggests that for each contextual factor, apart from number of patients' previous visits and communication barriers, a large amount of the variance in the perception of the influence of and frequency of receiving feedback on each factor was explained by the contextual factor.

For the clinical educators, there were fewer significant differences between how influential they perceived a contextual factor to be and how often they provided feedback on it (Table B5.4). There were significant differences for time ($t=-2.1(57)$, $p<0.05$, $\eta^2= 0.07$), the patient's number of previous visits ($t= 2.04(54)$, $p<0.05$, $\eta^2=0.07$) and knowledge ($t=3.38(56)$, $p<0.001$, $\eta^2=0.17$). The influence of a patient's number of previous visits and knowledge were seen as more common than the frequency with which feedback was provided on these factors. However, the clinical educators perceived they provided more feedback which took time into consideration in comparison with how influential they perceived this to be. The small to medium effect size of $\eta2=0.07$ for time and previous visits shows that only 7% of the variance between perceived influence and feedback is accounted for by the factor suggesting that the practical significance of these differences is relatively low. The higher effect size for knowledge shows that 17% of the variance between perceived influence and feedback is explained for by the factor of knowledge suggesting a greater practical significance of these differences.

Factor	Medical Students					Clinical Educators				
	Perceived influence on DDM Mean	Feedback received Mean	T value t=	Probability. * the mean difference is significant at the p=0.05 level	Effect size. η^2	Perceived influence on DDM Mean	Feedback given Mean	T value t=	Probability * the mean difference is significant at the p=0.05 level	Effect size η^2
Time	3.5	2.6	15.20	*p < 0.001	η2 = 0.45	3.2	3.5	-2.1	*p < 0.05	η2= 0.07
Noise	2.5	2	10.78	*p < 0.001	η2 =0.30	2.3	2.2	0.3	p> 0.05	η2= 0.00
Setting	2.9	2.3	12.21	*p < 0.001	η2=0.36	2.9	3	-0.32	p>0.05	η2=0.00
Number of patient previous visits	3.1	2.5	11.33	*p < 0.001	η2 =0.11	2.9	2.7	2.04	*p< 0.05	η2=0.07
Attitude	2.8	2.6	5.75	*p < 0.001	η2 =0.13	2.9	2.8	0.65	p>0.05	η2 =0.01
Communication barriers	3.1	2.9	5.71	*p < 0.001	η2 =0.11	3.2	3.1	0.94	p>0.05	η2=0.02
Confidence	3.4	2.9	10.27	*p < 0.001	η2 =0.28	3.7	3.6	1.6	p>0.05	η2=0.04
Knowledge	3.8	3.1	13.20	*p < 0.001	η2 =0.36	4.0	3.6	3.38	*p < 0.001	η2=0.17

Table B5.4. The perceived influence of contextual factors on DDM and how often feedback is provided on these
Mean. 1= Never, 5= Always

In summary, for each of the 8 contextual factors the students perceived the factors as having a greater influence on their DDM compared to how often they were provided with feedback on them. This suggests that medical students perceive that they do not often receive detailed, specific feedback on factors they perceive may have been relevant to their DDM performance. For 5 of the contextual factors clinical educators perceived that they provided feedback in keeping with how influential the factors were deemed to be on medical students' DDM. However, they did perceive that they provided less feedback which took into account the influence of a patient's number of previous visits and the student's prior knowledge compared with their perceived influence of these on DDM.

B5.4.3 Differences between Medical Students and Clinical Educators: the Influence of Contextual Factors

Independent t-tests revealed significant differences between the extent to which medical students and clinical educators perceived time constraints, noise in the setting, and the students' confidence and previous knowledge to affect DDM (Table B5.5). Medical students perceived time constraints ($t(364)=2.08$, $p<.04$), and the noise ($t(360)=2.5$, $p<.04$) in the setting as impacting their DDM more often than the clinicians did. The clinical educators in contrast perceived the students' confidence ($t(356)=-3.5$, $p<.001$) and previous knowledge ($t(349)=-2.4$, $p<.001$) as influencing their DDM more often than the students did (Table B5.5). However, the effect sizes for these differences were relatively small. The variance in the perceived influence of these contextual factors on DDM accounted for by the influence of these contextual factors, ranged from 1-6%. This suggests that there is a low practical significance of the differences between medical students and clinical educators' perceptions of the influence of contextual factors on DDM.

Factor Perceived to Influence DDM	Mean Medical Students	Mean Clinical Educators	T-test, Significance (*p)* and Effect size *(η^2).*
Time	3.5	3.2	2.08, $p<.04$*, $\eta^2= 0.01$
Noise	2.5	2.3	2.05, $p<.04$*, $\eta^2= 0.02$
Confidence	3.4	3.8	-3.46, $p<.001$*, $\eta^2= 0.06$
Knowledge	3.8	4.0	-2.43, $p<.001$*, $\eta^2= 0.06$

Table B5.5. Perceived differences between medical students and clinical educators perceptions of the influence of contextual factors

*The mean difference is significant at the p=.05 level. Mean: 1= never , 5= always

Independent t-tests revealed significant differences between how often medical students and clinical educators perceived that they received/provided feedback on time constraints, the setting, the student's confidence and their knowledge (Table B5.6). For each factor the students reported receiving less feedback which took these factors into account in comparison to how often the clinical educators perceived they provided such feedback. However, the effect sizes for these differences were relatively small. The variance in the frequency of feedback provided on these factors, as accounted for by perceived frequency of these factors, ranged from 5-11%. This suggests that there is a low practical significance of the differences between medical students' and clinical educators' perceptions of how often feedback is provided on the influence of these factors on DDM.

How Often Feedback is Provided on the Factor	Mean Medical Students	Mean Clinical Educators	T-test, Significance (*p*) and Effect size (η2).
Time	2.6	3.4	-6.4, $p<.001$*, $\eta^2=0.11$
Setting	2.3	3.0	-5.1, $p<.001$*, $\eta^2= 0.08$
Confidence	2.9	3.6	-5.2, $p<.001$*, $\eta^2=0.10$
Knowledge	3.1	3.6	-3.8, $p<.001$*, $\eta^2=0.05$

Table B5.6. Perceived differences between medical students and clinical educators in how often feedback is provided on contextual factors

*The mean difference is significant at the p=.05 level: Mean: 1= never , 5= always

To summarise, students view the contextual factors of noise in the setting and time constraints as more influential to their DDM than the clinical educators do. In contrast, the clinical educators view

the confidence and knowledge of the student to have a greater influence on the students' DDM than the students do. Furthermore, the students report receiving less feedback on the influential roles of time, setting, their confidence and knowledge, in comparison to how often clinical educators report providing feedback on these factors.

B5.4.4 Medical Students' Perceptions of the Frequency and Usefulness of Feedback

Poor Performance

Medical students perceive certain levels of feedback after poor performance to be differentially useful $F(1,288)= 385.25$, $p<.001$, $\eta 2 =0.57$). The large effect size here suggests a large observed effect with 57% of the variance in perceptions of how useful feedback is after poor performance being accounted for by the perceived usefulness of the five levels of feedback. Feedback which is focused on the processes the student employed in DDM (M= 3.39), on the goals and plans they set out to follow (M= 3.52), and feedback on their monitoring of their progression through their DDM (M= 3.31) is perceived to be significantly more useful than feedback focused on the self (M= 1.33, $p<.001$) and the task itself (M= 1.87, $p<.001$) (Table B5.7).

Level of Feedback after Poor Performance	Perception of Feedback Mean (M)	Perception of Levels of Feedback Compared with Each Level. Significance (p) and Effect size (η^2).			
		Self-praise	Task	Processes	Plans and Goals set
Self-praise	1.33	-	-	-	-
Task	1.87	*p<0.001, $\eta 2$ =0.25	-	-	-
Processes and techniques	3.39	*p<0.001, $\eta 2$=0.76	*p<0.00, $\eta 2$ =0.62	-	-
Plans and Goals set	3.52	*p<0.001, $\eta 2$ =0.76	*p<0.001, $\eta 2$ =0.60	p> 0.05, $\eta 2$ =0.02	-
Self-monitoring	3.31	*p<0.001, $\eta 2$ =0.66	*p<0.001, $\eta 2$ =0.48	p>0.05, $\eta 2$ =0.01	p<0.002, $\eta 2$ =0.04

Table B5.7. Medical students' perceptions of the usefulness of feedback after poor performance
*The mean difference is significant at the p=.05 level: Mean: 1= not very useful , 5= very useful

Medical students receive certain levels of feedback more often than others after poor DDM ($F(1, 222)= 37.21$, $p<.001$, $\eta 2 =0.11$). The small effect size here suggests that, despite the significant

differences in feedback received at the five levels, only 11% of the variance in perceptions of how frequently feedback is provided is explained by the perceived frequency of feedback. The students reported receiving significantly more feedback which focused on the processes they used in their DDM (M=2.22) compared to all other levels of feedback (p< .001). Feedback on the goals and plans set (M=1.97) was also received significantly more often than feedback about the self (M= 1.74, p< .001), the task (M= 1.75, p<.001), or monitoring throughout DDM (M=1.75, p< .001) (Table B5.8).

Level of feedback after poor performance	Frequency of feedback received Mean (M)	Perception of Levels of Feedback Compared with Each Level. Significance (p) and Effect size (η^2).			
		Self-praise	Task	Processes	Plans and goals set
Self-praise	1.74	-	-	-	-
Task	1.75	p>0.005 η2 =0.00			
Processes and techniques	2.22	*p<0.001 η2 =0.20	*p<0.001 η2 =0.25		
Plans and goals set	1.97	*p<0.001 η2 =0.06	*p<0.001 η2 =0.07	*p<0.001 η2 =0.09	
Self-monitoring	1.75	p>0.05 η2 =0	p>0.05 η2 =0	*p<0.001 η2 =0.26	*p<0.001 η2 =0.11

Table B5.8. Medical students' perceptions of the frequency of feedback received after poor performance
*The mean difference is significant at the p=.05 level. Mean: 1= never, 5= always

Good Performance

Medical students perceive certain levels of feedback to be more useful than others after good DDM ($F(1,309)= 322.365$, $p<.001$, $\eta 2 =0.69$). The large effect size here indicates that 69% of the variance in perceptions of how useful feedback is after good DDM is explained by the perception of the five levels of feedback; indicating that the differences have high practical significance. Feedback on the goals and plans used in good DDM (M=4.35) was perceived as being significantly more useful than feedback at any other level ($p<.001$). Furthermore, feedback at each level was perceived as being significantly more useful than feedback at the level of the self (M=2.52, $p<.001$) (Table B5.9).

Level of Feedback after Good Performance	Perception of Feedback Mean (M)	Perception of Levels of Feedback Compared with Each Level. Significance (p) and Effect size (η^2).			
		Self-praise	Task	Processes	Plans and Goals set
Self-praise	2.52	-	-	-	-
Task	2.94	* p<0.001, $\eta 2$ =0.15	-		
Processes and techniques	3.67	* p<0.001, $\eta 2$ =0.46	*p<0.001 $\eta 2$ =0.37		
Plans and Goals set	4.35	* p<0.001, $\eta 2$ =0.67	*p<0.001 $\eta 2$ =0.62	*p<0.001 $\eta 2$ =0.39	
Self-monitoring	4.04	*p<0.001, $\eta 2$ =0.60	*p<0.001 $\eta 2$ =0.50	*p<0.001 $\eta 2$ =0.13	*p<0.001 $\eta 2$ =0.15

Table B5.9. Medical students' perceptions of the usefulness of feedback after poor performance
*The mean difference is significant at the p=.05 level. Mean: 1= never, 5= always

Medical students receive certain levels of feedback more often than others after good performance ($F(1,295)=156.95$, $p<.001$, $\eta 2 =0.35$). The large effect size here shows that 35% of the variance in perceived frequency of feedback provision after good performance is explained by the perceived frequency of feedback at the five levels of feedback; this indicates a high practical significance of the differences. Feedback at the level of the self was the feedback received most often after good DDM ($M= 3.21$, $p<.001$) compared to feedback at any other level ($p<.001$). Feedback on the goals and plans set ($M= 2.03$) and the use of self-monitoring ($M=2.28$) was also received significantly less than the other levels of feedback ($p<.001$) (Table B5.10).

Level of feedback after good performance	Frequency of feedback received Mean (M)	Perception of Levels of Feedback Compared with Each Level. Significance (p) and Effect size (η^2).			
		Self-praise	Task	Processes	Plans and goals set
Self-praise	3.21	-	-	-	-
Task	2.92	*p<0.001 $\eta 2$ =0.15			
Processes and techniques	2.54	*p<0.001 $\eta 2$ =0.32	*p<0.001 $\eta 2$ =0.18		
Plans and goals set	2.03	*p<0.001 $\eta 2$ =0.53	*p<0.001 $\eta 2$ =0.44	*p<0.001 $\eta 2$ =0.25	
Self-monitoring	2.28	*p<0.001 $\eta 2$ =0.44	*p<0.001 $\eta 2$ =0.31	*p<0.001 $\eta 2$ =0.09	*p<0.001 $\eta 2$ =0.10

Table B5.10. Medical students' perceptions of the frequency of feedback received after poor performance
*The mean difference is significant at the .05 level: Mean- 1= never, 5= always

Medical students view feedback on plans and goals set, use of self-monitoring and their use of processes as being the most useful to improve their performance. After poor performance medical students perceive that they are most likely to receive feedback which focuses on their use of processes. However, after good performance they perceive being more likely to receive feedback which praises their performance or is focused on whether they performed the task correctly or not. Paired samples t-tests revealed for each level of feedback (except goal setting and planning) that the students reported receiving significantly (p<.001) more feedback after good performance (Table B5.11). The effect sizes of these differences range from 0.10- 0.65 demonstrating that for self-praise (0.65), task (0.56), process (0.10) and self-monitoring (0.25) there was a significant portion of the variation of how often feedback was received which was influenced by whether the feedback was provided after poor or good DDM at each of these levels. In particular, for feedback at the level of self-praise and task there is a large practical significance of the difference in how often participants reported receiving feedback after good DDM compared with after poor DDM.

Paired samples t-tests also revealed that the medical students perceived each level of feedback to be significantly more useful (p<.001) after good performance compared to after poor performance (Table B5.11). The effect sizes of these differences range from 0.05 to 0.49, demonstrating that for self-praise (49%), task (38%), plans and goals set (30%) and self-monitoring (24%) a significant portion of the variation in perceived usefulness of the feedback was influenced by whether the feedback was provided after poor or good DDM after each of these levels. However, for the perceived usefulness of processes the effect size indicated that only 5% of the variance in the perceived usefulness of feedback was influenced by whether the feedback was provided after poor or good DDM, suggesting a small practical significance.

Level of feedback	Perception of Feedback t value, p. value and effect size of difference for perceptions of feedback after poor and good DDM	Frequency of feedback received t value and p. value and effect size of difference for perceptions of feedback after poor and good DDM
Self-praise	*t= 17.42, p<.001, η2 =0.49	*t= 23.96, p< .001, η2 =0.65
Task	*t= 13.80, p<.001, η2 =0.38	*t= 20.19, *p*<.001, η2 =0.56
Processes and techniques	*t= 4.04, p<.001, η2 =0.05	*t=6.01, p<.001, η2 =0.10
Plans and goals set	*t= 11.37, p<.001, η2 =0.30	t=1.41, p>.05, η2 =0.01
Self-monitoring	*t= 9.95, p<.001, η2 =0.24	*t= 10.3. p<.001, η2 =0.25

Table B5.11. Differences between medical students' perceptions of feedback and the frequency of feedback after good and poor performance

*The mean difference is significant at the p=.05 level. Mean: 1= never, 5= always

B5.4.5 Clinical Educators' Perceptions of the Frequency of Feedback

Clinical educators report differences in how often they provide feedback at the different levels of feedback after poor performance ($F(1,60)= 46.6$, $p<.001$, $\eta^2 =0.44$). The large effect size shows that 44% of the variance in perceptions of how frequently feedback is provided after poor performance is explained by the different levels of feedback. Feedback at the level of the self (M= 1.1) and the task (M= 1.4) was provided significantly less often than feedback at the higher three levels ($p<.001$) of processes, planning and goal setting, and self-monitoring (Table B5.12).

Level of Feedback after Poor Performance	Frequency of Feedback Received Mean (M)	Perception of Levels of Feedback Compared with Each Level. Significance (p) and Effect size (η^2).			
		Self-praise	Task	Processes	Plans and Goals set
Self-praise	1.10	-	-	-	-
Task	1.41	*p<0.001 η^2 =0.24			
Processes and techniques	2.55	*p<0.001 η^2 =0.70	*p<0.001 η^2 =0.62		
Plans and goals set	2.46	*p<0.001 η^2 =0.59	*p<0.001 η^2 =0.46	p>0.05 η^2 =0.00	
Self-monitoring	2.15	*p<0.001 η^2 =0.56	*p<0.001 η^2 =0.32	p>0.05 η^2 =0.09	p>0.05 η^2 =0.09

Table B5.12. Clinical educators' perceptions of the frequency of feedback provided after poor performance
*The mean difference is significant at the p=.05 level. Mean; 1= never, 5= always

Clinical educators report differences in how often they provide feedback at the different levels after good performance ($F(1,61)=4.58$, $p<.04$, $\eta^2 =0.07$). The relatively small effect size shows that only 7% of the variance in perceptions of how frequently feedback is provided after good performance is explained by the different levels of feedback; indicating that these findings have low practical significance. Feedback at the level of the processes (M=2.92) employed is provided significantly more often than feedback at the level of the self (M=2.5, $p<.03$) and the task (M=2.45, $p<.01$). Feedback

on self-monitoring (M=3.0) is also provided more often than feedback on plans and goal setting (M=2.52, p<.02) (Table B5.13).

Level of feedback after good performance	Frequency of feedback received Mean (M)	Perception of Levels of Feedback Compared with Each Level. Significance (p) and Effect size (η^2).			
		Self-praise	Task	Processes	Plans and goals set
Self-praise	2.25	-	-	-	-
Task	2.45	p>0.05 η^2 =0.00			
Processes and techniques	2.92	*p=0.03 η^2 =0.13	*p<0.01 η^2 =0.16		
Plans and goals set	2.52	p>0.05 η^2 =0.00	p>0.05 η^2 =0.00	p>0.05 η^2 =0.07	
Self-monitoring	3.0	p>0.05 η^2 =0.11	p>0.05 η^2 =0.12	p>0.05 η^2 =0.00	*p=0.024 η^2 =0.14

Table B5.13. Clinical educators' perceptions of the frequency of feedback provided after good performance
*The mean difference is significant at the p=.05 level. Mean: 1= never, 5= always

Clinical educators report that they are most likely to provide feedback on medical students' use of processes and their self-monitoring of their performance after both poor and good performance, as well as goals and plans after poor performance. Self and task level feedback is reported to be provided less often after poor performance in comparison to good performance. Furthermore, paired samples t-tests revealed that for each level of feedback except feedback on plans and goals set, clinical educators report providing significantly more feedback after good DDM (Table B5.14). The effect sizes reveal that a large portion of the variation in the perceived frequency of feedback provided after poor and good DDM is explained by three levels of feedback, self, task and self-monitoring; indicating a practical significance for these differences.

Level of Feedback	Frequency of Feedback		T- value(t) , Significance (p) and Effect size (η^2) for difference in Feedback Frequency after Good and Poor DDM
	After Good DDM Mean	After Poor DDM Mean	
Self	2.5	1.1	*t= 10.90, p<.01, η^2=0.66
Task	2.5	1.4	*t= 7.78, p<.01, η^2=0.50
Processes and techniques	2.9	2.5	*t= 2.70, p<.01, η^2=0.11
Plans and goals	2.5	2.5	t= 0.43, p >.05, η^2=0.00
Self-monitoring	3	2.1	*t= 6.09, p<.01, η^2=0.39

Table B5.14. How frequently clinical educators provide feedback after good and poor performance
*The mean difference is significant at the p=.05 level. Mean: 1= never, 5= always

B5.4.6 Differences between Medical Students and Clinical Educators: The Frequency of Feedback Provision.

Independent samples t-tests were conducted to determine whether there was a significant difference between how often medical students perceived they were provided with feedback at the 5 levels and how often clinicians perceived that they provided such feedback (Table B5.15). After both poor and good performance, there were significant differences in the perceptions of the frequency of feedback at each level. Medical students perceive receiving significantly more feedback at the level of the self (p<.001) and the task (p<.001) after both poor and good performance than clinicians perceive they provide. In contrast, clinical educators report providing more feedback at the level of plans and goals set (p<.003), the processes (p < .005) and self-monitoring (p<.007) after poor and good performance than medical students perceive receiving.

Level of Feedback. After Good DDM	Medical Student Mean	Clinical Educator Mean	T-value (t), Significance (p) and Effect size (η^2)
Self	3.2	2.5	* 5.8, p<0.001, η^2=0.16
Task	2.9	2.5	* 3.5, p<0.001, η^2=0.10
Process and techniques	2.6	2.9	*-2.9, p<0.005, η^2=0.07
Plans and goals	2.1	2.5	*-3.1, p<0.003, η^2=0.08
Self-monitoring	2.3	3	*-5.4, p<0.001, η^2=0.09
Level of Feedback. After Poor DDM	Medical Student Mean	Clinical Educator Mean	T-value (t), Significance (p) and Effect size (η^2)
Self	1.8	1.1	*6.4, p<0.001, η^2=0.12
Task	1.7	1.4	*3.4, p<0.001, η^2=0.05
Process and techniques	2.2	2.5	*-2.3, p<0.02, η^2=0.05
Plans and goals	2	2.5	*-3.2, p<0.001, η^2=0.13
Self-monitoring	1.8	2.1	*-2.8, p<0.01, η^2=0.06

Table B5.15. Differences in medical students' and clinical educators' perceptions of how often feedback is given after good and poor performance

*The mean difference is significant at the p=.05 level. Mean: 1= never, 5= always

Overall, medical students report receiving more feedback at the levels of the self and task, and less feedback at the levels of the processes employed, goal-setting and planning, and self-monitoring. In contrast, clinical educators report providing less feedback at the levels of the self and task and more feedback at the levels of the processes employed, goal-setting and planning, and self-monitoring. However, it is important to note that the effect size for these differences mostly range from a small to medium effect size. This indicates that the differences in perceptions of the frequency of task, process and self-monitoring feedback after poor DDM; and process, planning and goal-setting and self-monitoring after good DDM, may only have a moderate practical significance. This could suggest that these differences have less impact on the amount of feedback received than may be indicated by the significance of the t-test.

B5.5 Qualitative Analysis and Results

The free-text response questions elicited more detailed information about the medical students' and the clinical educators' opinions about the feedback they receive and provide. Their responses were usually one or two word answers which meant they were easy to code into various categories. The data was collected with the participation of the subjects and was seen as both information to understand the situation (feedback provision) and as information leading to action to resolve a problem (how feedback could be improved) (Miles & Huberman, 1994). Researchers debate whether content analysis should be qualitative or quantitative (Berg, 2007); however, it is largely accepted that it can be both (Berg, 2007). As such, content analysis has been described as being able to describe any type of communication (Abrahamson, 1983). Conventional content analysis (Hsieh & Shannon, 2005) was used to analyse the comments and suggestions made by the clinical educators. Content analysis is employed as a systematic coding and categorizing approach for analysing the content in the data to determine the patterns and trends of the words used, their frequency and their relationships (Grbich, 2007; Pope et al., 2006; Mayring, 2000). The elements identified in this content analysis were the codes and categories running through participants responses. The categories identified were classed as 'theoretical classes' since they emerged in the process of analysing the data (Gray, 2013). This process was employed for each question in order to provide a list of key specific categories and ideas for each question. The individual categories were not grouped together with similar categories since I was interested in each individual category and the number of times this was mentioned. Of the 312 medical students who completed the questionnaire 250 completed at least one of these questions. Of the 62 clinical educators who completed the questionnaire 50 completed at least one of the questions.

B5.5.1 How Feedback Is Usually Provided

The clinical educators were asked how they usually provided feedback to their students (Table B5.16). The most common method appeared to be to focus on the student's goals, how they achieved these goals and what they may have done wrong:

> *"Ask peers to feedback if in a group situation. Give positive feedback as to what they did well. Explore with the student why certain areas did not go well and encourage them to think of ways they could improve and further develop in their areas of weakness."*

A main focus of the feedback tended to be on the students aims, what they set out to achieve and why this may not have worked as well as they would have liked. A number of clinicians also reported using the 'praise sandwich' technique of beginning and ending the feedback with positive affirmations and discussing any negatives in the middle. Another common strategy was to provide positive verbal feedback:

> *"I use a structured verbal system asking them to reflect on positive aspects before considering areas for improvement. I sometimes probe to determine how and why decisions were made and get them to talk through their thought processes."*

Feedback was often provided in a one-to-one setting, immediately after the clinical interaction. The clinicians also reported that they often asked the student to reflect on their performance. Only a small number of clinicians reported that their feedback was provided ad hoc, with little structure. However, it is unlikely that many would admit providing unstructured feedback as this may portray them negatively.

How Feedback is Usually Provided	Number of Respondents (n=50)
Focus on what the student aimed to do and how well they did. (Goal focus)	20
Verbal	17
Positive	14
Involve student reflection	13
Immediate	9
Negative	8
One on one	7
Praise sandwich	6
Structured	6
Focus on the process	4
Ad hoc with no structure	4
Focus on only one main area for improvement	3

Table B5.16. How clinical educators report feedback is usually provided

These responses suggest that feedback is overtly positive and is most likely to focus on the students' goal setting, taking into account what they did and what they may have done wrong. This pattern matches that of the quantitative results which showed feedback is most likely to focus on the students' goals and plans and be provided after good performance.

B5.5.2 Feedback Frequency After Good and Poor Performance

The medical students and the clinical educators were asked whether feedback was more likely after good or poor performance (Table B5.17). Two hundred and fifty medical students answered this question. Ninety-five stated that they were more likely to get feedback after very good DDM. Many participants believed that clinicians find it easier to give feedback after good DDM because it was perceived to be easier and they wanted to boost their students' confidence. Feedback after poor DDM was often associated with not being *nice*, rather than seen as a useful tool to assist performance.

Lack of time was also a reason given by the students for receiving more feedback after good performance:

> *"Very good, because clinicians just don't have the time to explain".*

These students tended to believe that clinicians avoided providing feedback after poor performance due to not feeling comfortable dealing with such situations and a lack of time to go over areas of weakness. In contrast, ninety-three students stated that they were more likely to get feedback after very poor DDM. This was reasoned because the clinician would want them to improve and would need to correct or identify poor or incorrect DDM. It was also highlighted that poor performance may lead to patient harm and so it was important that it was rectified:

> *"Yes, if your performance is poor, the chances of receiving useful an*d *constructive feedback is more likely than if you performed well. If you performed poorly it is probably more concerning to their teaching provided and your educational advancement".*

Sixty participants believed that they were equally likely to get feedback if they had performed exceptionally well or exceptionally poorly.

Feedback More Likely to be Provided After:	Number of Respondents			
	Medical Students		Clinical Educators	
	n=248	%	n= 48	%
Very Good DDM	95	38.3	7	14
Very Poor DDM	93	37.5	9	19
No Difference Between Very Good DDM or Very Poor DMM	60	24.2	32	67

Table B5.17. Perceptions of whether feedback is more likely after poor or good performance

The clinician's results portrayed a different pattern of feedback provision. Taken as a whole, their responses indicated no difference between feedback after good or poor performance (48 clinicians

answered this question). The majority (n=32) reported providing feedback equally as often after good or poor performance:

"I always give feedback after each consult regardless of performance".

Despite this, however, many additionally stated that they preferred to provide feedback after good performance (n=7) as it was easier and they disliked being overly critical of the students:

"Very good performance, as it is easier to give someone good feedback than negative feedback. If you are going to give negative feedback on something you need to make sure that it is constructive with points to work on".

These results suggest that in the eyes of the students, feedback is either provided more often after poor or good performance, or equally as likely as either. From the opinion of the clinical educators they are equally as likely to provide feedback after poor or good DDM. This may reflect clinical educators' desire to provide feedback after poor performance but finding this harder to deliver, as indicated by the quantitative results which showed that more feedback is provided after good performance.

B5.5.3 Problems with Current Feedback Provision

Medical students

Most participants gave one or two points which were summarised into the categories listed below (Table B5.18). The quantity of feedback was the main complaint; medical students believe that they do not get enough feedback on their DDM:

"I think the feedback is very few and far between. It is dependent on the consultant/placement".

Another major complaint was the feedback itself; medical students believe that it is often not very constructive, detailed or specific. The feedback is often generic comments such as "great job" or "well done" without discussing individual or specific causes, areas of weakness or areas for

improvement. Coupled with the lack of feedback, the students felt a general lack of opportunities to engage in DDM and the variability of opportunities afforded by different placements, settings and clinicians. Students also reported that even if they did get the opportunity to engage in DDM this interaction was not always observed by the clinician giving feedback. As most DDM takes place within the clinical setting, there is also the issue of regular, timely and detailed feedback. This is recognised by the students who identify the noise of the setting, the busyness, time constraints of the clinical educators and the inappropriateness of feedback in certain settings as negatively impacting the feedback that clinicians are able to provide. Another criticism was that the feedback does not always tell the students how they could have improved or provide feedback on the processes, strategies and methods they used to arrive at the diagnostic decision. The following summarises this well:

> *"Yes, although, the majority of the feedback received is useful and practical I do feel that the feedback could be more constructive and detailed and tailored to you as it is more likely to be generic if the diagnosis is accurate. Although, the time constraints of the clinicians affect the feedback greatly".*

Increasingly, students are provided with feedback using IPhone based apps. Some students feel there is an overreliance on such apps and methods of feedback provision, and that these are detrimental to the meaningfulness of the feedback provided. Some students also disliked receiving more verbal compared to written feedback and reported dissatisfaction with the lack of uniform structure with how they are provided with feedback across the medical school. The quantity and quality of feedback, as well as the method by which feedback is provided appears to differ depending on the clinical educator and the clinical setting. Some students perceived clinical educators as being reluctant to provide feedback and having to request it:

> *"Opportunities for feedback are not given equally to all students as they depend entirely on the clinicians supervising you and their enthusiasm".*

The problems highlighted by the medical students may make it harder for them to get used to receiving and using feedback effectively.

Problems with Feedback on DDM		Number of Respondents.	
		Medical Students	Clinical Educators
Quantity. Not enough feedback		85	2
Feedback is not specific or detailed and is often generic		81	11
Time constraints on the clinician		40	21
Feedback is not constructive		20	-
Not enough opportunities to be observed and DDM feedback provided		18	2
Not enough opportunities to make diagnostic decisions		12	-
Lack of uniform structure with how feedback is provided		12	11
No problems		10	10
Over use of Mini CX and Iphone Apps- WPBA		6	-
Tutors seem reluctant to provide feedback		6	-
Verbal feedback		5	-
Have to request		5	-
Do not like giving negative feedback		-	5
Feedback is dependent on tutors and whether they want to provide it		4	-
Not enough attention paid to feedback on how the decision was arrived at		3	-
Don’t how useful it was to the students		0	1
Does not take environment or confidence into account		-	2
Not monitored on how they provide feedback and need more training		-	2
Problems with the setting	Too busy	17	-
	Not appropriate	5	-
	Too noisy	1	-

Table B5.18. Problems with current feedback provision

Clinical Educators

Overall, the clinical educators' perceive similar problems with the feedback process to the medical students (Table B5.18). Of the 50 clinicians who responded to this question only 10 believed that there were no problems with how they provide feedback. The most common complaint was lack of time to provide detailed, useful feedback. Similar to the medical students, another common factor was a belief that the feedback they provide is not detailed enough and lacks structure in its delivery:

> *"I think it should be more structured and take account more of what students really need".*

> *"I would like to have a structure of four or five domains that the students are aware of, and that ensure that I comment on all areas for each consultation".*

Only two clinicians saw the lack of focus on contextual factors and the trainees' confidence as a problem. It is interesting to note that there were a number of common complaints made by the students that the clinicians did not report. These included, the feedback not being constructive enough and not having enough opportunities to make diagnostic decisions in real practice. Clinicians also did not see a problem with the feedback being verbal and did not find that the Apps were overused. It is possible that these approaches make feedback provision easier for the clinicians and so they are less likely to view them as hindrances. Furthermore, some of the medical students' responses were negative about the clinicians and their attitude to feedback provision; clinicians are unlikely to report that they themselves are reluctant to give feedback or that they only provide it if requested by the student. Only five people reported not liking giving negative feedback.

Despite the discrepancies the results suggest that both medical students and clinicians perceive time constraints, busy clinical settings and lack of formal structured feedback provision to be the overarching problems with current feedback provision. The claim made by the students that feedback is often more generic after good performance is supported by their perceptions of how often self and task level feedback are received after good performance. Students often also perceive that they are not given enough opportunities to make diagnostic decisions. It is noteworthy that the clinical

educators themselves perceive that they do not feel able to provide well-structured feedback. Furthermore, these statements conflict with the quantitative results of the clinical educators reporting they are most likely to give detailed feedback.

B5.5.4 Suggestions to Improve Feedback

Medical Students

In answer to this question students most commonly reported that they would like to have formal, structured one-to-one sessions with the clinician as soon as possible after a ward round or shift (Table B5.19):

> *"More protected time where we get to meet with a specific trainer and be provided with detailed feedback in a private setting".*

They also stated that they would like this time to be protected time in order for the clinician to be able to provide effective feedback. Specifically, there is a demand for there to be a greater quantity of feedback, provided more regularly, which is more detailed and provides specific information about what was done right and wrong. A smaller number of students suggested that this may be improved if there was a clearer link between teaching and the aims of the medical school and teaching within the clinical setting. Furthermore, many students recognised the potential need for clinical educators to receive some (or more) formal training in how to give effective feedback. This need was also recognised by the educators themselves. Despite some medical students preferring verbal feedback a number of students stated a desire for written feedback since this would allow them to reflect on the feedback for their learning needs at a later date:

> *"Write it down then it is more thought through and can be used in the future".*

Students also sought more opportunities to be observed making diagnostic decisions. They stated that they are not often observed by the clinical educator who gives them feedback or are not observed for the whole consultation. Additionally, third year students noted that, aside from GP placements, their clinical interactions with patients were not routinely observed nor were they provided with

feedback as regularly. A number of students also suggested the use of online or paper feedback forms. The suggestions for these forms varied from tick boxes to individual detailed forms for each student:

> *"A weekly feedback form like on the GP placements where we had to be observed doing consultations. If we had this on all placements it would be useful".*

> *"Maybe an automated concise electronic tool to standardise and ensure more useful feedback through performances".*

A number of students suggested giving the clinical educators certain criteria to comment on. Another suggestion was to add a diagnosis section to the log book, where clinicians could give feedback on the students' focus and confidence. However, they did not provide specific criteria or set questions. The use of IPhone Apps and assessment tools was mentioned previously as not being liked by the students as a tool for feedback delivery. However, students suggested a more structured and uniform use of these tools, or not relying on them so heavily. Some students suggested more tutors and clinicians should be available to provide feedback as well as making feedback mandatory and using more teaching strategies whilst in the clinical setting to aid their DDM.

Clinical Educators

Clinician responses mirror a number of the suggestions from the medical students for improving feedback, such as developing feedback forms, providing more time for feedback provision, and making the feedback more structured and detailed (Table B5.19). A number of clinicians suggested the need for a checklist as a basis to provide feedback from, or a standard format of feedback provision to work with:

> *"A standard format for feedback would help".*

The need for more time set aside to provide the feedback was also a common suggestion:

"More time for individual feedback and peer feedback- this is not available in the clinical setting".

Additionally, the clinical educators suggested that they would benefit from more training in how to provide feedback. A small number also suggested important feedback strategies to be that the feedback was face to face, written, provided immediately, use real patients and employ video feedback. Some participants suggested that placements be longer in duration so that a better relationship could develop between the student and the clinical educator:

"..a better relationship with the trainer- better student allocation. It is hard to give constructive feedback if you are only going to see the student for a single session".

This point is also alluded to by the medical students who desire longer placements to enhance the relationship and provide more opportunities for them to be observed making diagnostic decisions. The students also insinuate this in their criticism that they are often not observed by those who provide them with overall feedback within the placement. Only two participants suggested a greater focus on the students' confidence and the influence of environmental factors.

The medical students make a number of suggestions which the clinicians do not. These included providing the feedback more regularly and in a greater quantity as well as making the sessions more formal. The students' request for more opportunities to make diagnostic decisions is not mentioned by the clinicians. This could be because they are not aware of how much contact time the students get across the whole curriculum. The clinicians also do not note the need for more verbal feedback, as they evidently believe that most of the feedback is already verbal; nor do they call for a reduction in the reliance on apps. Again, since each clinical educator only teaches the medical student within their own area of expertise they may not be aware of whether the student feels the feedback is over reliant on such apps across the curriculum.

Ways Feedback could be Improved	No. of Respondents	
	Medical Students	Clinical Educators
Structured 1-1 sessions with a tutor/clinician	45	2
Make feedback provision more regular and can provide more feedback	36	-
Make feedback more structured, provide more detailed information	33	9
Provide written feedback so that it can be reflected upon at a later date	25	2
Longer placements: more observation and strengthen relationship	22	5
Feedback forms. Tick boxes or specific forms for each student	14	9
More dedicated time for feedback provision	12	15
Make feedback sessions formal	10	-
Greater structured use of Apps	8	3
Provide more opportunities to make diagnostic decisions	9	-
Provide more verbal feedback	8	-
Train clinicians how to give feedback	7	2
Make evident the link between medical school and clinical placements	6	-
Make feedback mandatory	5	-
Immediate	5	2
Less reliance on IPhone Apps, Mini cx and WPBA	4	-
Encourage ward teaching using real patients	4	2
More tutors	2	-
Provide suggestions for improvement	3	-
Unsure	-	6
Nothing	-	4
Ask the student to reflect on the feedback	-	2
Video the feedback	-	2
Focus on confidence and environmental feedback	-	

Table B5.19. How feedback could be improved

In summary, students' desire more structured individual feedback sessions. Both students and clinical educators desire time set aside for feedback to be provided, as well as the development of structured

feedback tools to assist in the provision of feedback, and in particular the provision of structured and detailed feedback. Students additionally highlighted the importance of structured one-to-one sessions with the tutor, a desire for written feedback, longer placements, more formal feedback sessions and more opportunities to make diagnostic decisions.

B5.6 Discussion

This questionnaire study aimed to investigate the perceptions of feedback provision to medical students on their DDM from the perspectives of both the medical student and clinical educator. The findings showed that there are significant differences in how medical students and clinical educators perceive feedback is provided, the focus of the feedback and its frequency after poor and good performance. This supports previous findings by research conducted on medical students and clinical educators which suggest a longstanding discrepancy between the quantities of feedback students recognise receiving with the amount clinical educators believe they provide (Delva et al., 2013; Gil et al., 1984). There are also significant differences between students' and clinical educators' perceptions of the influence of contextual factors on DDM and the feedback provided on these. The findings further revealed that students and clinical educators hold similar views regarding the general issues surrounding feedback provision and how these could be improved. These findings will be briefly discussed with reference to the previous research they support. The findings will also be summarised in relation to their impact on how feedback could be provided more effectively to medical trainees making diagnostic decisions.

B5.6.1 Typical Feedback Setting

Although the participants report receiving and providing feedback on both an individual basis and within a group setting the clinical educators report providing significantly more individual feedback. In support, Parikh, McReelis and Hodges (2001) showed that individual feedback is most common in the medical curriculum. Individual or group feedback provision is likely to reflect the setting and how many other medical students are in that learning environment at that time. The finding that

feedback is more often given verbally than in a written format contrasts with most research within education which suggests that written feedback is most common (Blair et al., 2013). However, the prevalence of verbal feedback reported by this sample is likely to be a function of the setting where DDM occurs; as written feedback is less feasible in authentic clinical settings. Verbal feedback just after the event is likely to be effective as it directly engages the student and a mutual discussion between the supervisor and the student can be held. However, by providing written feedback the student can easily revisit the feedback comments at a later date. This assertion is confirmed by the medical students' comments; they appear receptive to the verbal feedback but are keen to additionally receive written feedback so that they can revisit it at a later date.

B5.6.2 Feedback on Contextual Factors in DDM

Medical students perceive various contextual factors to influence their DDM; but they report being less likely to receive feedback which takes these factors into account. This is important. If these factors are influencing DDM, but no feedback is being provided then it is more likely that the same factor may continue to detrimentally influence performance and hinder improvement. This suggests that clinical educators are not aware of, or are not providing feedback which recognises the impact of these factors. This assertion is partially supported by the clinical educators' perceptions of the influence of contextual factors on students' DDM. For the influences of time, setting, the learners' confidence and knowledge, the medical students report receiving significantly less feedback on these factors than the clinical educators report providing. It is possible that this is explained by the medical students not recognising the feedback as feedback (Richards et al., 2007; also see Chapter B2.4.3) but it could also indicate that clinical educators provide less feedback then they believe they do. Either explanation will have a detrimental impact on the student's learning. Additionally, there is the possibility that students and educators do not agree on their strengths and weaknesses (Feldon et al., 2014) resulting in the focus of the feedback not being perceived as useful or accurate by the medical student. Furthermore, medical students perceive time constraints and the noise in the clinical setting to influence their DDM significantly more than the clinical educators do. However, the clinical educators perceive the students' confidence and knowledge to influence their DDM significantly

more than they recognise it to. This could be explained by thinking of the differences between the student and educator as novice and expert and as performer and observer. Medical students (novice, performer) may not be accurately aware of their own lack of knowledge or be realistic about their level of competence. Such a finding is in line with the Dunning-Kruger effect discussed in Chapter B2.3.1 (Kruger & Dunning, 1999).

The clinicians more limited focus on the influence of time and noise as negatively influencing medical students' DDM may result from their position as 'expert' in comparison to the 'novice' student. It is likely that experts have a greater awareness of contextual factors in the clinical setting and may be more aware of their influence (Durning et al., 2011). This awareness may cause them to compensate for these factors in their DDM - thus limiting the negative impact on their decision making. It is possible that they may assume that medical students also have the awareness and the competence to do this and therefore they may be more likely to dismiss such factors as influencing students' decision making. Consequently, feedback needs to focus on the potential influence of the contextual factors on DDM and provide feedback on these.

B5.6.3 Less Feedback is Provided After Poor DDM

After poor performance medical students report receiving more feedback on their use of processes compared to any other level of feedback. This suggests that after poor performance little feedback except feedback on the processes employed is provided. Whereas after good performance, although most of the feedback is focused at the self and task level, feedback is also provided on the higher three levels. Supporting this pattern, both clinical educators and medical students report less feedback provision at each level of feedback (except goal setting and planning) after poor performance. Less feedback after poor performance may be detrimental to students' improvement as they will be less likely to build on their areas of deficiency and improve. It is possible that clinicians view goal setting and planning feedback as the easiest to provide after poor performance- which is why it is given after both poor and good performance. A focus on the goals a learner set themselves or how they planned to diagnose the patient may be viewed by the learner as less negative and less threatening, and for the

clinical educator, requires less detail and specific negative critical comments. An advantage of this is the usefulness and importance of feedback on the students' goals and plans on improving performance (Fuch's et al., 1997). This finding also supports Dudek et al's. (2005) assertion that clinicians may feel uncomfortable providing negative feedback

B5.6.4 Medical Students Preference for Self-Regulation Feedback

The research showed support for the perceived usefulness of receiving detailed feedback- specifically, feedback on one's plans and goals employed in decision making after both poor and good performance. This could be seen as reflecting self-regulated learning (SRL) level feedback (see Chapter B2.2.4 and B2.3.7). The desire for detailed SRL feedback, particularly after good performance, may reflect students' desires for reassurance and insights about their strengths and their level of competency. In support, previous research has found that senior medical students desire feedback with a greater emphasis on their strengths (AlHaqwi, 2012). However, this contrasts with findings which suggested that more senior students prefer feedback which is constructively critical, viewing positive feedback as less helpful (Murdoch-Eaton & Sargeant, 2012). This may have been influenced by the style of feedback students were thinking of when answering the questionnaires. Murdoch-Eaton and Sergeants' (2012) questionnaire did not ask the students specifically about SRL level feedback. SRL level feedback after good performance does not solely praise the students' performance; rather it will be specific about what the learner did well and why. Consequently, positive SRL feedback can provide a basis for further improvement.

The prevalence of self-level feedback after good performance supports Bond, Smith, Baker and Hattie's (2000) claim that self-feedback is more likely to be used in place of task, process and SRL feedback. This is potentially problematic because providing students with too much self-level feedback in place of self-regulated or process focused feedback may be detrimental to the usefulness of the feedback and the student's subsequent improvement. Additionally, positive self-level feedback in the form of praise is of limited usefulness since it carries little information about how the learner can improve and may deflect the learners' attention from their actual performance in the task (Butler,

1987). Thus, it is more likely to increase the learners' self-attention and is less likely to enhance their interest in the task (Butler, 1987). According to some literature this may lead to an increase in effort in the task; but, not to an increase in skilled performance (Baumeister et al., 1990). Specifically, research on medical students found that although praise in the form of compliments was more satisfying it did not help them learn from their performance whereas specific, constructive feedback did (Boehler et al., 2006). Furthermore, various meta-analyses have highlighted the ineffectiveness of praise as a feedback strategy (Kluger & DeNisi, 1998; Butler, 1987).

B5.6.5 Contrasting Perceptions of Students and Clinicians on Feedback

Clinical educators perceive that they provide all five levels (self, task, processes, goal setting and planning, and self-monitoring) of feedback after good performance. However, they report being most likely to provide feedback on the student's use of processes and their self-monitoring after both good and poor performance (as well as feedback on goal setting and planning after poor performance). The clinical educators' perceptions contrast with those of the students. The medical students perceive that they receive more feedback after good and poor performance which is focused on the level of the self and the task. These two perspectives are in contrast with one another; the levels of feedback which medical students perceive they receive most often are the same levels that clinical educators perceive they provide the least often. Similarly, Carless (2006) found that tutors perceived their feedback more positively than their students did in terms of whether the feedback was used to improve student learning and how often detailed feedback was provided.

Such discrepancy is difficult to account for. It is possible that the medical students do not always recognise feedback as feedback if the comments are not prefaced by the words 'feedback' (Harrell, 2007). It is claimed that feedback to the learner needs to be clearly labelled as feedback in order for it to be recognised as such (Leggio & Albritton, 2015). Consequently, students may be provided with feedback on their use of processes, goal setting and planning, and self-monitoring but not recognise the comments as explicit feedback. Another possibility is that feedback may be provided in such a

manner that students do not recognise the link between their performance and the feedback comments (Harrell, 2007). Additionally a poor or non-existent relationship between the medical student and clinical educator may influence their interpretation of the feedback. This is likely to be influential in clinical placements since forging relationships is compromised by their short duration (Reddy et al., 2015).

B5.6.6 Feedback is Perceived as Less Useful After Poor DDM Compared with Good DDM

Students perceive feedback after good performance to be more useful than feedback after poor performance. This trend is the same for more detailed and constructive feedback at the levels of goal setting and self-monitoring. This is an interesting finding since it would be assumed that feedback after poor performance would be perceived as more useful since it could aid learners' improvement to a greater extent. This is not to lessen the importance of feedback after positive performance which increases the probability that a student will engage and persist with similar tasks in the future (Deci et al., 1999) and reassures the learner of their success (Fishbach et al., 2010). If a learner is engaged with the task and is committed and motivated to achieving a set goal they are more likely to learn from positive feedback (Van Dijk & Kluger, 2001). This is especially important for novices who are less likely to know when they have performed particularly well. This also may make learners more receptive to future negative feedback after less successful performance as it indicates they have at least reached a recognised level of ability (Swann et al., 1988). However, feedback on poor performance is important as it informs the learner where they went wrong and how to improve (Hattie & Timperley, 2007; Chowdhury & Kalu, 2004). There are a number of possible explanations for this finding. Firstly, if less feedback is received after poor performance there is not as much of it to view as being useful. Secondly, the feedback received may be of a lesser quality (for example, if clinical educators find it harder to give) and thus be perceived as less useful. Medical students do actually perceive they are most likely to receive feedback on their goals and planning, use of processes and self-monitoring after poor performance. However, perhaps more detailed feedback on at these levels would be more useful in helping them to understand why they underperformed and how to

improve. Thirdly, it is possible that both feedback quality and quantity after poor performance is influenced by the clinicians' reluctance to provide negative feedback (Bandiera & Lendrum, 2008). Fourthly, the students may be less receptive of negative feedback depending on their motivation to learn, their goal focus and their receptivity to the feedback (Delva et al., 2013; Sargeant et al., 2008b; Sargeant et al., 2005; Kluger & DeNisi, 1996). This may be further influenced by their perceptions of the feedback; if they do not agree with the feedback or place little value on the source of the feedback they are less likely to view it as useful (Sargeant et al., 2005).

B5.6.7 Potential Strategies for Improving Feedback

The clinical educators and medical students highlight salient points regarding the problems in feedback provision and how these could potentially be improved. Both groups believe that time constraints in the clinical setting are the most limiting factor on the feedback provided. Additionally, participants recognise the lack of structure and regularity in how feedback is provided. Consequently, ways to improve feedback included, giving more feedback and allowing more time to provide feedback, employing structured feedback sessions, the use of a checklist style form and additional feedback training for clinicians. This corroborates previous research findings that barriers to effective feedback include a lack of time, poor training, clinical educators' inadequate feedback skills and the absence of a clear system for feedback provision (AlHaqwi et al., 2012; Levy et al., 1997).

Participants' main dissatisfaction with feedback was in relation to its quality and quantity. Students believe that they do not get enough feedback and that the feedback given is not constructive, detailed or specific enough. Clinical educators agree that they struggle to provide structured feedback. This is concerning and implies the need for additional feedback training for clinical educators. Students also desired more written feedback. Previous research has discussed the impact of written feedback on performance, however such feedback is more time consuming. Additionally, students believe they are not observed making diagnostic decisions frequently enough- which then limits feedback opportunities. Such complaints are not new; previous research suggests that students frequently feel they are not observed enough and clinical educators perceive that observing students is too time

consuming (Levy et al., 1997). However, two previous studies have increased direct observation of students without increasing trainers' time investment too much (Walters et al., 2009; Walters et al., 2008). Observation is an important element in providing feedback and feedback based on observation is more instructive to the learner than feedback from a second hand source (Van Hell et al., 2009). As this is not an easy issue to resolve, it would be advantageous if clinical educators were able to use the time more effectively by providing as much detailed feedback as they can on the consultations they do observe. Based on these complaints it could be reasoned that clinical educators may benefit from more training specifically in how to provide detailed, specific feedback of a high quality which the learner will use to improve their performance. It could also be reasoned that learners would benefit from training in how to receive and act on feedback.

To improve the feedback provided, medical students desire structured protected one-to-one time with a trainer who has observed their DDM. Students also desire more opportunities to be observed making diagnostic decisions and for feedback to be given on these observations. Students suggest that feedback should be more detailed, telling them what they did right and wrong. A desire was also expressed to be questioned on their thought processes. These preferences are consistent with the techniques suggested by Hattie and Timperley (2007) and additionally reflect the idea of Butler and Winne (1995) that SRL and feedback be tightly linked. Students desired having a clinical educator who knew them in the clinical setting so that meaningful feedback could be provided. The feedback literature suggests that feedback is better received and acted upon if the provider has a rapport with the receiver (Eva, et al., 2012). However, this desire is difficult to fulfil given the placement structure of the medical curriculum. Similar to the results from this study, Rowe and Wood (2008) found that many students wanted more face-to-face individual contact, but were also aware that this was not always possible due to time demands. Additionally, Rowe and Woods' (2008) participants recognised the negative impact on time and resource requirements for them to have more feedback on a personalised level. Drew (2001) found that feedback on all elements of progress was important, supporting the assertion that more feedback is important on a daily basis across all areas of

performance. Feedback, therefore, should be an integral element of the education setting rather than a tick box or regimented exercise upon completion of a course or module.

B5.7 Strengths and Limitations

The main advantage of this study is the unique focus on feedback after DDM and the dual perspective of medical students and clinical educators' perceptions of the feedback. This research is also novel since previous research has not focused solely on one area of performance (DDM), the role of contextual factors on DDM, and the importance of feedback at the levels identified by Hattie and Timperley (2007). The use of free-text question responses in the questionnaire was also advantageous as it opened up the participants' responses to a more diverse range of answers than closed questionnaire questions do (Ballou, 2008).

Despite these strengths, the study has some limitations. Due to the specific nature of the content and the sample, the results cannot be generalized from feedback provided to medical students at the University of Leeds. Numerous efforts were made to recruit clinical educators to participate in the research and a moderate number responded. It is not clear how many clinicians the email was sent to and therefore the study sample may not be truly representative of the sample population (Oliver, 2006) and of how feedback is provided on DDM. To aid recruitment I ensured that the questionnaire was widely distributed via a number of different email lists and sent out reminders for completion (Coolican, 1999). If it is assumed that a certain personality type is likely to take the time to participate in questionnaire studies it could be postulated that these clinical educators who participated may be more 'involved' supervisors in the clinical setting and thus provide more detailed feedback anyway. Therefore it may be possible that those who responded to this study may potentially provide better feedback than those who did not respond.

Equally, a certain type of medical student may have taken the time to answer the questionnaire. This is most likely to have been the most studious learners and those who are dissatisfied with the feedback

they receive. Some researchers may perceive the sample size to be too small to provide adequate representation of the student population at the University of Leeds. However, 35% (n=312) of the medical student target population (n= 892) responded to the questionnaire. Although the reliability of results benefit from bigger sample sizes, 35% of the target sample size should provide a good reflection of the target population as the target sample was large. With a target sample size of 892 medical students, the required minimum sample size is 269 participants (Kadam & Bhalerao, 2010; Israel, 1992). As this sample size was achieved it is more likely that the responses do reflect that of the target population. Substantially fewer participants took part from year 3. It is possible that fewer students attended the 3rd year lecture where recruitment took place. But it is also possible that year 3 students are less engaged in DDM and saw the questionnaire as less relevant to them. Although there are maturational differences across the years these differences were deemed to have less impact on these results since the participants were not in the junior 1st or 2nd years of the MBChB course and 3rd year students are classed as senior students. However, investigating any differences in the perception of feedback the year groups may produce valuable insights. Due to the anonymous design of the questionnaire I was unable to determine whether the respondent population of the medical students and clinical educators differed in terms of level of performance and feedback provided compared to the non-respondents.

The quality of participants' responses to the questions surrounding the different levels of feedback rests upon the participants being able to distinguish between the five different levels. Failure of participants to understand the differences between these could be detrimental to the validity of the results. This is unlikely to have been the case however since participants in the pilot study showed understanding of the different levels and the results showed significant differences between how useful the different levels of feedback were perceived to be in line with what was expected (Hattie & Timperley, 2007). If participants had been unable to distinguish between the different levels it would have been more likely that perceptions of each level would have been more similar. However, the reliance on participants' perceptions and recollections about feedback means that recall bias may have influenced the results. Consequently, it is worth noting that the significant differences between the

clinical educators and the medical students may have been in part due to recall bias. I am unable to determine whether this resulted in the clinical educators over reporting the feedback provided or the medical students under reporting the feedback received. One approach to solve this issue could be to evaluate the feedback provision in real time in authentic clinical settings. This approach was not adopted here since it would have been too time consuming to recruit as many participants and assess DDM in the authentic clinical setting. Another potential weakness lies in the style of the feedback examples. Written examples may not be representative of verbal feedback in real settings and do not actively engage the learner in a feedback discussion. However, the examples were piloted to ensure that they were realistic and understandable. Using a real-life setting to conduct the research would have been difficult to set up and operationalize.

Despite the limitations of this research it contributes to the limited knowledge and evidence base surrounding how medical students are provided with feedback on their DDM. Furthermore, the results provide support for the assertions of Hattie and Timperley (2007) surrounding the likelihood of receiving mostly self-level feedback in contrast with learners reduced preference for this feedback. The students' desire for SRL focused feedback provides support for Butler and Winne's (1995) argument that feedback and self-regulated learning should be tightly coupled. Furthermore, the findings corroborate the growing recognition that DDM in real practice does not occur in a vacuum and that contextual factors may influence how well a learner makes diagnostic decisions and responds to feedback on their performance. As it stands, feedback rarely seems to take this into account. Additionally, the results provide further support for findings which suggest a discrepancy between how much feedback providers report providing in contrast with how little feedback receivers report receiving.

B5.8 Conclusion

The findings from this questionnaire demonstrate that the focus of the feedback influences how useful it is perceived to be. The lower levels of feedback (self and task) were found to be less useful than the higher levels of feedback (processes, goal setting and planning, and self-monitoring). However, feedback at the higher levels is less likely to be given. Medical students also believe that contextual factors influence their DDM and that feedback is seldom provided on these. This suggests that clinical educators need to be mindful regarding the focus of their feedback in order to provide feedback which will be well received and acted upon by the student. Furthermore, there are significant differences between how clinical educators report providing feedback and medical students report receiving it. These differences include: the setting in which feedback is provided, feedback provided on various contextual factors and awareness of the influence of these factors, and the focus (levels) of feedback provision after good and poor DDM. These differences indicate that perhaps clinical educators need to be more mindful of and pay greater attention to the methods they use to provide feedback and the focus of their feedback. Regardless of whether they believe their feedback is 'good', it is not 'effective' feedback unless it is perceived as such by the individual receiving that feedback. Future feedback needs to focus on these differences in order to reduce the reported gap between feedback provided by the clinical educator and feedback received by the medical student in order to provide feedback which the medical student perceives as useful.

These findings have been invaluable in supporting and developing the preliminary research phase of my EDR. They generated insights into the feedback provided to medical students and the possible discrepancies between students' and educators' perceptions of the feedback provided. The responses from the qualitative questions also alluded to limitations of current feedback provision and possible solutions for these. This questionnaire study was the final element of the preliminary research phase. Based on the summative findings from the work discussed in previous chapters and the findings from this questionnaire study I was able to outline the development of a conceptual model of effective feedback and an intervention to improve the feedback provided to medical trainees on their DDM (Chapter C1).

B5.9 Summary of Chapter

In this chapter I discussed the development, implementation and analysis of a questionnaire which aimed to investigate medical students' and clinical educators' perceptions of the frequency of feedback, as well as medical students perceived usefulness of this feedback. The questionnaire also aimed to address the perceived impact of contextual factors on DDM and how often feedback was provided on these factors. Lastly, the questionnaire aimed to elicit opinions on feedback provision and how this could be improved. The findings revealed that less feedback is provided after poor performance and feedback after poor performance is perceived as less useful. Students also prefer feedback which focuses on their self-regulated learning, but are more likely to receive feedback at the level of the self after good performance. Clinical educators also reported providing significantly more feedback at the levels of goal setting and planning, use of processes and self-monitoring compared to the students perceptions of how often they received this feedback. These findings were considered in relation to previous research on feedback and potential limitations were discussed. The influence of the findings for the development of an approach to improve feedback provision on DDM was also outlined which informs the next phase of my EDR. This marks the end of the preliminary research phase and leads into the development phase, where the ideas and concepts formulated throughout this initial phase are used to begin the development of an approach to improve feedback on DDM.

SECTION B: SUMMARY OF THE PRELIMINARY RESEARCH PHASE

This phase has guided the reader through the progression of the understanding of the research area from the initial recognition of two potentially problematic areas in medical education- DDM and feedback- to the development of an investigation which aims to address the problem of feedback provision to assist in improving medical trainees' DDM. The importance of both DDM and feedback was introduced and the problems surrounding both have been addressed. Notably, it appears that three important factors are largely ignored when it comes to feedback on DDM; the role of contextual factors on DDM, a focus on the medical trainees' confidence and a focus on the medical trainees' self-regulated learning (goal setting, planning and self-monitoring). A systematic review was carried out which revealed that there is little previous research which focuses on feedback provided after DDM and those that do are often described or reported in a manner which makes it difficult to understand what feedback was given. This makes it difficult to understand how feedback is currently provided after DDM. Subsequently, a questionnaire study was conducted to determine what feedback medical trainees are given after DDM from the view point of both the medical student and the clinical educator. This questionnaire revealed important insights into how feedback is currently provided and how medical students desire it be provided. The findings support the importance of a focus on contextual factors as well as the role of self-regulated learning in performance and feedback provision. These findings will now be used to attempt to develop an approach to improving the feedback to medical trainees after their DDM.

SECTION C: THE DEVELOPMENT PHASE

This phase involves the initial development and prototyping of the intervention. During this phase the findings from the preliminary research phase are drawn together to develop the intervention. The development of the intervention occurs over a series of iterations where it is tested and refined, gradually becoming more robust. There are a number of questions that can be used to guide the research conducted during this phase (Palalas & Anderson, 2013). These include:

- What are the desired characteristics of the intervention and the rationale behind incorporating them into the design and how will these characteristics be included in the design? (*Chapter C1.1, C1.2 & C1.4)*
- What are the preliminary design principles of the research? (*Chapter C1.2*)
- What are the specific design requirements needed for the intervention to work in the authentic clinical setting? (*Chapter C2*)
- What practical factors will influence and constrain the design and development (social, cultural, organisational, ethical, feasibility)? (*Chapter C2*)
- What are the specific processes and procedures involved in the design, development and implementation of the intervention? (*Chapter C3*)
- What is the selected theoretical framework and is this feasible in line with the intervention developed? (*Chapter C1.3*)

These questions will be addressed in the following Chapters (C1-C3) and were integral to the development and design of the conceptual model and the intervention to implement this. The stages of this phase are diagrammed in Figure C.1.

The work conducted in this phase involved the integration of the findings from the preliminary research phase (Chapters B1-B5) to draw out the features key to improving feedback provision on DDM. In this section I outline the process of the development of the conceptual model of feedback

(Chapter C1), an intervention to implement the feedback model (Chapter C1), a pilot study for the initial evaluation of the model and intervention (Chapter C2) and the final implementation of the model and intervention for providing effective feedback (Chapter C3). This research is conducted within the development phase of EDR, where findings from the preliminary research phase are collated and the intervention is developed.

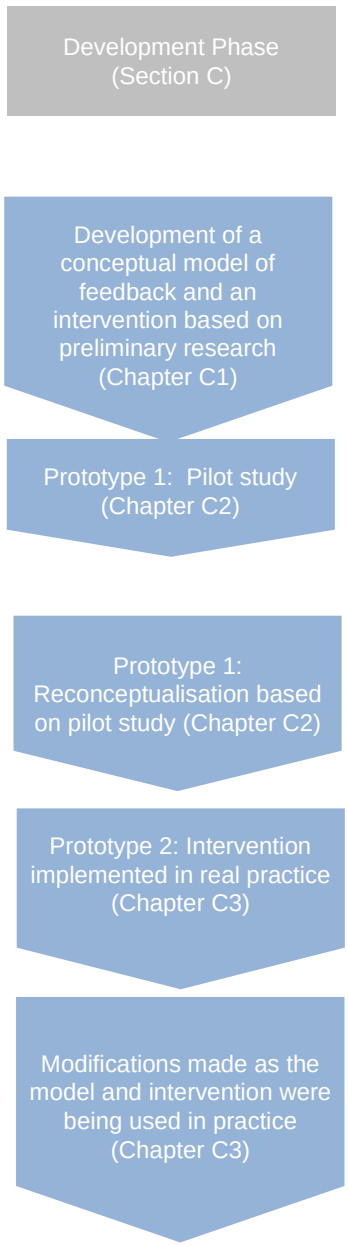

Figure C.1. Research conducted during the development phase

CHAPTER C1: DEVELOPMENT OF AN APPROACH TO ADDRESS THE PROBLEM: THE PERSONALISED FEEDBACK MODEL

In this chapter the research findings and understandings from the preliminary research phase are used to develop an approach to improve feedback on DDM in the authentic clinical setting. Using the research in Chapters B1-B5 this approach took the form of a conceptual model which focuses on what influences performance, and outlines pathways of internal and external feedback based on this performance. From this, an intervention was developed to implement this feedback to medical trainees on their DDM in the authentic clinical setting. The design principles that were established from the preliminary research phase are described and explained. Finally, the materials used to accompany the intervention are described.

C1.1 The Influence of the Preliminary Research

The aims of this thesis were to understand how medical trainees could be provided with more effective feedback on their DDM and to design a method by which this could be implemented. To achieve these aims it was important that I understood feedback provision within clinical medical education and the most salient factors surrounding feedback provision. It was also important that I was aware of current teaching and training techniques of those providing feedback as well as what was suggested in the literature to be effective feedback. The purposes of the tasks undertaken in the preliminary phase of this research therefore were to achieve the understanding of these issues. The information gathered from the preliminary phase led me to have an understanding of the current issues regarding feedback on DDM and how these could potentially be resolved. Table C1.1 provides an overview of each phase of the preliminary research phase, describing what I discovered and the implications of this for my research. To develop the conceptual model and a feedback intervention to address the problem of feedback provision on DDM, I revisited the literature discussed in Chapters B1 and B2, and considered the findings from the systematic review (Chapter B4) and the questionnaire study (Chapter B5) to determine how these would inform my feedback model and intervention.

Activity	What was Found	How this has Informed my Conceptual Model and Feedback Intervention
A general literature search on decision making. (Chapter B1)	DDM is a very important and common element in medical education and medical practice. Learning how to make diagnostic decisions is key to becoming a competent medical practitioner.	Confirmed that DDM is an important area of medical education. A best method of teaching it has not yet been found but feedback on it is important.
A general literature search on the role of contextual factors in learning and decision making (Chapter B1)	Decision making and DDM are influenced by factors within the environment, the patient and the clinician. The influence of these may influence learners' DDM.	Led to the realisation that teaching and feedback should take the role of contextual factors into account.
A general literature search on feedback in medical education (Chapter B2)	There are many theoretical 'how to' guides and 'top tip' articles published in the literature but little information on how these can be implemented practically.	Clinical educators require an easy to use model that specifically talks them through how to/ and what factors to provide feedback on.
Narrative literature review on feedback provision (Chapter B2)	A summary of the most helpful and unhelpful methods or approaches used in giving feedback	Has highlighted some key points that can be used in my research as well as affirmed some strategies that should be avoided.
Systematic literature review on feedback provision after diagnostic decision making (Chapter B4)	Confirmation that very little research has investigated or reports on feedback provision after DDM.	Has confirmed my supposition that there is limited research which focuses specifically on providing effective feedback to medical students after their DDM.
Questionnaire study on clinical educators' perceptions of the feedback provided (Chapter B5)	Clinical educators believe that they provide feedback on medical students' DDM that is focused on the processes they used, the strategic plans and goals set and their self-monitoring. They report focusing less on factors within the environment which may influence DDM.	Feedback should be provided on the learners' apparent confidence, taking into account their actual performance. Feedback should also be provided on any factors within the environment which may have influenced their DDM.

Questionnaire study on medical students' perceptions of the feedback provided (Chapter B5)	Medical students believe that they receive feedback on their DDM that is focused at the level of the self and task. They would prefer feedback on their use of goal setting and planning, and self-monitoring	Feedback should be provided on the medical students' use of goal setting and planning, and their self-monitoring.
Questionnaire study to medical students and clinical educators regarding what is wrong with current feedback provision and how they think this could be improved (Chapter B5)	Both groups highlight very similar key factors as limiting feedback provision such as time, lack of quality and quantity of feedback and few opportunities to be observed. Both groups suggest similar methods to improve the feedback that is provided, such as making it more structured and using feedback tools.	Time should be set aside for feedback and should be provided after observation in a private setting. The feedback should be structured and detailed and be provided after both good and poor DDM.

Table C1.1. Research conducted in each chapter and how this informed the conceptual model of feedback and the intervention

In addition to the information from each chapter described in Table C1.1 there were a number of theories, models and propositions which directly influenced how I developed the conceptual model of feedback, what it would focus on and how it would be implemented. The influence of these is listed below and a more in-depth description of each theory, model or proposition was given in Chapter B2.2.4 and Table B2.1.

The conceptual model of feedback draws on the importance of providing feedback which is focused on the learner's use of self-regulated learning strategies to complete the task. Feedback which solely praises or criticises the learner is avoided. The importance of feedback with a focus on these factors is discussed by Hattie and Timperley (2007). The feedback model focused on the SRL level of feedback and not on the three lower levels since feedback on self, task and processes are more common and are more likely to be given as part of clinical educators' usual approach to feedback. The feedback model was also influenced by Sadlers' (1989) recommendation of the importance of the learner gaining evaluative expertise in authentic settings. He also emphasised the encouragement of learner self-monitoring and a reduction in the reliance on external feedback providers. As such, feedback will be given after performance in authentic clinical settings and the focus of the feedback provided will encourage the learner to monitor their own performance and develop their own internal feedback. In line with Kluger and DeNisi's (1996) FIT model, the model of feedback will focus on feedback on the task details and task-motivation. Furthermore, where applicable, Kluger and DeNisis' (1996) five basic arguments of FIT and the promoters of effective feedback they suggested will be adhered to when developing the model (see Chapter B2.2.4).

Bangert-Drowns et al's. (1991) idea that learners need to receive the feedback mindfully has also influenced the conceptual model of feedback. This is reflected in the need for learners to focus on self-monitoring their performance and adapting or modifying their performance or approach based on this self-monitoring. Bangert-Drowns et al's. (1991) five stage model also fits with my view of task progression and feedback provision (see Table B2.1). In line with suggestions made by Black and William (1998), the feedback encouraged by the conceptual model will also focus on the learner's

self-assessment of their performance and use meaningful assessments. It will also involve the learner in a dialogue about their performance to explore their understanding, give the learner guidance on how to improve and provide opportunities to work on the improvement (Black & William, 1998). It will do this by concentrating on encouraging the learners' self-monitoring of their performance, encouraging the learners' engagement in the feedback, provide constructive points for improvement and encourage the development of an action plan.

By focusing on the learners' self-monitoring the conceptual model can also focus on the internal feedback this generates and how this is used as internal feedback by the learner (Butler & Winne, 1995). It will also focus on providing the learner with external feedback on their knowledge and their use of self-regulatory strategies during the performance. Such strategies include goal setting and strategic planning, and their self-monitoring (Butler & Winne, 1995). The conceptual model also highlights the importance of asking the learner to explain what they are thinking during diagnostic decision making in order to determine what goals and plans they set, their approach to the decision making, their confidence and their ability to self-monitor their performance. This focus then allows the clinical educator to provide feedback based on the learners responses. This approach is in line with that suggested by Pinnock and Welch (2014) of asking the learner to explain how they are thinking during decision making. The conceptual model also includes an element of reflection on the performance and on the feedback that was provided. Mamede et al. (2007) postulate that reflective practice may reduce failures in clinical reasoning in complex cases; this suggests that a lack of reflective practice may explain some of the biases evident in diagnostic error.

C1.2 Preliminary Design Principles

Design principles can be viewed as the integrated product of declarative and procedural information from the research. There are two main types of design principles, procedural (characteristics of the design approach viewed to be the most promising) and substantive (characteristics of the design-intervention itself) (van den Akker, 1999).

Design principles have been described as:

> *"…an intermediate step between scientific findings, which must be generalized and replicable, and local experiences or examples that come up in practice. Because of the need to interpret design-principles, they are not as readily falsifiable as scientific laws. The principles are generated inductively from prior examples of success and are subject to refinement over time as others try to adapt them to their own experiences."* (Bell et al., 2004, p. 83).

Preliminary design principles were created to inform, drive and advance the conceptual model of feedback and the feedback intervention developed. Design principles must contain a detailed and accurate portrayal of the context, procedures and results so that an outsider could replicate the study (Herrington et al., 2007). Importantly, within EDR the research findings can be used to inform theory outside of the local context. In this manner, the acceptance of a specific design framework results in the development and advancement of a specific set of theoretical constructs rather than only showing the value of a specific set of instructions (Barab & Squire, 2004). Evidently, design principles must be described in sufficient detail.

Design principles are created as a solution to the problem, rather than the other way around. For example, they are created to solve a problem, rather than being decided upon and then going in search of a problem to apply them to. These principles underpin the educational design process and are fundamental to the conduct of EDR. They can be viewed as important facets that the conceptual model must contain to accurately represent performance and feedback provision. Design principles

are also facets that the feedback intervention must do, or contain in order to be conducted successfully (McKenney et al., 2006). Such principles therefore allow other researchers to "select and apply the most appropriate substantive and procedural knowledge for specific design and development tasks in their own settings" (McKenney et al., 2006, p.73).

The design principles in this research were created through a process of review and advancement from the findings from the preliminary research phase. The design principles were refined during the iterative cycles (Chapters C2 and C3) of the intervention and were reflected upon to produce a final set of design principles which are described in Chapter D3.4-D3.5). To simplify the description of design principles, van den Akker (1999) describes them in more detail as heuristic statements:

> "If you want to design intervention X [for the purpose of/function Y in context Z], then you are best advised to give that intervention the characteristics A, B, C [substantive emphasis], and to do that via procedures K, L M [procedural emphasis], because of arguments P, Q and R" (van den Akker, 1999, p. 9).

Van den Akker's (1999) heuristic statement was used in this research to clearly outline the design principles. The design principles for this research are identified in bold and their characteristics and their consequences for designing the conceptual model and the feedback intervention are described in Table C1.2:

> In order to design an approach for the purpose of providing effective feedback to medical trainees on their diagnostic decision making in clinical practice the approach should have the characteristics of: providing **immediate**, **frequent** feedback, making the feedback **personalised and individualised**, and providing feedback which focuses on the **learner's self-regulated learning strategies** and on the influence of **contextual factors** on their decision making. This should be done via **observing** them in **authentic clinical interactions**, asking them to complete **questions before and after** the clinical interaction about their confidence, their perceived influence of contextual factors, their goal setting, planning and

self-monitoring. Feedback is then provided with a focus on these elements. The learner is **involved** in the feedback **reflection** process and develops an **action plan** based on the feedback provided.

Design Principles	Characteristics	Consequences of the Design Principles for Designing the Conceptual Model and the Feedback Intervention
An add on to existing feedback provision	The feedback is provided in addition to the usual feedback provided to medical trainees in authentic clinical settings.	The feedback model will be designed so that it can be easily provided in addition to the regular feedback given. This means it must not be too time consuming and must be able to tie in to the regular feedback.
Provided frequently	The feedback must be provided relatively frequently, such as twice a week. It should be provided more with struggling medical trainees and after consultations the medical trainee has found difficult.	The model needs to be a tool that can be used frequently and easily by the clinical educators
Observation	The feedback must be given as soon as possible after a clinical interaction has been observed by the clinical educator.	The model must be developed to aid and assist the observation of medical trainees making diagnostic decisions.
Timing and setting of feedback	The feedback will be provided immediately and provided individually in authentic clinical settings	The model must be usable in authentic clinical settings and be designed in a manner so that the provision of the additional feedback is not too time consuming. The feedback must be provided as soon as possible after the DDM.
*Direct involvement of the learners in order to deliver personalised and individualised feedback. *Modification here included which questions were asked at which time point.*	Request the student to complete the consultation questions before and after the consultation	The model and intervention must be designed in a way which incorporates the involvement of the medical trainee via the use of consultation questions. These can be used to begin a discussion around the medical trainees' DDM.
Focus of the feedback	Using the medical trainees' answers to the consultation questions and the clinical educators' perceptions of the diagnostic decision making: -Focus the feedback on goal setting, strategic planning and the processes used in these plans and self-observations	The model must be designed in a manner which encourages and emphasises a focus of feedback on the most relevant areas of feedback provision (as identified in the characteristics section).

	-Focus the feedback on an awareness of contextual factors -Focus feedback on self-efficacy beliefs -Encourage the clinical educators to provide detailed and specific feedback	
Takes the role of contextual factors into account	The medical trainee is asked whether they perceive these factors to be influencing their diagnostic decision making. Feedback is given on the influence of these based on their responses to the questions and the clinical educator's perceptions of whether they were influenced by these factors.	The model is designed in a way which encourages a focus on the influence of contextual factors on DDM from the perspective of the medical trainee and the clinical educator.
Reflection and action plan **The action plan was added in after pilot study*	This is encouraged by the medical trainee answering the 5 consultation questions and also by their involvement in developing an action plan.	The model is designed to encourage the medical trainee to reflect on their DDM. The feedback session must encourage the learner to reflect on what they did well and not so well, why this may have been the case and how this can be improved in the future
Reflection on feedback **This was added in after pilot study*	The medical trainee is asked to write down the feedback they were provided with and then develop a plan of action based on this.	The model is developed to include an action plan that the medical trainees must develop after they have been provided with feedback.

Table C1.2. Preliminary design principles and how these influence the design of the conceptual model and the intervention.

*The inclusion of these design principles were confirmed after discussion with the participations in the pilot study (Chapter B2). However, they are listed here so that they can be discussed in detail in section C1.4.

C1.3 The Conceptual Model and Feedback Intervention

From the influence of background reading and the design principles, a conceptual model of feedback depicting learning through performance and feedback provision was developed as shown in Figure C1.1. Based on this, a feedback intervention was developed for how the conceptual model can be applied in practice to provide more effective feedback in the authentic clinical setting. This conceptual model was adapted from Butler and Winne's (1995) model of self-regulated learning and feedback.

The conceptual model in Figure C1.1 shows that learners use their knowledge of the area, their beliefs relevant to the subject, their beliefs relating to how motivated they are to do well, their confidence in their ability to do this, and their perception of the presence of contextual factors in the environment to create their interpretation of the tasks requirements and properties. Using this interpretation they set goals to be achieved during the task, plan strategies for how they will do this and decide on the processes to employ so that they can achieve this. This results in both internal performance outcomes and in externally observable performance outcomes. Internal outcomes are cognitive and affective/emotional, which occur during engagement of the task. These include changes in confidence and increased understanding of the requirements of the task (Nicol & Macfarlane-Dick, 2006). Internal outcomes are likely to be closely linked to internal feedback. External performance outcomes are behavioural and can be observed by a witness, such as performance in the task (Nicol & Macfarlane-Dick, 2006).

The red arrows and boxes in Figure C1.1 reflect the '*learner internal elements*'. These elements are all important aspects of SRL. As indicated by the red arrows in the diagram, during the task the learner is likely to be self-monitoring their performance by assessing their goal setting, their strategic planning (including the use of processes to enact these plans), and being aware of how these influence their internal and performance outcomes. The information gathered during self-monitoring then provides the learner with internal feedback (orange arrows) from each of these elements. This internal feedback may cause the individual to reinterpret or modify their engagement with the tasks and various aspects of the task; this then influences subsequent engagement with the task. Upon subsequent engagement

the learner may modify their goals and plans, change the processes employed, and potentially select more adaptive processes or approaches. A consequence of self-monitoring task engagement is that the learner may alter their knowledge and beliefs which then may influence future self-regulation (Butler & Winne, 1995).

The individual who observed the learner's performance, then provides the learner with feedback on their knowledge, their motivational beliefs and confidence, and the influence of contextual factors as well as their goal setting, strategic planning (including the use of processes to enact these plans) and their overall performance. This information may then further confirm, conflict, or modify the learner's interpretations of the aspects they were given feedback on.

The main components of this conceptual model are similar to Butler and Winnes' (1995) model of self-regulated learning. However, the conceptual model developed here also places an emphasis on the role of confidence and contextual factors as components the learner draws on to construct an interpretation of the task. This conceptual model also depicts the two-way process of self-monitoring and the internal feedback this creates. Finally, this conceptual model also includes arrows to depict how the learner's knowledge, goals, processes and performance directly influence the external feedback they are provided with.

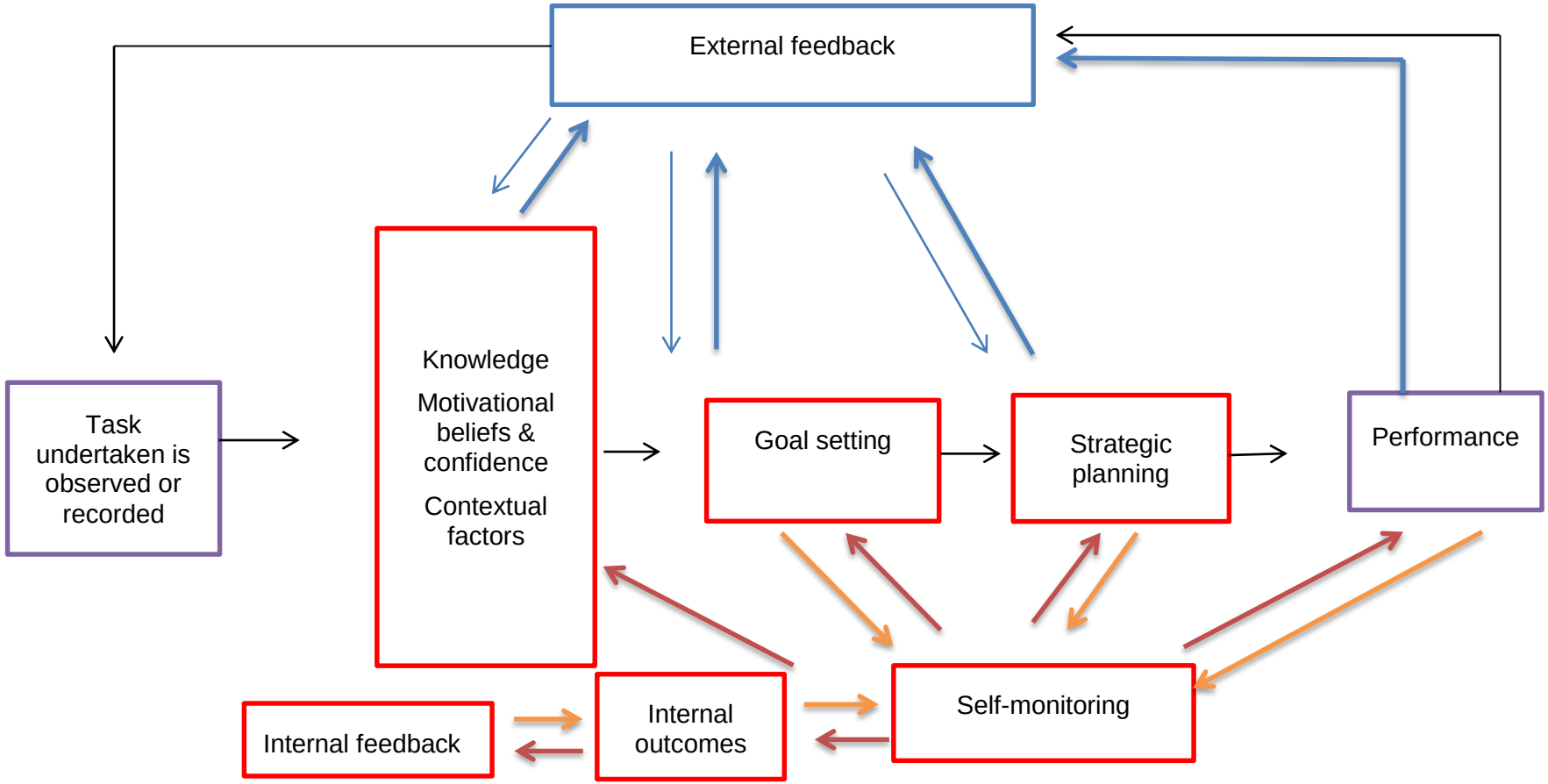

Figure C1.1. A Conceptual Model of Feedback.
Adapted from Butler and Winne (1995, p. 248)

Key:

Black arrows denote progression through the task.

Red arrows denote learner internal elements. Red arrow: Self-monitoring of the internal processes and performance

Orange arrows denote internal feedback from each of the internal processes and results in self-monitoring

Blue bold arrows denote what influences external feedback

Blue light arrows denote what external feedback is provided on

This conceptual model depicts how learners progress through a task, how they use their knowledge and beliefs, motivation and confidence, and how they are influenced by contextual factors to set goals, and strategically plan using task specific processes in order to perform the task. This provides them with internal feedback about their performance via self-monitoring of their performance. They are then also provided with external feedback on these elements. Their self-monitoring and external feedback may modify their future task performance.

In order to apply the conceptual model in practice it was necessary to develop a practical intervention. This intervention was developed closely with the conceptual model discussed above and is shown below in Figure C1.2. This intervention was developed as the tool to implement the conceptual model of feedback and includes an initial educational element before it can be used by the clinical educators. This was to aid adoption of the model and provided clinical educators with the necessary information and confidence to provide the feedback suggested. In addition, there is a current focus on the use of 'how to' or 'top tip' style guides for providing feedback as discussed in Chapter B2.4.5 (Ramani & Krackov, 2012; Cantillon & Sargeant, 2008; Hesketh & Laidlaw, 2002). Whilst these publications are important, it was considered that clinical educators may be more receptive to a feedback model which promotes more personalised and specific feedback in addition to what they already provide i.e. it doesn't ask the clinician to change their teaching or feedback approach but asks them to provide more feedback with a specific focus. Furthermore, by developing an intervention based on the conceptual model of how to provide the feedback, the clinical educators are provided with a specific set of instructions to follow to provide feedback on DDM. Rather than a list of suggested approaches or techniques, they are provided with a process to follow. Lastly, as it is possible that the clinical educator has had little or no formal training on giving effective feedback (Ramani & Krackov, 2012; Cantillion & Sargeant, 2008; Dudek et al., 2005; Brukner et al., 1999) this structured approach may aid their feedback skills and their confidence in providing feedback.

From the findings in the preliminary research phase (Table C1.1), the design principles, (Table C1.2) and the conceptual model of feedback (Figure C1.1) a summary of what this means in terms of how effective feedback should be provided to medical trainees is as follows:

> Provide specific feedback which incorporates a focus on an awareness of contextual factors, the goals set, plans made and the processes used, the self-monitoring of performance and the trainee's self-efficacy or confidence beliefs (these are depicted in the red boxes as the *learner internal elements* in Figure C1.1). Additionally, the trainee must play an active role in the feedback session, feedback must be given as soon as possible after the event in a private setting, the

clinical interaction must have taken place in the authentic clinical setting and been observed by the person providing the feedback.

The intervention of using the conceptual model in the authentic clinical setting is referred to as the Personalised Feedback Model intervention (PFM intervention) since it promotes the provision of feedback which is specifically tailored to each individual. The PFM intervention has four main components, referred to as stages A-D (Figure C1.2). The clinician makes a plan to observe or record the clinical interaction (stage A), the learner answers consultation questions during (stage B) and after the clinical interaction (stage C), and the clinical educator then provides feedback to the trainee as they usually would, as well as feedback based on the trainee's answers to the consultation questions (stage D).

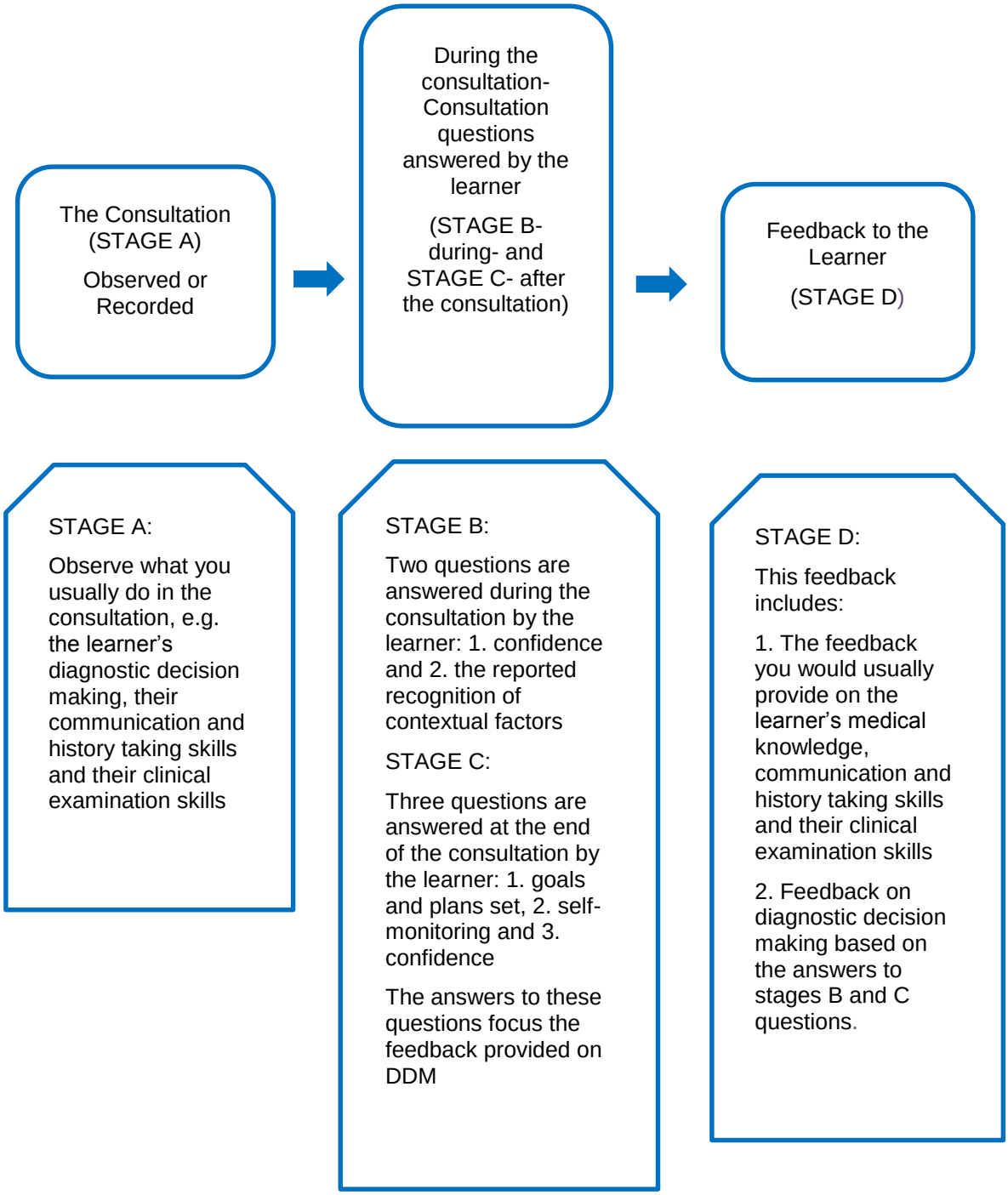

Figure C1.2. The Personalised Feedback Model

The four stages of the PFM intervention described map directly onto the conceptual model; this is shown in Figure C1.3. 'Task undertaken' is part of Stage A in the PFM intervention. The learner internal elements are related to Stages B and C, where the learner is questioned on their use of these elements. 'External feedback' is part of Stage D, where the learner is given feedback on their performance. The use of the conceptual model within the intervention to provide feedback is further exampled in Figure C1.4.

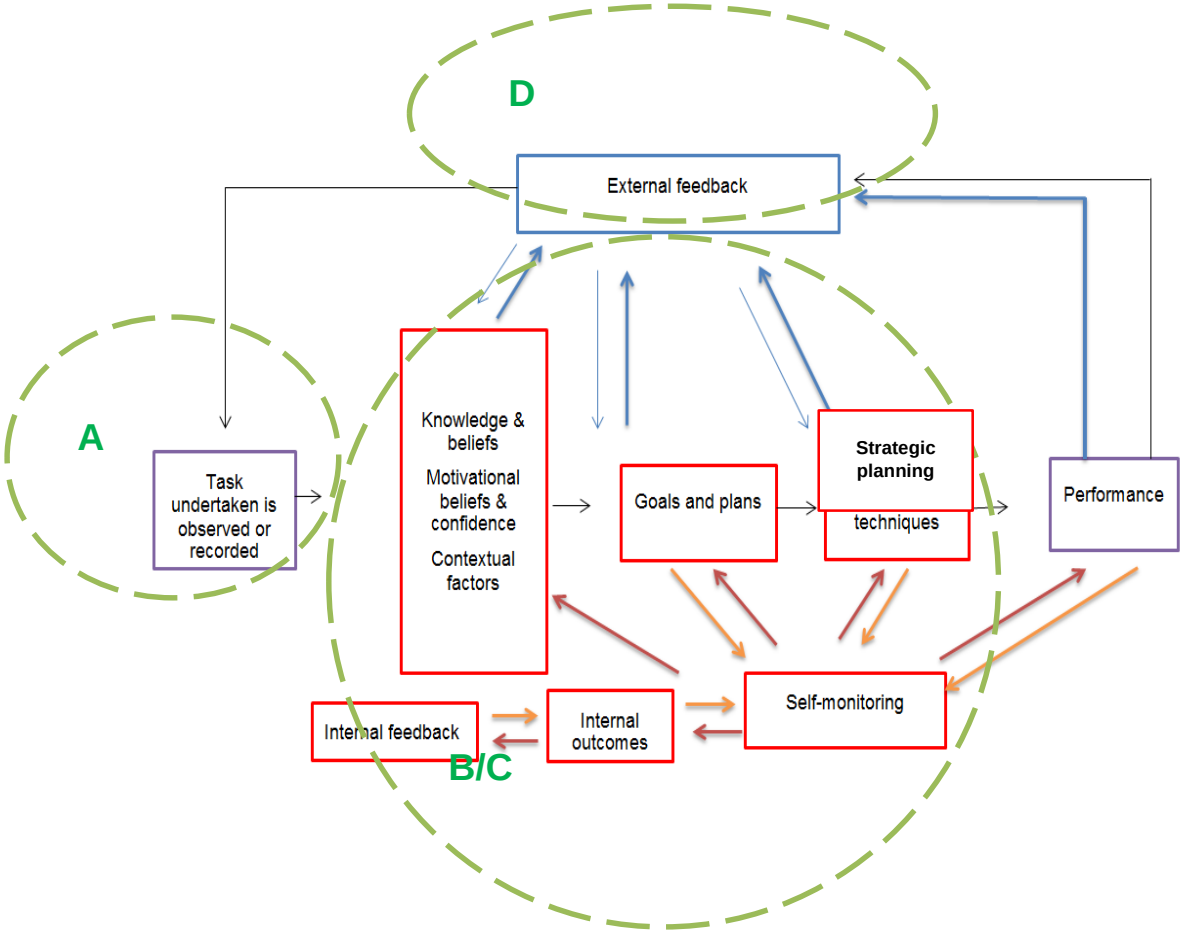

Figure C1.3. Diagram to show how the three phases of the PFM intervention map onto the conceptual model

An example of how the conceptual model of feedback is used in an intervention to provide feedback after DDM in authentic clinical settings to a good learner

The task is to diagnose calf pain in a 25 year old male. The learner has some knowledge about what calf pain may be symptomatic of and has knowledge of strategies to diagnose calf pain. These strategies may include knowledge about what the strategy is (declarative knowledge) and how to use it (procedural knowledge) as well as knowledge about under what conditions it is appropriate to use that strategy (conditional knowledge). The learner is highly motivated to do well in this consultation and is somewhat confident that they will be able to diagnose the calf pain. The learner is aware that their performance in this consultation may be influenced by various factors such as the fact that the patient has presented with these symptoms twice previously and that the consultation is running 10 minutes behind schedule.

At the beginning of the consultation the learner is asked to note down their level of confidence that they can make a diagnosis in this patient and their perception of contextual factors.

The learner begins by setting a goal to achieve and a plan to follow during the consultation. These goals are specific and focused: "My goal is to diagnose the patient's calf pain. To achieve this I will take a detailed history to rule out a number of potential diagnoses and I will examine the patient's calf". The learner also sets in place in their mind the specific processes and techniques they are going to employ in the consultation; these include a focused history and a detailed clinical examination. In particular, the learner was focused on ruling out a deep vein thrombosis in the patient.

During the consultation the learner is self-monitoring their progression through their strategic plan, using task-specific processes to reach their set goal. This results in internal feedback and enables them to identify whether they are on track to make a diagnosis, whether the patient's responses to history taking questions and the examination fit with their current plan and use of processes, and whether these need to be adapted, modified or added to in order to diagnose the patient. If necessary, the learner is able to make these changes. These internal outcomes resulted in the learner having more confidence in their ability to make a diagnosis and reaffirmed their opinion of what the diagnosis is likely to be. The consultation ends with the learner making a diagnosis of muscle strain in the patient. The learner then answers three questions about what their plans and goals were, whether they were able to self-monitor and their confidence at the end of the consultation.

The clinical educator who observed the consultation then provides the learner with feedback on their performance using their observation and the learner's answers to the questions. The clinical educator provides feedback on various aspects of the learner's engagement with the consultation such as their reported confidence, perception of contextual factors, their goal setting and planning and their self-monitoring of the observation. This feedback will add to the learner's own internal feedback and will influence each of the aspects feedback is provided on and the learner's overall future engagement in the task.

Figure C1.4. Using the conceptual model within the PFM intervention

C1.4 Justification for the Design Principles

In order to justify the design principles, and explain the design and development of the conceptual model and the PFM intervention it is important to pull out the key features of these and discuss each feature in detail. The design principles are discussed below in terms of the role each plays in the conceptual model and the PFM intervention.

C1.4.1 Providing Feedback as an Add On

Previous research indicates that it is not clear how medical trainees are taught how to make diagnostic decisions (Mehdizadeh, 2011; Norman, 2005; Kempainen et al., 2003). Furthermore, it is also not clear what the best methods are of giving effective feedback, or how clinical educators are taught how to give feedback (Charlin et al., 2012; Mehdizadeh, 2011). It is likely that most clinical educators follow the Pendleton rules of feedback provision (Pendleton et al.,1984) as this is advocated in most clinical teaching handbooks (McKimm & Swanwick, 2013; Brown & Cooke, 2009; Chowdhury & Kalu, 2004). Due to their busy working days they are unlikely (unless they have a particular interest in feedback) to modify their feedback approach based on the 'how to' or 'top tip' guides for giving feedback. Consequently, it is unlikely that any intervention will change how clinical educators teach DDM and provide feedback. Resultantly, the conceptual model and the PFM intervention can be used in addition to the feedback clinical educators usually provide.

C1.4.2 Providing Feedback Frequently

Feedback needs to be provided frequently to be most effective (Ivers et al., 2012; Hesketh & Laidlaw, 2002). Frequent feedback is more likely to be representative of trainees' performance and is more likely to give them more information on how they can improve. Furthermore by providing frequent feedback it is more likely that the trainee will be able to use the feedback in future similar tasks to improve. Consequently, the feedback intervention will be designed to be used at least once a week during the medical trainees' placements to ensure that they are getting frequent feedback they can use to improve their performance.

C1.4.3 Feedback after Authentic Clinical Encounters

Previous research has demonstrated the existence of feedback provided in the authentic clinical setting on bedside encounters (Gonzalo et al., 2014). Feedback provided in this manner provides more authentic evaluations of the trainee in a patient centred environment. Such evaluations are vital to effective medical education (Watling & Lingard, 2012). As demonstrated by the questionnaires

conducted in Chapter B5 trainees also prefer feedback which is clear, detailed, accurate and which relates to specific behaviours (Hewson & Little, 1998). In addition, trainees place a high value on feedback which assesses their performance in authentic clinical interactions. As such, high quality teaching and feedback is associated with feedback which focuses on the trainees' needs, is on their bedside skills and case summaries and is from a credible or authoritative source (Ivers et al., 2012; Watling & Lingard, 2012; Norcini & Burch, 2007; Veloski et al., 2006; Torre et al., 2003). Consequently, the PFM intervention is to be used in the authentic clinical setting after watching medical trainees interact with a real patient.

C1.4.4 Feedback after Observation

It is important that feedback is provided by those who have observed performance since this will give more authenticity to the feedback (Smith & Irby 1997; Ende, 1983). Feedback based on observation is likely to be more detailed, specific, focused and more accurate (Kilminster & Jolly 2000; Sachdeva 1996; Ende 1983). One explanation for this is that observation makes the learner feel more valued and taken seriously; this may induce a more positive perception of the feedback (Van Hell et al., 2009). Feedback based on observation also allows the trainee to ask the observer for clarification on the feedback which could aid their understanding and their use of such feedback. The conceptual model of feedback and the PFM intervention promote feedback provision after observation in authentic clinical settings.

C1.4.5 Feedback Given as Soon as Possible

The research on whether feedback should be provided immediately or after a delay paints an often contradictory picture (Kluger & DeNisi, 1996; Azevedo & Bernard, 1995; Kulik & Kulik, 1988). However, it is most likely that immediate feedback is more effective after tasks in authentic settings that are more complex and use conceptual and procedural knowledge (Shute, 2008). Delayed feedback is more effective when the task is simple and transfer of learning is important (Shute, 2008). The conceptual model promotes the provision of feedback which is given as immediately as possible

and this is implemented via the PFM intervention. Feedback should be given immediately since DDM in authentic clinical settings is likely to be challenging and involves procedural and conceptual knowledge.

C1.4.6 Feedback in Private

The feedback should be provided in private in order to lessen any discomfort or embarrassment to the trainee (Branch & Paranjape, 2002). This may be more pertinent for struggling trainees, particularly those who have quite high or low confidence. Furthermore, by providing feedback in private the trainee is less likely to compare themselves and their performance with their peers. However, it is not always possible to give feedback privately or individually. In these cases any negative feedback should be given discretely and any serious problems with the performance addressed on a separate occasion in private.

C1.4.7 The Active Role of the Trainee

Despite Ende's (1983) assertion that medical students should play an active role in the feedback process, research is only recently beginning to focus on the importance of including the learner as an active participant in feedback provision (Chapter B2.4.4). Viewing the trainee in this way means taking account of individual differences which may influence what type of feedback they prefer, how they respond to feedback, recognising the influence of various factors on their performance and recognising their perspective and input in the feedback (Urqhart et al., 2014; Pelgrim & Kramer, 2013; Eva, et al., 2012; Murchdoch Eaton, 2012; Murdoch-Eaton & Sargeant, 2012; Van Dijk & Kluger, 2011; Teunissen et al., 2009; Norcini & Burch, 2007). In this research, external feedback will be conceptualised as something given to the trainee by an educator. Here the focus is placed on the clinical educator as the giver of the feedback. However, the trainees' role is not passive; rather, they are instrumental in guiding the clinical educator in providing feedback which is detailed, individualised and specific. Trainees prefer interactive feedback (Perera et al., 2008) and as such, the conceptual model of feedback encourages the trainee to be an active participant in feedback. This is enabled by

the intervention in a number of ways. Firstly the trainee is asked a number of questions during and after the consultation to determine what may have been influencing their DDM and how they engaged in it. Secondly, they are encouraged to play an active role in the feedback provision and to complete an action plan based on the feedback they were given.

C1.4.8 A Focus on SRL: Goal Setting and Strategic Planning

Feedback is most effective if it focuses on the trainee's plans and goal setting and the strategy they used to make diagnostic decisions. This is because by engaging in these areas feedback can provide the trainee with information which can be used to help them to understand specifically where and how they have gone wrong, and what they need to do differently next time. As discussed in Chapter B2.2.4 and B2.3.7, those who set task-specific plans and goals when performing a task and who think about and plan for the task-specific processes they will employ, are likely to be more self-regulated learners, have higher levels of performance and be able to learn from past performances. As demonstrated by the systematic review (Chapter B4) there is little feedback on DDM which focuses on these points. However, it is not clear whether this is a true representation of feedback provided or is due to the lack of research which reports what feedback is provided (most feedback is given in day to day education without being recorded or assessed by research studies). The discrepancy between feedback provided and received as highlighted in Chapter B5 indicates that there is a need to improve the feedback which focuses on these factors and make it more evident to trainees. Consequently, the conceptual model incorporates an emphasis on understanding medical trainee's goal setting, strategic planning and the processes used to achieve these by providing feedback with a focus on these elements. This will serve to improve the amount of feedback with a focus on these factors.

C1.4.9 A Focus on SRL: Self-Monitoring

As identified by Butler and Winne (1995) feedback which focuses on trainee's self-monitoring of their performance is important for future performance. It is important that trainees are able to self-

monitor their own performance as it enables them to provide their own internal feedback (Butler & Winne, 1995). This internal feedback is then added to by educators' external feedback. By focusing feedback on whether the trainee is self-monitoring and how effective the educator and the trainee perceive this to be, the trainee can be provided with information which will help them improve this skill. The questionnaire study (Chapter B5) indicated that medical students do not perceive that they receive much feedback on their self-monitoring. However they believe that this would be useful in helping them to improve their performance. Consequently the conceptual model places importance on the medical trainee's self-monitoring and provides them with feedback based on this. This feedback, along with feedback on goal setting and planning should improve the learners' SRL and the transfer from a reliance on SRL feedback from external sources to reliance on SRL feedback from internal sources (themselves) using effective self-monitoring. The conceptual model does not promote a focus on feedback at the levels of the self, task or processes (Hattie & Timperley, 2007) since this is the feedback usually given by educators (Hattie and Timperley, 2007; also see Chapter B5.4.4-B5.4.5). Instead, the conceptual model focuses on providing feedback on the least provided level of feedback, self-regulated learning. Although a specific focus on the use of processes will not be employed in the PFM intervention, the feedback will focus on trainees' strategic planning (an element of SRL) which involves a focus on the processes employed in planning.

C1.4.10 A Focus on SRL: Self-Efficacy and Confidence

As discussed in Chapter B2.3.1 self-efficacy and confidence can play an important role in influencing DDM and influence how receptive the trainee is to feedback and how they may utilise the feedback for future performance. For example, an under-confident learner is less likely to believe in their ability to improve, whereas an over-confident learner is less likely to recognise when they have underperformed and not attribute this to their own skills (Hadwin & Webster, 2013; VandeWalle et al., 1999; Dweck & Leggett, 1988). Feedback on confidence helps the learner to self-calibrate their performance and their confidence i.e. have a more accurate awareness of how well they are performing; this is a skill which is essential for SRL. However, there is little previous research which suggests that confidence is assessed during performance or that feedback is provided on it. As shown

in Chapter B5, medical students perceive that they do not receive enough feedback which takes their confidence into account. The clinical educators perceive confidence to be more influential on DDM than the medical students do, further suggesting that they may not always be aware of its influence (Chapter B5). Consequently, the conceptual model places an emphasis on understanding the medical trainee's confidence in their ability to make a diagnostic decision during and at the end of the clinical interaction. When used in the feedback intervention these two measures of confidence will indicate to the clinical educator whether the medical trainee is over or under-confident and they can then provide appropriate feedback. As confidence is a skill essential for SRL, feedback which focuses on the trainee's confidence will aid their SRL.

C1.4.11 A Focus on Contextual Factors

The conceptual model places an emphasis on the role of contextual factors in DDM and the PFM includes the provision of feedback on the influence of such factors. Previous research conducted by Durning and colleagues (Durning et al., 2012; Durning et al., 2011) has suggested and supported the potential detrimental influence of contextual factors on DDM. These factors are most likely to include factors within the environment, the patient and the trainee themselves and can be referred to as contextual factors. Contextual factors will be focused on instead of using cognitive debiasing strategies. Cognitive debiasing strategies are techniques which may work to debias the individual to a cognitive bias (see Croskerry et al., 2013; Croskerry, 2003b for a discussion of these). However as novice learners are less likely to be aware of their biases (Tversky & Kahneman, 1973), they are more likely to struggle with cognitive debiasing, and so it was anticipated that contextual factors which can be linked to cognitive biases (see Table B1.2) would be more easily recognisable to the trainees. As evidenced in the questionnaire study (Chapter B5) medical students perceive these contextual factors as influencing their DDM and desire feedback which focuses on them. To address this issue the conceptual model places an emphasis on the influence of contextual factors on DDM, and feedback will be provided which addresses their influence. The main purpose of a focus on contextual factors is to highlight the potential negative impact they can have on DDM and to heighten medical trainees' awareness of when they may be influenced by such factors.

C1.4.12 A Focus on Reflection

Previous research has discussed the importance of learner self-reflection in improving performance (Carr & Johnson, 2013; Di Stefano et al., 2014; Lew & Schmidt, 2011). In particular, research has discussed the relationship between reflection and feedback and reflection and the learners' use of the feedback. It suggests that reflection will assist the learner in creating their own internal feedback (Mann et al., 2009; Hattie & Timpereley, 2007; Butler & Winne, 1995), that reflection prior to feedback may improve how well the feedback is received (Pelgrim & Kramer, 2013) and that reflection after feedback may influence later use of that feedback (Sargeant et al., 2009). In addition, Mamede et al. (2012) demonstrated that structured reflection during practising making clinical diagnoses fosters student's learning of the clinical presentations associated with each illness more effectively than making diagnoses. This suggests that reflection during making a diagnosis helps to improve trainees' diagnostic competence by fostering the restructuring of their existing medical knowledge about the diagnosis and associated diseases they reflected on (Mamede et al., 2012). Consequently, the conceptual model incorporates a focus on encouraging the trainee to reflect on their performance during the task (self-monitoring) and self-reflect on their performance after the consultation, both before and after they have been given feedback. The questions that the trainee is asked to complete (on their planning and goal setting, their self-observation and their confidence) will force them to reflect on their performance immediately after their performance. Getting the trainee to reflect on their performance and record the feedback provided in an action plan will promote further reflection on their performance and on the feedback provided. The development of an action plan was proposed by one of the clinical educators in the pilot study (Chapter C2). However, it is included here for ease of explaining the design principles.

C1.4.13 Using Specific Questions to Focus Feedback

The conceptual model demonstrates the importance of the medical trainee's confidence, the influence of contextual factors, their goal setting, strategic planning, and their self-monitoring on their DDM. Consequently, medical trainees should be provided with feedback on these elements. To achieve this, the feedback intervention includes asking the medical trainees five questions during and after the

clinical interaction relating to these elements; referred to as the 'consultation questions'. Their answers to these questions will influence what feedback they are given. This enables the clinical educator to provide detailed, focused and meaningful feedback to the trainee. The reasons why these specific areas are focused on was highlighted in the above sections. Learner-based questions are used to gather this information since it would not be appropriate for the clinical educator to ask these questions during a clinical interaction. The questions can also be a useful tool for the trainee's self-appraisal, encouraging them to reflect on their thoughts, opinions and approach to the DDM (Hattie & Timpereley, 2007). This may then encourage trainee's future self-management (Paris & Winograd, 1990). Such questions elicit an interactive feedback process and could be viewed as encouraging the trainee to seek feedback. Interactive feedback is preferred by learners (Perera et al., 2008) and feedback-seeking is a skill which is associated with improvement (Duffy & Holmboe, 2006). The answers to the consultation questions may provide the clinical educator with some insight into the trainee's thought processes and behaviours. A focus on these questions may also make the trainee more aware of the importance of these elements and may enhance their awareness and self-monitoring of these elements during future DDM. These questions are similar to micro-analysis since they are enquiring about trainee's SRL (and contextual factors) during real time performance. Micro-analysis is used to assess a learner's use of SRL and has been used to show that poorer performers engage in fewer self-regulated learning strategies (Cleary, 2011; Cleary & Zimmerman, 2001). This approach therefore goes a step further than traditional micro-analysis since the trainee's answers to these questions are used to provide them with feedback on their performance and their use of SRL strategies. However, it is referred to as microanalysis in the PFM handbook (Appendix 5.1) to aid the clinical educators understanding.

C1.5 Development of the Materials for the PFM Intervention

It was necessary to develop appropriate materials in order to implement the conceptual model using the PFM intervention. These comprised of a handbook for the clinical educators and worksheets for the medical trainees. The clinical educators were also given examples of using the PFM intervention

to provide feedback (see Figure C1.4 and Table C1.3). The medical trainees were given sections of the PFM handbook which explained why the feedback was important.

C1.5.1 The PFM Handbook

In order for the clinical educators to use the PFM intervention to provide feedback, a handbook style document was developed to explain the conceptual model and the PFM intervention (Appendix 5.1). This provided the clinical educator with an overview of the background of the area of research, why feedback on DDM is important and how the conceptual model aims to address this. How to use the PFM intervention was explained, along with a list of the consultation questions and how these would influence the feedback provided. The handbook also outlined when and where to use the model and how often it should be used. The handbook was designed using information and understandings gathered from the preliminary research phase and the conceptual model.

C1.5.2 Materials to Aid Feedback Provision

In order to provide feedback the clinical educators were instructed to use the medical trainee's answers to the structured consultation questions. These questions gathered information on the medical trainees: perceived confidence, perceived influence of contextual factors on DDM, reported planning and goal setting and their perceived self-monitoring. These are referred to as the 'consultation questions' and their importance was explained in section C1.4.13. The medical trainees were provided with an A4 sheet of paper which presented these questions and gave space for their answers (in the PFM handbook; Appendix 5.1). A reflection and action plan form was also developed (in the PFM handbook; Appendix 5.1). This sheet asked the medical trainee to reflect on their performance and their feedback to develop an action plan for future performance. The action plan form was developed after the pilot study (Chapter C2) but is described here for ease of explanation of the materials.

C1.6 Using the PFM Intervention

As described in C1.3 and C1.4 the PFM intervention includes the use of 5 questions to illicit an understanding of the trainees' confidence, perceived influence of contextual factors, goal setting and planning, self-monitoring for that clinical interaction and confidence at the end of the interaction. The trainees answer the questions about their confidence and their perception of the presence of contextual factors at the beginning of the consultation. At the end of the consultation the trainee answers questions about their plans and goals, their self-monitoring of their progression through the consultation and their confidence. Flow diagrams are used in the PFM handbook to show how different answers to these questions influence the feedback given (Appendix 5.1). Examples of trainees' responses to the questions and the feedback given in response to these answers after good and poor DDM is given in Table C1.3.

An Example of a Medical Trainee Who is Struggling with DDM		
Questions at the Beginning of the Consultation:	Trainee's Response	Feedback Given at the End of the Consultation
Confidence	6	N/A
Influence of Contextual factors	I have not seen a patient with calf pain before (knowledge). The notes said the patient presented previously with the same problem- this may influence my treatment of the patient (patient).	One way to reduce the impact of a lack of knowledge is to do some extra reading on that subject. Good that you noticed their previous visits may influence your DDM. Try to keep an open mind about this and not be led down one diagnostic pathway or another based on their previous presentations. It is important not to be influenced by numerous previous visits but at the same time it is important not to ignore any prolonged symptom presentation. I also think there was quite a lot of noise from the waiting room and you were running 10 minutes behind- just note these things when beginning a consultation and try not to let these factors make you feel pressured, flustered or distracted in the consultation.
Questions at the End of the Consultation:	Trainee's Response	Feedback Given at the end of the Consultation
Plans and Goals Set	My goal was to make a diagnosis. I planned to achieve this by following through the right steps.	Whilst this is accurate, your DDM will be aided by breaking down the overall goal into more specific sub-goals. It is also important to set a series of task-specific plans to achieve this overall goal. For example, instead of following the right steps make sure you can be more explicit and that you know what these steps are and what you must do to get from one to the next.
Self-monitoring	I struggled to self-monitor my progress through the consultation. I found it difficult to do this and focus on what the patient was telling me at the same time	I agree that this can be difficult sometimes. However, it is an important skill to master as it will help you to determine whether your DDM is on the right track and whether you need to modify your current goals and plans. Don't be afraid to take a moment for quiet thinking in the consultation if you need this time to think about what the patient has told you and what your next steps are.
Confidence (1-10)	7	From your confidence ratings it appears that you are quite confident however, based on your performance in this consultation I think you could take some steps to improve your DDM. I suggest that you practise using the strategies outlined above and take steps to improve your knowledge base. A useful tool would be to reflect on what you would do differently in a similar consultation in order to improve. Think about your reported level of confidence and whether you think your performance matched this rating.

An Example of a Medical trainee who is Successful at DDM		
Questions at the Beginning of the Consultation:	Trainee's Response	Feedback Given at the End of the Consultation
Confidence (1-10)	5	N/A
Influence of contextual factors	I have not seen a patient with calf pain before (knowledge), the patient has presented several times before with these symptoms (patient), I was running 10 minutes behind in the clinic	I agree with your recognition of these contextual factors. Despite a lack of experience in patients with calf pain you performed very well. Good recognition of the patient's previous visits, I noted you made sure you were not influenced by their leading comments regarding their symptoms- yet you did take the duration of their symptoms into account. You noted the time as a factor and I noticed that whilst providing adequate time for the consultation you did not allow it to be any longer than necessary. Well done for your recognition and management of these contextual factors.
Questions at the End of the Consultation:	Trainee's Response	Feedback Given at the End of the Consultation
Plans and Goals Set	My goal was to diagnose the patient by taking a detailed history and conducting an appropriate examination. I planned to use the information from the history and the examination to look for a pattern that emerges from the symptoms and findings to diagnose the patient.	Well done, you set specific and focused goals and plans and used these to guide you through the consultation. As you discovered, this allows you to focus specifically on what you need and want to achieve and means you are less likely to be distracted by other aspects of the interaction within the consultation. Setting a goal also provided you with something to aim towards and something to measure your progress against.
Self-monitoring	Yes I was able to self-monitor and consequently, based on new information provided by the patient about his symptoms and from my examination of the calf I noticed that my initial differential diagnosis of a DVT was ruled out.	Well done, your self-monitoring of your performance enabled you to be aware of your progression through the consultation and to evaluate its effect on your progress and whether you needed to make any changes to your plans and techniques. This enabled you to make effective diagnostic decisions in the consultation and enabled you to rule out a DVT.
Confidence (1-10)	5	Your reported confidence is quite low in comparison to how well you have performed. Your DDM in this consultation was very good- try to have greater beliefs in your ability to make diagnostic decisions in consultations. To help foster this you could reflect on how well you did in this consultation and why you did this well. This may help you to have more confidence in your abilities.

Table C1.3. Using the PFM to provide better feedback: Examples of how the consultation questions influence feedback provided

C1.7 Summary of Chapter

This chapter is the first stage in the design and development of a conceptual model and an intervention of how feedback can be provided to medical trainees after DDM. This design and development was based on findings from the preliminary research phase and was described and justified in this chapter. The key principles and features of the conceptual model and the intervention were also discussed with reference to the preliminary research findings which supported their use. This chapter provided the reader with an in-depth explanation and demonstration of how the conceptual model led to the development of the PFM intervention and how this intervention is used to give feedback in the authentic clinical setting. Finally, the information presented outlined how the conceptual model and the PFM intervention were evaluated and how these materials were developed and modified. An important characteristic of EDR is the use of repeated iterations of the intervention in the process of its development. Chapter C2 describes the first iteration in the development of this intervention using a pilot study to assess potential participants' opinions on the usefulness, usability and effectiveness of the PFM intervention.

CHAPTER C2: A PILOT STUDY OF THE PERSONALISED FEEDBACK MODEL INTERVENTION

As a means to test and further develop the PFM intervention a pilot study was conducted to determine the potential usefulness, usability and effectiveness of the conceptual model and the PFM intervention. This research is the first iteration of testing the PFM intervention. The implementation of the pilot study is described and the qualitative research findings are analysed. Finally, the modifications made to the model on the basis of findings from the pilot study are outlined and justified.

C2.1 Background

It was important to obtain the opinions and perceptions of the potential users of the conceptual model of feedback and the PFM intervention before implementing it in authentic clinical settings. Consequently, a small scale pilot study was conducted. A pilot study refers to conducting a trial run or the pre-testing of a specific research instrument in preparation for the main study (Polit et al., 2001; Baker, 1994). Pilot studies allow for the identification of any potential limitations in the research design, as well as whether the proposed methods are appropriate. Identifying any limitations or issues at this stage enables their amendment so that the quality and efficiency of the main study is not compromised. The pilot study aimed to investigate clinical educators' perceptions regarding the potential effectiveness, usefulness and usability of the conceptual model and the PFM intervention. It also afforded the participants the opportunity to use their expertise of supervising medical trainees to suggest ways in which the model and intervention could be made more effective, useful and usable. Recruiting participants for the pilot study also helped me to determine the likely success of the proposed recruitment techniques as well as the identification of any logistical issues with implementing the PFM in authentic clinical settings.

C2.2 Methodology

C2.2.1 Participants

Initially, the model was intended to target GPs who supervised medical students on placement or GPs who trained GP registrars. GP placements provided the ideal setting for trialling the PFM intervention since medical students are regularly observed with patients and given feedback. I contacted Dr Michael Scales to determine whether he thought this design of the PFM intervention would be suitable within GP practices and whether he could assist with recruitment. Dr Scales is a GP and the year 3 lead for placements in general practice; he was able to support recruitment and was valuable in providing insight into the use of the model in GP settings. He advised to trial the model with GPs who trained students from year 3 in GP placements since they have more one-on-one time with the GP and are observed and provided with feedback in a structured setting more

often than 4th and 5th year medical students. Furthermore, they are just beginning to make diagnostic decisions and so would benefit from the extra feedback support. Resultantly, I began recruiting participants for the pilot study from this set of GP trainers. The participants were recruited at a clinical away day at the University of Leeds. They were shown a short slide show introducing the model and were provided with an information sheet which gave them more information on the study. They were given my email address and could either sign up to take part at the clinical away day or email me afterwards. However, after failing to obtain much support from GPs during the questionnaire phase of the research (Chapter B5) and having a poor response rate to this recruitment, it was decided that participation would be open to anyone who observed and provided feedback on DDM in authentic clinical settings. Consequently, I decided to recruit participants in an additional number of ways. I emailed the participants who had completed the questionnaire study in Chapter B5 and had left contact details and permission to be contacted for any follow-up research. I also attempted to recruit clinical educators who taught DDM on any placement with students from years 3, 4 and 5 by sending an email out from the head of each year. GPs who supervise medical students or train registrars within the Yorkshire and Humber Commissioning Support unit were also recruited via an email inviting them to take part. The emails introduced the research and the pilot study, and contained an information sheet for more information. Participants were recruited when they responded to this email. These multiple methods of recruitment were employed to ensure maximum promotion of the research and recruitment of the clinicians fitting the inclusion criteria.

The final target participants were any clinicians who provide feedback to medical trainees after DDM. The clinicians must supervise medical students and this supervision must include the provision of feedback after observing them make diagnostic decisions in the authentic clinical setting.

C2.2.2 Ethical Approval

This study received ethical approval in September 2014 from the University of Leeds, Faculty of Medicine and Health Research Ethics committee (Ethics number SOMREC 13088, Appendix 4.1).

C2.2.3 Materials

The Personalised Feedback Model (PFM)

After agreeing to take part the participants were sent the PFM handbook described in Chapter C2.5.1 and located in Appendix 5.1.

Interview Guide Structure

A structured guide was developed to inform the semi-structured interviews (Appendix 4.2). This focused on a number of areas: whether the clinical educators thought the model was useful, usable and could be effective, anything they believed may limit the usefulness, usability and effectiveness of the model and any ideas or suggestions they had for how the usefulness, usability and effectiveness could be improved (the importance of evaluating usefulness, usability and effectiveness is discussed in Chapter C3.2). The guide also included general questions regarding using the PFM intervention such as time commitment and confidence in providing feedback. Participants were not provided with the interview guide.

C2.2.4 Procedure.

After agreeing to take part in the research, participants were emailed the PFM handbook. This was sent prior to the participants meeting with myself to ensure that they were familiar with the PFM intervention. The participants were asked to familiarise themselves with the handbook and a reminder email was sent before the meeting. At this time, a meeting date at each participant's practice was agreed.

It was anticipated that the meetings would take between 30 – 45 minutes. In the meeting, participants were asked to read the information sheet and sign the consent form. The general structure of the meeting was as follows:

- Re-explain and discuss the PFM documents. Explain how to use the model and how to use it to provide feedback. This allowed the participants to discuss any concerns or questions they had.
- Short discussion about the usefulness, usability and effectiveness of the model using the interview structure (the interview structure is in Appendix 5.2).

At the end of the meeting participants were thanked and asked whether they would be interested in being contacted for the main research study using the PFM intervention.

C2.3 Qualitative Analysis

Twelve participants took part in the pilot study. Table C2.1 shows the demographics of the participants; their employer and which disciplines they were from.

Discipline	No. of Participants Employed the University of Leeds	No. of Participants Employed by the NHS
General Practice	-	6
Oncology	-	1
Gastroenterology	-	1
Psychiatry	3	-
Paediatrics	-	1

Table C2.1. Demographic information of the participants

C2.3.1 Structure of the Interviews:

The interviews were audio recorded and ranged in length from 25 minutes to 45 minutes. I had intended to use the interview guide as the structured basis for my questioning. However, it quickly became apparent when discussing the conceptual model and the PFM intervention that such a formal approach to questioning was not appropriate. There were a number of reasons for this, which will be explained. Firstly, despite sending the clinicians a copy of the PFM handbook and an email reminder for them to read through it, two of the participants had not done so. This made it harder to stick to the interview guide as the participants were less able to provide informed or thought-through opinions. Secondly, the questions felt too formal and unnatural when asked in the context of an on-going conversation. Thirdly, many of the participants did not need as much prompting as the interview guide provided. The participants' discussed the usefulness, usability and effectiveness of the model without needing to be asked individually about all three. A weakness of this approach was that upon re-listening to the recorded interviews it was sometimes difficult to distinguish between comments that applied to the usefulness, usability and effectiveness since some comments could apply to all three points. This is a weakness in my questions and focus of the interview. These factors (usefulness, usability and effectiveness) are independent of each other but in the context of preliminary interviews around a topic new to the clinicians such boundaries were not always clear. Another example is that participants often went from discussing a potential barrier, to discussing the implementation of the model, to suggesting some strategies as to how this could be improved or avoided. For these reasons the interviews became structured discussions which I steered in the right direction with the use of the interview guide to ensure that all the relevant points had been considered.

C2.3.2 Analysis of the Interviews

Thematic analysis was used to analyse the interviews since it is a method which can be used to identify and analyse patterns of information within data (Braun & Clarke, 2006). A salient factor of thematic analysis is that it aims to find patterns in the data, which become represented by a 'theme'. Thematic analysis allows one to interpret the desired aspects of the research topic (Boyatzis, 1998). Thus

thematic analysis was used to identify common themes in the participants' opinions on the usefulness, usability and effectiveness of the PFM. Here, a theme was identified as that which "captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set" (Braun & Clarke, 2006 p. 82). Thematic analysis allowed for theoretical freedom since it is not tied to a particular theory or epistemological approach (Braun & Clarke, 2006). Thematic analysis therefore, allowed me to extract the important codes and themes from the data in relation to participants' opinions of the PFM without being concerned with their theoretical underpinning or a deeper interpretation of their opinions. Although these are important in understanding participant's opinions and perceptions of the model, analysis on this level is not appropriate, necessary or required for this pilot study. Consequently, I employed thematic analysis as it can be a flexible research tool, providing a rich, thorough and complex account of the data (Braun & Clarke, 2006). This is a great strength of thematic analysis, however it is coupled with a lack of concise guidelines of what thematic analysis constitutes; this runs the risk of an 'anything goes approach' (Antaki et al., 2002). Some researchers criticise thematic analysis as having little stature as an analytic tool despite the fact it is widely used. However, more theory-based approaches were not applicable here and thematic analysis was used to understand participants' responses to the PFM since it allows for flexibility in how the data are analysed. Furthermore, it is useful when working within a participatory research paradigm where one's participants are also collaborators, as was the case in my research design. Since I aimed to elicit participants' perceptions and opinions of the PFM in terms of any perceived weaknesses and how it could be improved, thematic analysis was useful since it allowed me to summarise key findings from the large body of data and offer a detailed description of the data (Braun & Clarke, 2006). Braun and Clarke (2006) suggest that thematic analysis can be helpful in producing analysis and findings which are suited for informing policy development. This advantage is also relevant to my research since the participants' responses were used to modify the PFM intervention.

The recorded interviews were transcribed and analysis began by reading the data repeatedly. The data were read through word for word to ensure immersion in the text. During this phase I made an initial

list of ideas about what was in the data in terms of participants' opinions about the PFM and their suggestions for improvement, as well why these points were interesting. From these initial ideas, I began to develop codes (Braun & Clarke, 2006). A code is used to identify interesting features of the data and refers to the "most basic segment, or element, of the raw data or information that can be assessed in a meaningful way regarding the phenomenon" (Boyatzis, 1998, p. 63). It was vital here that I coded for as many themes as possible to ensure that nothing important was missed. After the data were coded I began to search the data for themes. This involved organising the codes into groups under a central common shared theme. In my data the likely themes had been highlighted prior to this stage. This is because I had some ideas as to what the clinical educators might view as potential limitations of the model. These ideas became clearer as I conducted more interviews and as I became more aware of what issues and limitations the clinical educators had with the model. After an initial set of themes were developed they were reviewed and refined to ensure that each originally identified theme was a theme and to ensure that no main themes had been missed. At this stage I also re-read my entire data set to ensure that no data had been missed in the earlier coding stages. This also enabled me to determine whether the themes worked in relation to the data set as a whole. I then named the themes based on their focus.

C2.4 Themes

Five main themes were identified in the responses from the participants. These were: (1) balancing a desire to provide feedback with a lack of time, (2) understanding the PFM intervention, (3) fear of not understanding how to use the PFM intervention, (4) perceptions of using the PFM intervention, and (5) a desire to give more effective feedback. General comments on the usefulness, usability and effectiveness of the PFM intervention were also highlighted.

C2.4.1 Balancing a Desire to Provide Feedback with a Lack of Time

A number of participants reported time as being an issue with using the PFM intervention. This largely focused on the time taken to provide the feedback using the conceptual model. For some

participants there appeared to be an internal dilemma concerning the time it takes to provide feedback and the amount of protected time they are given to do so, perceiving the latter to be insufficient. One participant related this back to the amount they are paid for supervising students:

> *"The problem with this is that it takes time and we don't have the time- hence the problem with feedback in the first place. They don't pay us enough to remove us from clinical practice- it's mainly done on the side- not because there is enough money in it to do it how you would really like to do it".* (Clinical Educator 2)

Such a comment indicates that this participant believes they do not get paid enough to have a more vested interest in providing more detailed feedback. Other participants mentioned time as an issue; however they were able to generate some ideas as to how the impact of this could be lessened and the PFM intervention integrated into their daily teaching of the students:

> *"I can work in the extra time at the end into what is already done with the registrar".* (CE6)

> *"It will take more time- but it should be okay to use the model during a planned session when I know I will have a bit more time. We could always see one fewer patient so that the feedback could be given at the end of the surgery".* (CE9)

This suggests that the clinical educators valued the PFM intervention and were prepared to find ways to make it work with their current approach to observing the trainee, despite time constraints. Regarding the assessment of the PFM intervention, the clinical educators stated that it needed to be simple to complete and not too time consuming. They also agreed that half an hour was an acceptable length of time for the pre and post-PFM intervention questionnaires.

C2.4.2 Understanding the PFM Intervention

Another theme that emerged from analysis was a lack of clarity for the participants regarding what was required of them when using the PFM intervention and some uncertainty about what the terminology meant. The title of the PFM handbook given to the participants included the words "feedback on diagnostic decision making". However, despite it also being stated in the recruitment email one participant thought the model was to be used on consultation skills:

> *"Need to make it clearer that this is not on consultation skills and is on diagnostic decision making- I don't think this is clear enough".* (CE2)

Such comments suggest that some participants may not have been engaged with the PFM intervention. Some participants also gave certain suggestions for improving the PFM intervention- which suggested that they did not fully understand how it should be used:

> *"Separate out what jobs are for the trainee and what are for the educator so that this is clearer".* (CE1)

Such comments suggest that some participants were engaged with the PFM intervention and desired further information to help them be able to use it effectively. Another example of participants engaging with the PFM intervention, but requiring more information on its theoretical underpinning, was evident in participants' need to better understand the terminology:

> *"Maybe you could make this clearer and give some examples of what you mean by self-monitoring- maybe you could draw a linear diagram of what might make someone change their mind about self-monitoring".* (CE2)

Furthermore, two participants requested some articles to give them some more information about feedback and decision making to aid their understanding.

It appears that most of the participants were engaged with the PFM intervention and understood how to use it to provide feedback, although they did desire further clarity and information on the PFM intervention to assist their use of it.

C2.4.3 Fear of Not Understanding How to Use the PFM Intervention.

It appeared that the clinical educators feared not understanding how to use the PFM intervention and not using it properly. Often these comments were conveyed in their desire for more information on how to use the PFM intervention and specific suggestions were also given about how to achieve this:

> *"I think you should give fewer additional points about feedback provision or we won't do them... just make it easy for us and we will do it".* (CE2)

> *"I think it would be good if you showed us exactly what type of feedback we need to give for each question, depending on what the student says. You could use flowcharts to show how different responses lead to different feedback".* (CE1)

Other clinical educators agreed with this suggestion:

> *"I think people like pathways and boxes- I can see why people would prefer that. I am not sure I would need one, but I can see why others would".* (CE4)

> *"I think it would be beneficial to have some structure or scoring system about how to give the feedback and what this means".* (CE3)

Some participants voiced a concern over their abilities to provide the feedback

> *"It seems as though quite a lot of planning is involved and understanding of what the trainee has said to be able to provide feedback".* (CE3)

It is apparent that in order to understand how to use the PFM the participants require a simple approach with more structured guidance to help them provide the PFM intervention feedback.

C2.4.4 Perceptions of Using the PFM Intervention

Participants voiced many viewpoints on how the PFM intervention could be used in the authentic clinical setting and their concerns regarding its use. A number of the participants gave examples of how they felt they could use the PFM intervention. These examples often consisted of slight modifications they would need to make to their teaching/observation of the trainee and/or the structure of the PFM intervention:

> *"It would be easier for me to give if it was on a recorded observation as I could just pick out each important bit and look at it. I often give my main feedback at the end of the surgery not in between patients so it would be easier if it could be videoed and then watched back and points picked out."* (CE3)

The clinical educators' suggestions indicated that the PFM intervention needs to be flexible to adapt to different teaching and observation approaches. Their comments regarding how they would achieve this indicated that they believed that it was flexible and could be adapted for use in their specific setting. This also suggests they thought it could be an important teaching and learning tool worth spending time on. In support of this assertion, the participants had many positive comments concerning using the PFM intervention:

> *"Thinking about the consultation questions- I could set him up so that he can have a few minutes more at the beginning of the session- yes we could do that".* (CE4)

The participants did voice a number of concerns with the design which would hinder their use of the PFM intervention. In terms of getting the trainees to answer the consultation questions, most

participants believed it would not be feasible to ask the goal setting and planning question before the consultation:

> *"With my third years, they often lack confidence and I don't think they would feel comfortable taking the time out of the consultation to answer such detailed questions".* (CE5)

However, another clinical educator believed that the students would be able to find a natural break. The participants were asked whether they thought the trainees should answer the consultation questions by writing down the answers or be asked them verbally by the clinician. It quickly became apparent that they favoured the trainee writing down their answers. This was because they didn't think the trainee would feel comfortable answering these questions in front of a patient, or answer them honestly. Some participants also thought that asking the questions would be more time consuming.

The participants' comments surrounding their use of the PFM intervention revealed that they had confidence in their abilities to use it:

> *"I think it will feel a bit clunky to start with but I don't believe it will take too long to get familiar with it- I guess that will depend to some extent on how good the trainee is at completing the questions- they may not give us much to work with".* (CE5)

> *"I think I would just need a bit of practice".* (CE4)

Despite some uncertainty regarding how to use the model the clinical educators appear to have felt that they would be able to use the PFM intervention to provide feedback to their trainees.

In an early interview CE2 suggested that in addition to the trainees reflecting on their feedback it would be beneficial if they developed an action plan based on the feedback and reflection for future improvement. This suggestion was then put to the subsequent clinical educators and it was agreed that this would be very useful:

> *"Yes, I think this would be very useful- it would allow me to make sure they were then going to use the feedback and we could work together to develop an action plan".* (CE7)

> *"Yes this would be good- it could be used in future observations to determine if they have taken notice of the feedback".* (CE12)

Four participants commented on the need for prolonged use of the PFM- for both the clinical educators and the medical trainees:

> *"The more often it can be used the better as the more it will become part and parcel of what is done rather than a bolt on".* (CE5)

> *"The longer it is used the more used to answering the questions I think the student will get, and find it much easier to answer the questions".* (CE7)

Such suggestions for the modification and development of the PFM intervention show that the participants were willing to engage with the PFM intervention.

The participants also made comments which referred to their opinions on the importance of the PFM as a method of providing feedback:

> *"I think I would like to use your model with a trainee who was observed and video recorded at the same time-that way we could revisit how they performed and I could show them exactly what I mean on the video".* (CE8)

> *"I can see the value in this model- it seems to be getting the student to think about what they are doing in advance of what they are actually doing- and then this is all wrapped up in the feedback provided".* (CE11)

The participants felt that the PFM intervention could be used and possibly adapted to be used in their clinical practice. They also thought that the PFM intervention was a valuable learning tool and most felt confident in their ability to use it to provide feedback. Participants also placed value on the importance of the PFM intervention as a method of feedback. Discussions with the participants highlighted the need for the consultation questions to be answered in a written format by the medical trainees and for an action plan to be developed after feedback.

C2.4.5 A Desire to Give More Effective Feedback

Through the dialogue created with the participants regarding the usefulness, usability and effectiveness of the PFM intervention it was evident that many of the clinical educators recognised the need for improved feedback and expressed a desire to improve the feedback they gave. Feedback was seen as an important skill that was often overlooked:

> *"I worry I don't give feedback well enough for them to get lots out of it- so that's why I would be interested in this so I can give them focused feedback and information they can take away with them for future consultations".*(CE4)

> *"There is a huge push for feedback- so I thought this would be helpful. There is a lot of theory about feedback but not much practical advice about how to actually implement it".* (CE3)

Regarding the need for feedback on poor DDM, one participant blamed the medical trainees for playing a role, implying that they do not have to take responsibility for their actions in the current medical curriculum:

> *"I think a lot of it is because they are so much more protected they do not have to make as many decisions. When I do OSCEs the amount of times students say, 'I'll ask a senior'- I think, come on- at some point you need to know this yourself. I don't think there is a lot of encouragement with decision making because everyone is so risk averse".* (CE9)

The idea of clinical educators being risk averse is confirmed by the point made by another clinical educator who reported often not letting students make diagnostic decisions in front of the patient due to fears of patient distress. This highlights current issues with training and feeding back to medical students on their DDM. If the medical trainees' teaching and the responsibilities given are not consistent between placements, it makes it harder for the medical trainee to get used to receiving feedback and learning from it.

Feedback may be perceived as negative by medical trainees if they have performed poorly. The clinical educators viewed experience in a role, rather than age, to influence how individuals would respond to the feedback:

> *"The more comfortable you become in a role in a job the more relaxed you are about feedback and negative feedback because you think well fundamentally I do this job well so any feedback will only improve on me where as at the start of a role you have this less and are more sensitive. So I think it is more time in the role rather than age".* (CE12)

This would suggest that when medical trainees have limited experience in clinical settings they may be less receptive to negative feedback. However, as discussed in Chapter B2.3.6 negative feedback can be useful if it is given in a constructive manner, as portrayed by the PFM intervention. Building on this, another participant also recognised the role of personality in influencing reaction to feedback:

"Overall, personality plays a big part in feedback- some of us react better or worse to feedback full stop. The people who will gain most will be those who do not react badly to feedback". (CE9)

Overall, the clinical educators recognised the need for feedback to help medical trainees improve their DDM. However, some clinical educators were concerned that medical trainees often have to take little responsibility for DDM, whilst others felt uncertain in letting medical trainees make diagnostic decisions in front of patients. Clinical educators also highlighted differences in personality which may influence how trainees respond to the feedback.

C2.4.6 Effectiveness, Usability and Usefulness

The participants were asked for their opinions on the usefulness, usability and effectiveness of the PFM. The answers to these questions were often incorporated into responses which fell into the above themes. However, there were a number of direct comments on these aspects. Regarding the effectiveness, most participants commented that they thought the model would be effective in providing better feedback.

"I can see it helping them because it is much more structured, individualised and focused". (CE6)

"I think this feedback will be effective for the trainees. I think it focuses on elements we often ignore". (CE12)

Some recognised the potential effectiveness, but commented that modifications may be necessary first:

"I think this model can be effective, but I think the instructions on how to use it need to be made clearer first". (CE7)

Suggestions for improving the effectiveness of the PFM intervention included, clear instructions on how to use it to give the feedback, finding the right time to use it with the student, and making sure the consultation questions were asked at the correct time and were worded appropriately for the trainees to understand.

The participants made explicit comments regarding the usability of the PFM intervention. Some wondered whether its usability would be hindered by time constraints, the engagement of the participants and the ease of using the intervention. Other participants had fewer concerns and thought the PFM was usable in authentic clinical settings:

> *"I think the time taken to use it may hinder its usability to some extent- it seems as though we would need to plan in advance when we are going to use it, to make sure we have enough time. This may make its use less spontaneous and used less".* (CE3*)*

> *"I think the goal setting and planning question should definitely be asked at the end of the consultation".* (CE6)

In terms of the usability for trainees, participants' concerns were mainly related to the trainees seeing the relevance of the feedback. Participants worried that it would be harder to use the PFM if the trainees were not engaged with it:

> *"I think it is usable definitely. I think this would be increased if the trainees were given some background information about the feedback and why the feedback given is important. I think that will help them engage with it".* (CE9)

In terms of the perceived usefulness of the PFM, participants believed it would be a useful tool for providing feedback. Reasons given for this were similar to those for effectiveness in that the PFM offered a more structured approach to feedback. Participants also thought the PFM would encourage

them to provide feedback on a more regular basis and that it would be useful in encouraging the trainee to be more involved in the feedback provided:

> *"I think it is useful in that it provides much more focused and structured feedback. We don't give feedback like this so it would be interesting to see what trainees thought about it".* (CE3)

The clinical educators perceived the PFM intervention to be useful, usable and effective to some degree. The PFM intervention was seen to be potentially effective for improving feedback, but participants suggested modifications be made to enhance this. The PFM intervention was seen as usable but more consideration was needed on the time constraints, the ease of use and the engagement of the medical trainee. The PFM intervention was also seen as useful since it offered a structured approach which could be used regularly.

C2.5 Summary of Findings from the Pilot Study

The themes developed from the pilot study interviews suggest that the participants did value the PFM intervention and viewed it to be a useful tool for providing feedback. The interview structure focused on the usability, usefulness and effectiveness of the PFM intervention, and these factors were evident within the themes developed. Overall, the participants did perceive the PFM intervention as useful to aid feedback, usable in authentic clinical settings and as potentially effective in improving the feedback. However, there were issues relating to the time taken to use the PFM intervention, its ease of use, their understanding of it, as well as other general feedback issues. The findings demonstrate that the PFM intervention is a potentially useful, usable and effective method of providing feedback. The interviews were invaluable for the insights they provided into what issues the current PFM intervention raised regarding its use in authentic clinical settings.

C2.6 Modifications

Based on the findings from the pilot study a number of modifications were made to the PFM intervention and the accompanying documents. The modifications were categorised as either modifying specific aspects of the PFM intervention or modifying the design of the document to explain the intervention. The modifications carried out under each category are listed below in bullet points for ease of reference. The issue of time taken to use the PFM is a difficult factor to modify without drastically changing the conceptual model of feedback and the intervention. If this was changed, the conceptual model may not focus on all the relevant aspects it currently focuses on. Consequently, the approach to addressing the issue of time was to streamline how participants' used the PFM and to provide guidance and information.

C2.6.1 Modifications to the PFM Intervention

From the themes drawn out in the thematic analysis of the interviews I decided on the following modifications to the PFM intervention. These related to the design of the PFM intervention and how it would be used by the clinical educators:

- The findings confirm that consultation question three (goal setting and planning) should be asked after the clinical interaction.
- Confirm that consultation question one (confidence) should be enquired about before and after the clinical interaction.
- Ask the medical trainees to write down answers to the consultation questions at the beginning and at the end of the clinical interaction, rather than the clinical educator asking the questions verbally (this should be quicker than the verbal approach).
- Advise the learner to develop an action plan based on the feedback given and to reflect on the feedback they were given.
- Confirmed that the PFM intervention should be used twice a week at the most due to time constraints.

C2.6.2 Modifications to the PFM Intervention Handbook

The themes drawn out of the thematic analysis of the interviews also lent themselves to some suggestions for the modification of the handbook used to explain the PFM intervention. These related to the content and presentation of the handbook. This was important since it was the main tool used to train the clinical educators in how to use the PFM intervention.

- Create two separate documents: (1) an information sheet which describes the study, what is being asked of them, and how to take part; (2) a document which informs the clinical educator how to use the PFM.
- Ensure that the wording in documents 1 and 2 is clear and can be understood by the clinical educators and the medical trainees; use more lay terminology
- Make it clear that the feedback is on DDM and not consultation skills in general
- Provide clear information regarding how the answers given to the consultation questions influence the feedback provided
- Include examples of medical trainee responses to the five consultation questions for the clinical educator to see as a guide- Table C1.3 was used for this purpose
- Include flow diagrams to demonstrate how the answers to the questions influence the feedback provided
- Make it clear that the feedback is in addition to the feedback that the clinical educators usually provide.
- Make clearer the wording for question 4 (self-monitoring) to ensure the medical trainees understand what they are being asked
- Provide a better lay terminology explanation of goal setting, planning and self-monitoring in DDM in the PFM handbook

- Provide information which outlines why each of the questions are important areas on which to provide feedback

C2.6 Conclusion

The findings from this pilot study clearly indicate the benefits to the design and development of the research of having input from those who will use the intervention. The pilot study has supported that the PFM intervention is a potentially useful, usable and effective approach to improve feedback on DDM. Importantly it also highlighted some issues with the current design and materials, as well as some concerns of the clinical educators. The pilot interviews revealed that the clinical educators often had to balance their desire to provide better feedback with a lack of time, they also had a fear of not understanding the PFM intervention coupled with some misunderstandings regarding its use. The participants did believe that they would be able to use the PFM intervention with their medical trainees and voiced a desire to be able to provide more effective feedback. The modifications developed from these themes should address the participants' concerns and make the PFM intervention more useful, usable and effective.

C2.7 Summary of Chapter

This chapter discussed the implementation of a pilot study to evaluate clinical educators' opinions of the potential usefulness, usability and effectiveness of the conceptual model and the PFM intervention. The pilot study was described and the results analysed and discussed to determine what modifications were required in the conceptual model and the PFM intervention, before its implementation in authentic clinical settings. It is anticipated that these modifications would make the model more useful, usable and effective in authentic clinical settings. This pilot study can be viewed as the first iteration in the on-going development of the conceptual model and the PFM intervention. The findings of the pilot study resulted in the modification of the conceptual model and the PFM intervention which leads into the second iteration- the implementation of the PFM intervention in authentic clinical settings which is described in Chapter C3.

CHAPTER C3: IMPLEMENTATION OF THE CONCEPTUAL MODEL: THE PERSONALISED FEEDBACK MODEL INTERVENTION

In this chapter the implementation of the conceptual model of feedback by the use of the PFM intervention is described. This is the second iteration of the conceptual model and the PFM intervention. It was situated in the authentic clinical setting and involved recruiting clinical educators to provide feedback to their medical trainees. The implementation and evaluation of the PFM intervention is described along with a description of the recruitment strategy, how the clinical educators were taught how to use the PFM and how the intervention was evaluated.

C3.1 Design

The design for this research is a one-group, pre-test post-test design (Gravetter & Forzano 2015; McBurney & White, 2009; Morgan et al., 2008). This is a non-experimental design with no control group. This threatens its internal validity and is limited in its ability to control extraneous variables that may influence the results (Gravetter & Forzano 2015; McBurney & White, 2009; Morgan et al., 2000). However, it was employed since other experimental deigns were inappropriate (McBurney & White, 2009). It was not possible to use a control group due to the small number of potential participants and the possible ethical implications of denying participants the instruction that may be relevant to their teaching and learning. A one-group cross-over design was also not feasible since the initial training group could not act as a control group after being introduced to the model. However, the implementation of a pre and post-test design allowed the participants to act as their own control group with the pre-training evaluation acting as baseline measurements (Gravetter & Forzano, 2015). Such designs are often employed in EDR and such issues are more likely to be expected when using this approach; one of the advantages of EDR is its value in settings where such control is not always possible. Due to the expected small sample size and since baseline measures were obtained for each clinical educator and medical trainee pair, descriptive statistics were used to identify any change within the two groups of participants (medical trainees and clinical educators).

C3.2 Evaluating the Model

The PFM intervention was evaluated by determining whether it led to an increase in how often feedback was provided on the elements focused on by the PFM intervention, such as the medical trainees' self-regulated learning, their confidence, and their perception of the influence of contextual factors on their DDM. The conceptual model of feedback was evaluated by assessing whether the medical trainees and the clinical educators perceived this feedback to be effective and useful for their DDM. The PFM intervention was also assessed by determining whether it led to any changes in the clinical educators' approach to feedback provision on a hypothetical consultation and the medical trainees' approach to DDM in hypothetical clinical reasoning cases.

This research aimed to develop an approach of providing more 'effective' feedback to medical trainees on their DDM. The meaning of the term 'effective' is highly dependent on what one is interested in evaluating. Effectiveness has been defined as "achieving the intended result" (The Oxford Popular English Dictionary, 2000, p. 160). Effectiveness has two meanings in the evaluation of this research. Firstly, the effectiveness of the conceptual model in providing the medical trainees with feedback they perceive to be useful and effective for improving their DDM. Secondly, the effectiveness of the PFM intervention in encouraging the provision of feedback in accordance with the conceptual model. Due to time and resource restraints it was not possible to assess whether the feedback was effective in terms of leading to improved DDM in the authentic clinical setting.

For these evaluations usefulness refers to how useful the participants found the model to be in providing feedback and the usability refers to how practicable it was to use the model to provide feedback in authentic clinical settings. Effectiveness refers to how successful the model was at improving feedback provision and whether participants perceived this feedback would be more effective at aiding DDM than usual feedback. It was important to assess participants' perceptions of the PFM and the PFM intervention in relation to these three terms since they all provided independent contributions to evaluation. For example, participants may have found the model useful but not usable in authentic settings, or they may have found it useful and usable but not more effective. This allowed me to evaluate each aspect and assess its' impact individually. The evaluation questionnaires were discussed with my supervisor, Professor John Sandars to ensure that the style of the questions and the focus was correct to elicit opinions of the model.

Evaluation took place pre and post-training in the PFM intervention. After the clinical educators completed the pre-training I met with them in their place of work to teach them how to use the PFM intervention. They were then instructed to use the PFM intervention to provide feedback to their medical trainee after they had made a diagnostic decision in the authentic clinical setting. The post-training evaluation took place at the end of the clinical educators' and the medical trainees'

involvement in the intervention. For the medical students this was most likely to be at the end of the placement. The post-training evaluation used a format identical to the pre-training evaluation and included an additional questionnaire which evaluated clinical educators' and medical trainees' perceptions of providing or receiving feedback in line with the PFM intervention.

These evaluations create a user-centred design which places an emphasis on the needs of the users. Usability testing is a "systematic process that evaluates the ease with which users can use the tool to achieve their goals" (Sandars & Lafferty, 2010, p. 957). Usability testing is important during the development of an intervention or product since it allows the opinions and perceptions of the users to influence development (Sandars & Lafferty, 2010; Dumas & Redish, 1999). For this reason usability testing was crucial for the thorough evaluation of the feedback model. In order to be effective usability testing must: maintain a user focus, be systematic, use the most appropriate method to collect the data, consider the characteristics of the users and the context in which the intervention will be used in real life, consider the instructional design of the intervention developed, decide on the level of the users participation and reflect on the overall development process and use of the intervention (Sandars & Lafferty, 2010).

The PFM intervention has three components: pre-training evaluation, training the clinical educators and post-training evaluation. This is shown below in Figure C3.1.

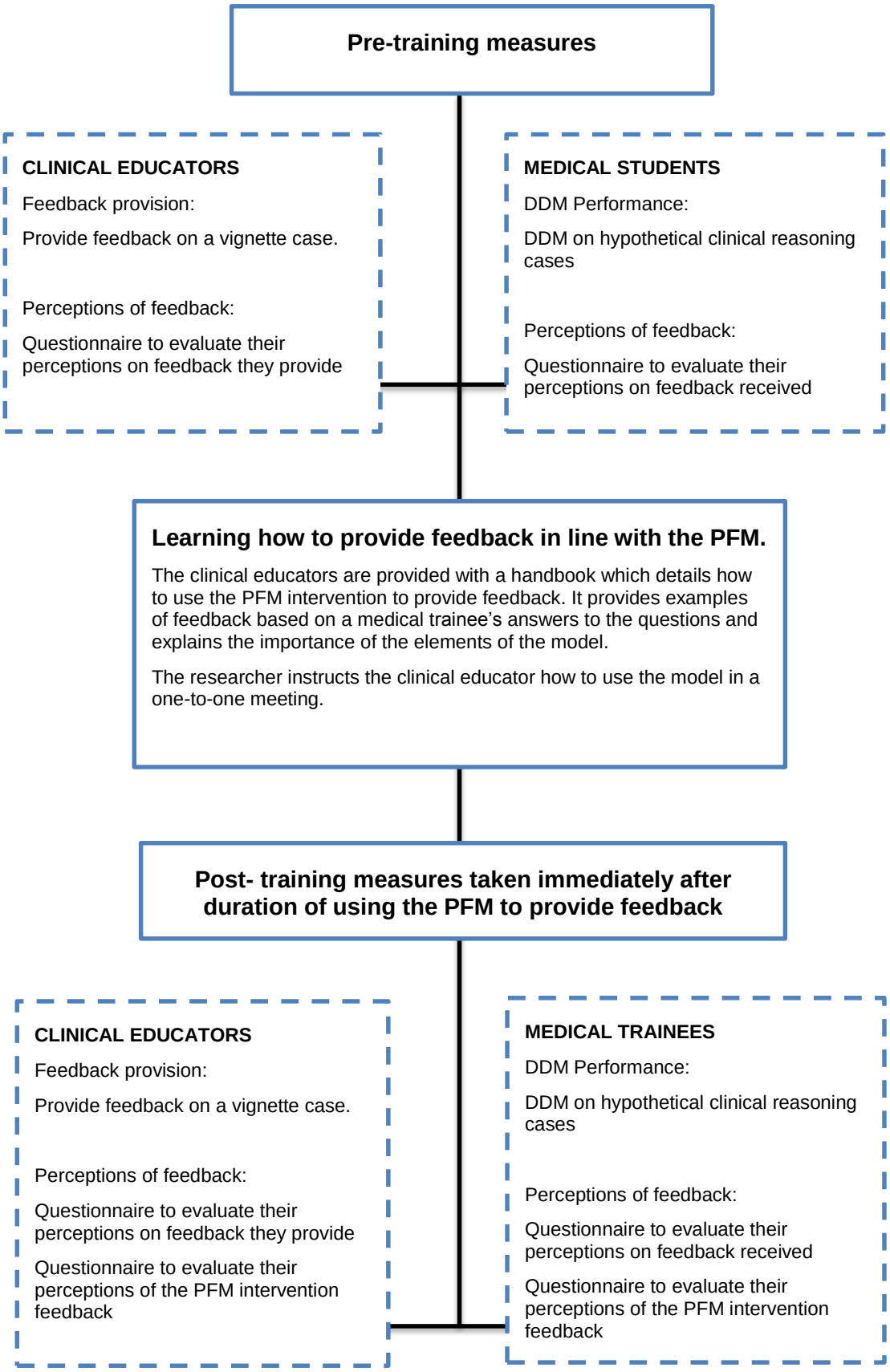

Figure C3.1. Diagram to show the design of the intervention

C3.2.1 Clinical Educators

Before being taught how to use the model, clinical educators answered a questionnaire to ascertain what feedback they provide, what it focuses on and how useful they believe medical trainees find this to be. Clinical educators were also evaluated on their feedback provision to a video recorded hypothetical case. For ease of distribution this video was a training video taken from You Tube. The link is: https://www.youtube.com/watch?v=Ygv4UQssoh0. It demonstrates a poor consultation and was chosen because it had elements that the clinicians could easily pick out and comment on as being poor, and was relatively short (7 minutes 58 seconds). The video was watched by three GPs to ensure it was relevant and that poor elements of the consultation could be highlighted. The feedback provision was evaluated in terms of whether the feedback focused on the elements emphasised by the PFM intervention: goal setting and planning, self-monitoring, confidence and contextual factors. Goal setting and planning was also assessed in terms of how specific and it was and whether the comments focused on task-specific strategies to improve. The extent to which the clinical educators' feedback involved the medical trainee in the feedback was also assessed.

After participating in the PFM intervention, the clinical educators were asked the same questions and shown the same video consultation to provide feedback on. They were also asked about their opinions of using the PFM and whether they thought this improved the feedback provided. This questionnaire was developed to evaluate the participants' perceptions of the model. With this emphasis in mind it focused on asking the clinical educators whether there had been an obvious change in the way they provided feedback. They were also asked whether they considered this feedback to be more effective in helping their students improve, whether the method helped them provide more useful feedback and how easy it was to provide the feedback. These questions required likert scale responses on a scale of 1-5; additional space was provided so they could expand on their response. The clinical educators were also asked whether they had any opinions on how the PFM could be improved and what they thought were the strengths and weaknesses of providing feedback in this way. These questionnaires can be found in Appendix 5.2.

C3.2.2 Medical Trainees

Medical trainees answered a questionnaire to ascertain their perceptions of the feedback they receive and what this feedback focuses on. Medical trainees were also evaluated on their approach to DDM in three hypothetical clinical reasoning cases. Cases 1 and 2 (see Appendix 5.4) were taken from the resource section of the Pennine GP Training website (http://pennine-gp-training.weebly.com; this website has been updated since I retrieved the cases in September 2014 and are no longer on the website) and Case 3 was adapted from a clinical problem solving case in the New England Journal of Medicine (Bliss et al., 2004). The trainee was given the history information of a patient and was asked a number of questions: how confident they were that they could achieve a diagnosis, what their goals were and how they planned to achieve them. They were then given the patient examination information and were asked whether they felt they were on the right track and whether they needed to make any modifications in their approach to making a diagnosis. They were then given the examination findings or test results and were asked to make a diagnosis and state how confident they were in their diagnosis. The hypothetical consultations were trialled with 2 medical students and 1 GP registrar to ensure that they could be used across the two groups and to ensure that the questions did not distract from completing the reasoning problem. The hypothetical consultations assessed the trainees' DDM and also assessed aspects of SRL focused on by the PFM.

The hypothetical clinical reasoning cases were analysed using a form of microanalysis (Cleary, 2011; Cleary & Zimmerman, 2001) to determine whether there were any changes in the medical trainees' self-regulation in their approach to DDM before and after the PFM intervention and whether this led to an improvement in their DDM in these cases. This procedure involves questioning the trainee about specific SRL processes as they engage in the task or activity of interest (Cleary, 2011). An advantage of this is that it can be customised to particular tasks or activities and involve the use of context specific questions to target the various processes at each phase of the cyclical SRL model. The approach attempts to assess how the individual approaches, executes and reflects during specific tasks or events and does this by using a variant of 'think-aloud protocols'. Here, individuals are asked open-ended questions before, during and after their performance. This process directly targets the

key SRL cyclical processes (goal setting and planning, self-monitoring, strategy use, self-evaluation and causal attributions) (Cleary & Zimmerman, 2004).

To analyse the microanalysis, the coding scheme developed by Artino et al. (2014) (which was adapted from that used by Cleary & Sandars, 2012; Cleary & Zimmerman 2001) to be used on microanalysis on the clinical reasoning of medical trainees was used. The coding scheme involved the following categories for goal setting and strategic planning: task-specific process, task-general process, outcome (goal setting only), self-control, non-task strategy, do not know/none and other. 'Task-specific' processes involved specific processes for diagnostic reasoning tasks such as proposing relevant symptoms, identifying contextual factors, synthesising symptoms and comparing diagnoses. 'Task-general' processes were reporting a general approach or method to follow. An 'outcome' response pertained to getting the correct outcome (diagnosis). A 'self-control' response involved a focus on effort, concentration or focus or other skills to enhance performance (Artino et al., 2014). The 'non-task' strategy responses involved reports of using processes or outcomes which were irrelevant or not possible in that task. The 'do not know/ none' response involved reports of not having a goal or plan. The category of 'other' pertained to responses which did not fit the above categories. The coding scheme for self-monitoring was categorised as task-specific process, task-general process, outcome, self-control, other, perceived ability (to perform the task and their related knowledge), and task difficulty (the challenges or difficulty of the task) (Artino et al., 2014).

After being provided with feedback in line with the PFM the medical trainees answered the same questions and completed the hypothetical clinical reasoning cases. They were also asked about their opinions of the feedback they received in line with the PFM intervention and whether they thought this improved the feedback provided. The questionnaire for the medical trainees followed the same structure as the clinical educators' questionnaire but with the questions re-phrased to evaluate their perceptions of being provided with feedback in line with the PFM intervention. In addition, they were provided with nine statements about the focus of the feedback and were asked to rate their

agreement on a scale of 1-10 (1= strongly disagree and 10= strongly agree). These questionnaires can be found in Appendix 5.3.

C3.3 Development of Evaluation Materials

The final evaluation materials were described in C3.2, however, the evaluation method underwent several changes during the development of the intervention. Development of the intervention and testing materials is a key part of EDR and subsequently the substantial changes which influenced the design of the evaluation are listed in Table C3.1 along with the justification for their modification.

Ideas for Evaluation Design that were Modified	Reason Why this Evaluation Design was Modified
Clinical Educators	
Evaluate feedback provision by watching four vignettes of differing performance and providing feedback on these.	Difficulty of obtaining four suitable vignettes of differing performance all with a focus on diagnostic decision making. The length of time it would take for four vignettes to be viewed and feedback provided.
Feedback provision will be evaluated by filming the clinical educator providing a medical trainee with feedback on their DDM after performing a consultation.*	It was not practical for the researcher to observe or record the clinical educator observing and providing feedback to a medical trainee. This would be too disruptive to the consultation and too time consuming for the clinical educator and the researcher. The researcher's presence would also have been unethical for the patient and the clinical educator may have changed the feedback provided since they knew they were being observed.
After the training, to determine whether the clinical educators use the model in their daily practice and teaching they will be asked to video record at least four interactions of providing the medical trainee with feedback in line with the PFM. These will then be analysed by the researcher to determine whether the clinical educator is using the intervention correctly.	Too time consuming and extra work for a busy clinical educator Not always practical to record four interactions within each placement setting Some placements are too short to do four interactions Practicality of recording in each placement May influence the feedback knowing they were being recorded
Medical Trainees	

A measure of the trainees' DDM will be obtained from above (see the *) before and after the clinical educators have been introduced to the tutor-led feedback intervention. This measure of evaluation will be what the clinician usually uses. This measure of DDM ability will be recorded in order to provide a baseline measure of DDM skills.	Time consuming. Added too much extra work for the clinician in that placement. Some placements were longer than others so this would not always be representative. Also, some clinical educators began using the PFM during the trainee's placement so this would have been harder to do.
To measure affective components that may influence student performance, the student will be asked to complete self-report questions before and after they see the patient. Before seeing the patient the questions will evaluate the trainee's motivation, learning attributions, self-efficacy and confidence in their ability and whether they have any goals or strategies for conducting the consultation. After they have seen the patient the questions will evaluate their self-efficacy and confidence in their ability, their performance attributions and self-monitoring. This method will be employed before and after the clinical educator has completed training to determine whether feedback provision which takes into account student individual differences and the processes they use leads to improvements in their level of self-efficacy, confidence, attributions, motivation and their use of processes.	Time consuming Did not have time within the placements to do such detailed and time consuming pre and post-evaluations such as these. Also, each placement was unlikely to be long enough for this to have changed. My involvement was via the clinical educators- they would have had to have implemented this as I did not have contact with the medical trainees.

Table C3.1. Modified ideas for evaluation and why these were modified.

C3.4 Participants and Recruitment

C3.4.1 Clinical Educators

The participants were clinical educators who taught and observed medical students on clinical placements from the years 3, 4 or 5. To take part, these individuals needed to observe medical students making diagnostic decisions in the authentic clinical setting and provide feedback to them. This participant group was decided upon after extensive discussion with potential users of the model and individuals within the School of Medical Education involved in organising the students' placements. The final clinical educator target sample population was much broader than had initially been identified; this was mainly to aid recruitment. The target population was decided upon as other potential target samples were not suitable. This iterative process of participant identification used participant input and is in line with an EDR approach. This was described in detail in Chapter C2.2.1. It was decided that this target participant sample would also be the same for the final intervention. These participants were recruited in the following ways:

- Emails sent out by myself to participants who took part in the questionnaire study (Chapter B5) or the pilot study (Chapter C2) and had given their contact details and permission to be contacted for future research.

- Email sent out by Dr Jonathan Darling (Head of year 4) to any clinical educator who taught DDM to year 4 students from the University of Leeds- February 2015.

- Email sent out by Dr Graham Woodrow (Head of year 5) to any clinical educator who taught DDM to year 4 students from the University of Leeds - February 2015.

- Two emails sent out by Dr Michael Scales (GP and Clinical Lecturer- involved in the management of GPs who take medical students on placement) to GP tutors who took year 3 students on placement from the University of Leeds - December 2014 and February 2015.

- Two emails send out by Sofya Loren (GP Training Administrator at Bradford Teaching Hospitals NHS Foundation Trust) to GP tutors who took any medical students from the University of Leeds on placements or trained GP registrars in Bradford- December 2014 and January 2015.

- One email sent out by Julie Miller (Research Facilitator, NIHR Clinical Research Network: Yorkshire and Humber) to GP tutors who take any medical students from the University of Leeds on placements or train GP registrars in Bradford- February 2015.

C3.4.2 Medical Trainees

The medical trainees were medical students or GP registrars. I had intended to recruit GP registrars and medical students on GP placements from years 4 and 5. When the questionnaire study was conducted (Chapter B5), I failed to recruit any GP registrars and recruited only a handful of GP trainers. Therefore, as discussed above the recruitment strategy was changed to focus on medical students from year 3 on GP placements. Again, as discussed in Chapter C2.2.1, this strategy was amended due to recruitment issues during the pilot study. Consequently, the medical trainees were medical students from any placement where they made diagnostic decisions from years 3, 4 and 5.

Additionally, as GP trainers were also recruited, GP registrars took part in the study. Medical trainees were recruited in to the research by their clinical educator.

C3.5 Barriers to Participation

During recruitment an additional questionnaire was developed and implemented to determine why potential participants did not want to participate in the PFM intervention. The questionnaire provided participants with 13 reasons which may have influenced their decision not to participate (see Appendix 5.4). These reasons focused around workload, time constraints, not finding the PFM intervention useful, not understanding what was being asked and not seeing feedback as an area which needed improving. Participants were emailed and asked if they would complete a questionnaire to understand why they chose not to take part in the PFM intervention. The email contained a link to the questionnaire which was hosted on Bristol Online Surveys. Participants were recruited using the same approach as described in C3.5 for the intervention.

C3.6 PFM Intervention Training

The approach to training clinical educators to use the PFM intervention in this research was similar to the concept of academic detailing. Academic detailing is an approach used within the primary care setting whereby a trained individual meets with the GP in their office to provide them with an educational session on a specific topic (Soumerai & Avorn, 1990). This often involves the defining and discussing of specific problems and objectives, using unbiased sources of information, the identification of the participant's motivations and values and tailoring the message accordingly. It also involves stimulating the active involvement of the clinician in the sessions, using graphic and concise educational materials, repeating the main message and continued contact and reinforcement to have a positive impact on their practice (Soumerai & Avorn, 1990). This approach has been found to reduce GPs prescribing rates across a range of drugs (Collier et al., 2015; Rognstad et al., 2013), improve their knowledge in given clinical areas (Markey & Schattner, 2001) and make them more reflective regarding their prescriptions (Frich et al., 2010).

Using academic detailing in one-to-one meetings the clinical educators were taught how the conceptual model and the PFM intervention are used to provide feedback via the use of the detailed PFM handbook. The handbook repeated the key message of the importance of providing feedback and used diagrams to instruct the clinical educator how to use the PFM. Educational information was also provided which informed the clinical educator why feedback in line with the conceptual model of feedback was important. The clinical educators were actively involved in this session as they were given examples of trainee's responses to the consultation questions and asked what feedback they would provide using the PFM handbook as a guide. The materials shown in Figure C1.4 and Table C1.3 were used here. Clinical educators were asked whether they envisaged having any issues using the PFM in the authentic clinical setting and these issues were discussed and most often resolved. Contact was made with the clinical educator after the training session to determine if they were using the model and whether they were having any problems using it.

One of the anticipated strengths of the PFM intervention and the accompanying documentation about its use was the ease at which the model can be followed and learnt by the clinical educator. Although the academic detailing approach used may be less thorough than other commonly used methods such as training workshops its use here was advantageous for a number of reasons:

- *Time constraints on busy clinicians*. Providing training via a workshop means that the clinical educator needs to find a spare day or half day in their busy schedule. It also often means the clinician has to travel to another location. By ensuring the model can be taught using a one-to-one or practice-sized meeting in under an hour takes up less of the clinician's time and can be provided at the clinician's place of work.
- *Easy to learn the PFM intervention*. Ideally, in the future the PFM handbook will be developed as a standalone instruction booklet which the clinical educator can use to learn how to use the PFM intervention without any input from a researcher.

- *Increased uptake*. It was hoped that the ease of training would promote an increased uptake due to the reduced time commitments.

It is unlikely that one session of teaching how to provide feedback is adequate and this use is reflected in the medical culture where feedback is viewed as poorly used (Henderson et al., 2005). Henderson et al. (2005) suggest that feedback should be taught over a period of time and reflect a number of different types of feedback provision. Baroffio et al. (2007) found that students' ratings of feedback one month after their clinical educators took part in an intervention was only improved for those clinical educators who were already perceived as being good feedback providers. However when evaluated a year later, those who had taken part in the intervention received significantly higher ratings for feedback provision compared to those that had not. This suggests that clinical educators need time to put their new skills into practice. Whilst the approach taken in this research has not addressed different formats of feedback it does reflect the idea that a single training session cannot provide a clinical educator with all the answers and skills needed for effective feedback. By training the clinical educators and providing them with the PFM handbook it could be argued that this enabled the clinical educators to acquire, develop and refine their feedback skills over a period of time whilst using the PFM intervention to provide feedback.

C3.7 Procedure

Participants (clinical educators) were recruited into the study when they responded to an email sent out by one of the methods listed in Chapter C3.4.1. The email contained information about the PFM intervention and what would be required of them if they agreed to take part. An information sheet was also attached to the email. After receiving responses to the email I answered any further questions and provided the clinical educators with a link to the online questionnaires which they were asked to complete. The clinical educators were informed that these would take 20-30 minutes to complete. After these had been completed I emailed the participants to arrange a time to meet them in their work place so that they could be trained in using the PFM intervention. The clinical educators were

sent the PFM handbook by email when the meeting was arranged. This ensured that they had looked at the model before we met and could therefore formulate any questions on the PFM intervention. The clinical educators were instructed to inform their medical trainees that they were taking part in the research and to ask them if they consented to being given additional feedback on their DDM. If they agreed, they were given a consent form and emailed (by their clinical educator) a link to the pre-training online questionnaire to complete. The clinical educators were sent information to give to the medical trainees (before using the PFM intervention) which explained why feedback on each the consultation questions are important. The clinical educator was instructed to use the PFM in authentic clinical settings where the medical trainee got to make diagnostic decisions. They were instructed that they needed to decide in advance when they were going to use the PFM intervention to provide feedback to ensure that the medical trainee could answer the consultation questions before and after the clinical interaction. Before the consultation began the medical trainee was informed that they would be completing the consultation questions during this consultation and that they would be provided with PFM feedback afterwards. They met the patient, completed the before consultation questions, conducted the consultation and then completed the after consultation questions. The clinical educator then provided the medical trainee with feedback based on their answers to these questions and based on their observations of the trainee. The medical trainees were then asked to complete a feedback reflection and action plan. The clinical educator was encouraged to use the PFM to provide feedback as often as possible. At the end of the placement the clinical educator and the medical trainee completed the post-training questionnaires.

C3.8 Ethical Approval

This study received ethical approval in December 2014 from the University of Leeds Faculty of Medicine and Health Research Ethics committee (Ethics number SOMREC14006- Appendix 5.5).

C3.9 Summary of Chapter

In this chapter I have described the second iteration of the PFM intervention. This was the implementation of the PFM intervention in the authentic clinical setting and involved training the clinical educators to give feedback to the medical trainees using the intervention. The design of the research was described and justified. The materials developed to evaluate the model were also described. These were questionnaires to assess perceptions of feedback, a video of a consultation to assess the clinical educators' feedback focus and three hypothetical clinical reasoning cases to assess the medical trainees approach to DDM. The method used to train the clinical educators was discussed and the recruitment strategy was described. Detail was provided regarding the struggles with recruitment and the steps taken to try and address this. The use of the PFM intervention to provide medical trainees with feedback after DDM in the authentic clinical setting was also described and the procedure of the intervention was outlined. It was feasible in the time scale of this PhD to complete only two iterations of the PFM intervention. This therefore marks the end of the current development phase and the beginning of the assessment phase. The results from the second iteration of the PFM intervention are discussed in the assessment phase, Chapter D1.

SECTION C: SUMMARY OF THE DEVELOPMENT PHASE

This phase involved the design and development of a conceptual model of feedback, and an intervention to implement the conceptual model (the PFM intervention). The conceptual model of feedback shows how a learner progresses through a task and demonstrates the role of internal and external feedback in influencing performance. The PFM intervention was developed as a means to demonstrate how the conceptual model of feedback can be used to provide medical trainees with feedback after DDM. Each important element in the conceptual model for providing feedback was decided upon based on previous research, theories and models; this was made clear in Chapter C1. The PFM intervention was then piloted with clinical educators to determine how useful, usable and effective they found the model to be in order to ensure it met their needs. Based on the pilot study, relevant modifications were made and the PFM intervention was ready to be trialled in authentic clinical contexts with medical trainees and clinical educators.

The practical contributions of this phase were the development of the conceptual model of feedback and the PFM intervention with which to implement it. This was a practical contribution since it led to the development of a tool which could be put in to practice within authentic clinical settings. The development of the conceptual model allowed for a theoretical contribution since it is based on previous research and theories. The knowledge and information from this has been used, and built on with other information to create a detailed and comprehensive approach to providing feedback after DDM. The potential theoretical contribution of the conceptual model of feedback and the PFM intervention were recognised in this phase.

SECTION D: THE ASSESSMENT PHASE

The assessment phase involved a detailed evaluation of the intervention that was developed in order to assess the conceptual model of feedback and the PFM intervention in terms of its usability, usefulness and effectiveness. Both the conceptual model and the PFM intervention were developed from the initial problem identification and exploration in the preliminary research phase (Chapters B1-B5) and from the iterative cycles of design and modification in the prototyping phase (Chapters C1-C3).

A number of questions were asked in order to guide the assessment and evaluation of this phase (Palalas & Anderson, 2013). These included:

1. Is the design usable, valid and relevant in the specific educational context? (*Chapter D2.1*)
2. How is the design and the use of the intervention impacted by uncontrolled factors? (*Chapter D2.1.9*)
3. How effective is the design in terms of meeting the objectives and the participants' satisfaction? (*Chapter D1.3*)
4. What is the practical and theoretical contribution of the design and findings? (*Chapter D2.2-D2.3*)
5. How useful, usable and effective do participants perceive the intervention to be? (*Chapter D1.3, D2.1*)
6. Does the design follow the selected theoretical framework? (*Chapter D3.1.2.*)
7. Under what conditions is the intervention less effective and what may act as a barrier to implementation?(*Chapter D2.1.9-D2.1.10, D3.3*)
8. What modifications should be made for the next iteration of the PFM? (*Chapter D3.5-D3.6)*

These questions will be addressed in the following Chapters D1-D3. They were integral to the evaluation of the conceptual model and the PFM intervention. The stages of the assessment phase are shown in Figure D.1.

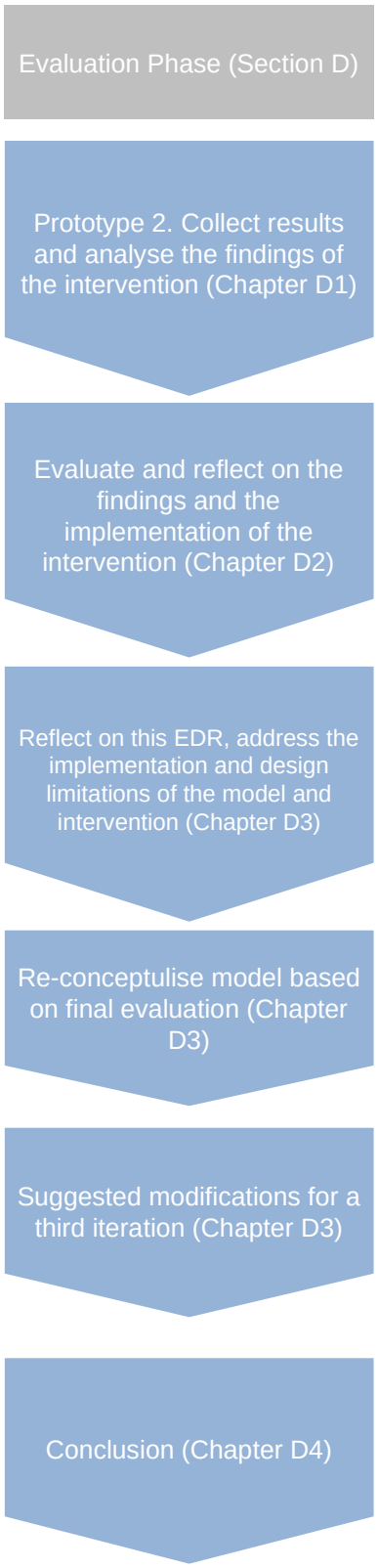

Figure D.1. Research conducted during the assessment phase

The findings from the preliminary research phase and the development phase were evaluated and reflected upon to assess the impact, effectiveness and usability of the conceptual model and the PFM. The practical and theoretical contributions of the research were considered by evaluating and reflecting upon these findings. In this research the goals of the evaluation were both summative and formative, to understand how to improve the design and to understand how well it is currently working in the authentic context (McKenney & Reeves, 2012). Strengths, limitations and future research were also addressed to determine the current weaknesses of the conceptual model and the PFM intervention and how these could be improved in future iterations of development.

CHAPTER D1: RESULTS

In this chapter I describe and analyse the results from the PFM intervention. The results are examined in terms of whether feedback was provided in line with the PFM intervention, whether it led to any changes in the medical trainees' use of SRL skills, or the clinical educators' approach to feedback, and finally their evaluation of the PFM intervention. Lastly, clinical educators' reasons for choosing not to participate were analysed to understand what hindered participation.

D1.1 Analysis of the PFM intervention

The results were analysed by comparing the participants' mean responses on the intervention questionnaires before and after the PFM intervention. Participants' responses to an additional evaluation questionnaire answered after the PFM intervention were also assessed. The questionnaires were designed to elicit the participants' perceptions on how often feedback was given with a focus on SRL, contextual factors and confidence, and how useful and effective the medical trainees found this to be. Perceived usefulness, usability and effectiveness of the PFM intervention were also assessed. Medical students' use of SRL learning strategies to make diagnostic decisions was compared before and after the PFM intervention using hypothetical consultation cases. The clinical educators' approach to providing feedback on DDM was compared before and after the PFM intervention, using a video of a poor clinical interaction. Due to the small sample size, it was not appropriate to use paired samples t-tests to determine whether there were significant differences in the participants' perceptions of the feedback before and after the PFM intervention. Therefore a measure of central tendency known as the mean was used (Manikandan, 2011). The mean provides the most accurate average of the set of numbers since all the numbers in the set are included. However, it is important to note that the mean can be distorted by outliers (Manikandan, 2011). The mean measure of central tendency was used to compare participants' responses before and after the PFM intervention. Qualitative responses to the questions were also reported to illustrate participants' perceptions of the PFM intervention and to support the quantitative results. These responses were taken at face value and no qualitative analysis was used to interpret the results further.

D1.2 Demographics

Twenty clinical educators responded to the recruitment emails voicing an interest in taking part. Thirty-three individuals visited the online questionnaire (although these may not have been unique views) and eight completed the questionnaire and received training in how to use the PFM intervention. Of these eight clinical educators, two did not get the opportunity to use the PFM with their trainees and did not complete the post-PFM intervention evaluation measures. Consequently

they are not included in the analysis. Two of the six clinical educators were female and four were male. Table D1.1 below shows their specialities. Five medical trainees completed the pre and post-PFM intervention evaluation measures. Two trainees were GP registrars, one was a third year medical student in a GP placement, one was a 4th year medical student on a GP placement and one was a 4th year student on a Psychiatry placement.

Clinical Educators	Male	Female	Total
General Practice	4	1	5
Psychiatry	0	1	1
Medical Trainees	**Male**	**Female**	**Total**
GP registrar	1	1	2
Medical students	1	2	3

Table D1.1. Demographics of the clinical educators and the medical trainees

D1.3 Results from the PFM Intervention

The participants' answers to the pre-and post-PFM intervention questionnaires and the evaluation questionnaire were assessed. The results for the clinical educators were analysed separately from those of the medical trainees. For each set of participants the mean response for each question was used to compare differences in perceptions pre-and post-PFM intervention. Mean responses were also used in the evaluation questionnaire to give an overall evaluation of the PFM intervention and the conceptual model.

D1.3.1 Clinical educators: The Focus of the Feedback

The clinical educators were asked to state how often they provided feedback on various elements of performance relevant to the conceptual model of feedback. These included feedback on important PFM processes (such as SRL) (Table D1.2) and on contextual factors (Table D1.3). In terms of the focus of the feedback, there was an increased focus on all of the important elements, except for the overall outcome of the clinical interaction. Importantly, the largest increases in the frequency of

feedback were on the goals set to make a diagnosis, the process followed to aid making a diagnosis, the trainees' ability to adapt their approach and their ability to self-observe their progression through the consultation. The increase in feedback on these elements is important since they can be viewed as vital to self-regulated learning and were emphasised as important by the PFM intervention. Thus the findings suggest that the PFM intervention was successful in encouraging clinical educators to provide more feedback on their trainee's self-regulated learning.

Frequency of Feedback with a Focus on:	Mean Pre-intervention 1= Never 5= Always	Mean Post-intervention 1= Never 5= Always
Overall outcome of clinical interaction	4	4
Medical knowledge	3.5	3.8
Techniques employed to make a diagnosis	4	4.5
Goals set to achieve in making the diagnosis	3	4.1
Process followed in interaction to aid making a diagnosis	3.6	4.6
Their ability to adapt their approach in making a diagnosis in light of information gathered	3.3	4.3
Their ability to self-observe their progress through the consultation	3.2	4.2

Table D1.2 Clinical educators' perceived frequency of feedback provided with a PFM intervention focus

The results show an increase in the clinical educators' perceptions of how often the contextual factors influenced DDM and an increase in how often feedback was provided on each factor (Table D1.3). The largest increases in the perception of the influence of the contextual factor on DDM were for the influence of noise, setting, attitude of the patient, communication barriers, confidence and patient characteristics. The largest increases in how much feedback was given on the impact of the contextual factor were for setting, noise, attitude of the patient, communication barriers, confidence and knowledge. This is important since contextual factors can impact trainees' DDM. Thus the findings suggest that to some extent the PFM intervention was successful in encouraging clinical educators to

place more importance on the impact of contextual factors and to provide more feedback on the impact of such factors in DDM.

Contextual Factor	Mean Pre-intervention 1= Never, 5= Always	Mean Post-intervention 1= Never, 5= Always
Perception of time constraints influencing DDM	3.3	4
Feedback which takes time constraints into account	3.5	4.2
Perception of noise in the environment influencing DDM	2.5	3.5
Feedback which takes noise into account	2.3	4
Perception of the setting itself influencing DDM	2.7	4
Feedback which takes the setting into account	2.6	4
Perception of patient characteristics influencing DDM	3.3	4.2
Feedback which takes patient characteristics into account	3.6	4.2
Perception of attitude toward the patient influencing DDM	3.6	4.2
Feedback which takes attitude toward the patient into account	3.5	4
Perception of attitude of the patient influencing DDM	3.5	4.3
Feedback which takes attitude of the patient into account	3.6	4.5
Perception of communication barriers influencing DDM	3.5	4.5
Feedback which takes communication barriers into account	3.5	4.6
Perception of confidence influencing DDM	3.2	4.3
Feedback which takes confidence into account	3.2	4.5
Perception of knowledge and experience influencing DDM	3.8	4.5
Feedback which takes knowledge and experience into account	3.5	4.3

Table D1.3. Clinical educators' perceived influence of contextual factors and frequency of feedback provided on these

D1.3.2 Clinical educators: Feedback on a Videoed Poor Consultation

The clinical educators were asked to watch a video of a poor consultation before and after participation in the PFM intervention. They were asked to state what feedback they would give to the trainee and what areas of the consultation they would focus on. These responses were qualitative; it was not practicable to report these responses individually so each pre-and post-intervention questionnaire was read for each participant and generalisations were made across the clinical educators. This was a feasible approach since the clinical educators' pre-and post-PFM intervention responses were largely similar; any dissimilar comments are discussed. One of the clinical educators did not complete this part of the questionnaire post-PFM intervention, therefore the results are from five clinical educators. Analysis of the responses showed that overall, the clinical educators changed their approach to giving feedback after the PFM intervention, but that one participant did not. The feedback provision was evaluated in terms of whether the feedback focused on the medical trainees' goal setting and planning, self-monitoring, confidence and contextual factors. Goal setting and planning was also assessed in terms of how specific it was and whether the comments focused on task-specific strategies for the trainee to improve on.

The clinical educators focused their feedback on the medical trainee's goal setting and planning to a greater extent after the PFM intervention. This feedback became more specific and focused on goal setting and planning after the PFM intervention whereas it had been fairly vague before. In particular, after the PFM intervention these responses focused more on ways in which the learner needed to improve or change their goal setting and planning. The responses also focused to a greater extent on the trainee's use of task-specific strategies and what they needed to do to improve. In addition the feedback focused more on the trainee's self-efficacy and the influence of contextual factors on their DDM compared to before the PFM intervention.

"Ask trainee how she can improve". (CB35, pre-PFM)

"By getting her to watch the video and observe herself". (SW72, pre-PFM)

> *"I would ask her what goals she set herself, how she planned to achieve these and whether she felt she met these".* (CB35, post-PFM)

> *"I would try to work out whether she was aware of her poor progress and approach, and whether she felt this was appropriate".* (SW72, post-PFM)

The clinical educators' feedback also discussed in greater detail the way in which the trainee approached the consultation:

> *"Ask the trainee what they were thinking at that time and what made them say or do that. What were they aiming to achieve and what was their goal*?". (HH62, post-PFM)

After the PFM intervention, the clinical educators changed the ways in which they stated they would involve the learner in the feedback and the suggestions they would make for improvement. Before the PFM intervention these were largely focused on vague ways to improve performance such as discussing which areas needed improving and asking them to think of what they did wrong and how they could improve:

> *"Discuss areas needing improvement, suggest methods including theory and practice".* (CB25, pre-PFM)

> *"Spend time on each area, get the student's current understanding of it, use consultation models to discuss and encourage self-reflection".* (NS15, pre-PFM)

After the PFM intervention the comments tended to be more detailed and specific, and provided more information on what needed to be done for improvement. For example:

> *"Get the student to identify their own constraints/feelings about the consultation and start with these".* (HH44, post-PFM)

> *"Watch consultation again. Stop and ask them what they were thinking at that time and what made them say or do that. What were they aiming to achieve and what was their goal".* (HH62, post-PFM)

All five participants stated that they would ask the learner to reflect on their performance whereas only two had commented on this before the PFM intervention. The participants also reported using a video of the consultation in the feedback sessions; this video would be watched by the trainee and the educator and stopped at pertinent parts of the consultation so that performance could be discussed and feedback given. This approach was suggested by three of the clinical educators before the PFM intervention but by all five afterwards.

Overall, after the PFM intervention the feedback the clinical educators reported they would give to medical trainees was more detailed and specific in its focus on task-specific strategies. In addition, the clinical educators reported providing more feedback on the trainees' goal setting and planning, their use of processes, their self-efficacy and the influence of contextual factors. These are the elements focused on in the PFM intervention. This could suggest that the clinical educators were using the focus encouraged in the PFM intervention and were internalising this approach to transfer these skills to other feedback situations.

D1.3.3. Clinical educators: Evaluation of the Feedback

The clinical educators were asked how useful, usable and effective they perceived their feedback to be for the medical trainees improving their DDM before and after participating in the PFM intervention. At the end of the PFM intervention they were asked how useful and effective they perceived the intervention was compared to their usual feedback, how easy the PFM feedback was to provide and whether they had used the feedback approach encouraged by the PFM intervention.

As shown in Table D1.4 the clinical educators perceived the feedback as being more useful, more effective and more usable for the medical trainees after participation in the PFM intervention, suggesting that the PFM intervention was more useful, usable and effective at helping the medical trainees improve their DDM. In particular the feedback as perceived as being more usable by the medical trainees (increase in mean from 3.1-4). Additionally, the feedback provided after participation was perceived as being useful and effective compared to the usual method of providing feedback. Additionally, 5 of the 6 participants stated that the PFM intervention led to an evident change in the way they provided feedback and that the feedback model was easy to use. It is important to note that these differences are quite small, particularly for perceived usefulness. Despite there being an increase in the perceived usefulness, usability and effectiveness of the PFM intervention, the findings may not be statistically or clinically relevant.

	Mean Pre-intervention	Mean Post-intervention	Mean Evaluation of PFM	Mean Evaluation of PFM
Usefulness of Feedback 1= Not very useful, 5= very useful	3.5	4	Perceived usefulness of PFM feedback compared to usual feedback 1= Not very useful, 5= Very useful	4
Effectiveness of Feedback 1= Not very effective, 5= very effective	3.2	4.2	Perceived effectiveness of PFM feedback compared to usual feedback 1= Not very effective, 5= Very effective	4.1
Usability of Feedback 1= Not very usable, 5= very usable	3.1	4.0	Ease of use 1= Not very easy to use 5= Very easy to use	4

Table D1.4. Clinical educators' perceived usefulness, usability and effectiveness of feedback pre and post-PFM intervention

The clinical educators were asked what they viewed the strengths and weaknesses of the PFM intervention to be and if they had any suggestions for improvement. The most common strength was the structure it gave their feedback. This was a feature that was reported by all participants:

> *"I find it difficult to give specific useful feedback using other tools apart from the diagnostic decision making tool. Although it* (the PFM) *takes more time it is structured and allows for consideration of other constraining factors which is useful".* (HH44)

> *"It provided more structure and allows the student to self-assess. It also enabled them to see what is being looked for in the consultation".* (WL70)

The clinical educators also valued the specific and focused approach offered by the PFM intervention:

> *"The feedback was personal to each student and enabled me to give much more specific and focused feedback than usual".* (NS15)

> *"The model is relatively easy to follow to give detailed feedback".* (HH62)

Another strength was the focus on contextual factors. The clinical educators agreed that these are important but are not routinely focused on during usual feedback:

> *"The focus on the contextual factors was interesting and useful. I think this influences them more than I realised".* (CB35)

Weaknesses of the PFM intervention were the time it took to use the conceptual model to provide feedback and difficulties with finding opportunities to use it. Participants reported issues with organising enough time in their daily schedules to use the PFM intervention properly:

> *"I think it would be a good model but I have not been able to use it effectively due to time constraints and the time taken to familiarise myself with it".* (WL70)

One clinical educator also queried the usefulness of the feedback for higher performing trainees; they considered that such trainees may not benefit as much from such focused and specific feedback if they were competent diagnostic decision makers. Some educators disliked the consultation questions which they felt to be 'clunky' and so did not allow the consultation to flow. However, most of the

clinical educators did not find these questions to be intrusive to the consultation or to be time consuming. A number of the clinical educators gave suggestions to improve the conceptual model and the PFM. These included providing feedback using only the most relevant components of the conceptual model so that this would make it more time effective, as well as using a more shorthand or tick sheet version of the consultation questions. Participants also suggested making the PFM intervention less time consuming, but did not offer any suggestions on how this could be done.

D1.3.4 Medical Trainees: The Focus of the feedback

The medical trainees were asked how often they were provided with feedback on elements of performance relevant to the conceptual model of feedback. These included feedback on their SRL processes (Table D1.5) and contextual factors (Table D1.6).

In terms of the focus of the feedback there was an increased focus in all of the important elements focused on by the conceptual model (Table D1.5). Importantly, the largest increases in the perceived frequency of feedback provision were on the goals set to make a diagnosis, the overall outcome of the consultation, their medical knowledge and the process they followed to aid making a diagnosis. This is important since these elements can be viewed as vital to self-regulated learning and were emphasised as important by the PFM intervention. The findings suggest that the PFM intervention was successful in aiding feedback provision on trainees' self-regulated learning. Interestingly, there was a greater difference in the perceived frequency of the provision of feedback on these elements by the clinical educators; this reflects previous findings where the clinical educators reported providing more feedback than the trainees' reported receiving.

Frequency of Feedback with a Focus on:	Frequency of Feedback Provided. 1= Never, 5= Always	
	Mean Pre-intervention	Mean Post-intervention
Overall outcome of clinical interaction	3.4	4
Medical knowledge	3.6	4.4
Techniques employed to make a diagnosis	4.2	4.4
Goals set to achieve in making the diagnosis	3.4	4.2
Process followed in interaction to aid making a diagnosis	3.6	4.2
Your ability to adapt your approach in making a diagnosis in light of information gathered	3.8	3.8
Your ability to self-observe your progress through the consultation	3.6	4.2

Table D1.5. Medical trainees' perception of the frequency of feedback provided with a PFM intervention focus

The PFM intervention led to an increase in medical trainees' perceptions of how often each contextual factor influenced their DDM and how often they were provided with feedback on each factor (Table D1.6). The largest increases were for the perception of the influence of patient characteristics, the attitude toward the patient, attitude of the patient, communication barriers, confidence and knowledge on DDM. The largest increases in how often feedback was given on the influence of the contextual was for setting, patient characteristics, attitude of the patient, attitude toward the patient, communication barriers and knowledge (Table D1.6). This is important since these contextual factors can impact on the trainees' DDM. Thus, the findings support those from the clinical educators and suggest that to some extent the PFM intervention was successful in encouraging medical trainees to place more importance on the impact of contextual factors and that the clinical educators provided more feedback on their impact on DDM.

Contextual Factor	Mean Pre-intervention 1= Never, 5= Always	Mean Post-intervention 1= Never, 5= Always
Perception of time constraints influencing DDM	3	3.4
Feedback which takes time constraints into account	3	3.6
Perception of noise in the environment influencing DDM	2.4	3.2
Feedback which takes noise into account	3.2	3.2
Perception of the setting itself influencing DDM	2.8	3.4
Feedback which takes the setting into account	1.75	3.75
Perception of patient characteristics influencing DDM	3.4	4.4
Feedback which takes patient characteristics into account	2.6	4.2
Perception of attitude toward the patient influencing DDM	2.4	3.8
Feedback which takes attitude toward the patient into account	2	3.6
Perception of attitude of the patient influencing DDM	2.8	4
Feedback which takes attitude of the patient into account	2.6	3.6
Perception of communication barriers influencing DDM	2.2	4
Feedback which takes communication barriers into account	2.2	3.8
Perception of confidence influencing DDM	3.6	4.2
Feedback which takes confidence into account	2.8	3.6
Perception of knowledge and experience influencing DDM	3.6	4.4
Feedback which takes knowledge and experience into account	2.8	4.2

Table D1.6. The influence of contextual factors on DDM perceived by medical trainees and the frequency of feedback provided on these factors.

D1.3.5 Medical Trainees: DDM in Hypothetical Consultations

The medical trainees were asked to read through three hypothetical clinical reasoning cases online before and after participation in the PFM intervention (see Appendix 5.2). They were given the information in three separate stages: history, additional history and examination, and examination findings. After each stage they were asked questions which enquired about their approach to making a diagnostic decision for that case. The questions focused on elements relevant to the conceptual model, specifically self-regulated learning. This was to enable me to determine whether the medical trainees became more self-regulated after being provided with feedback in line with the conceptual model. The responses to these questions were analysed using micro-analysis. This was described in Chapter C3.2.2.

Each participant became more confident after the PFM intervention compared to before (Table D1.7). This increase in confidence reflected their greater use of self-regulated learning strategies after the PFM intervention; each participant became more self-regulated on each of the three cases after the PFM intervention. As evidenced in Table D1.7 the medical trainees' goal setting became more specific and more focused on task-specific processes needed to be achieved to make a diagnostic decision. This is in comparison to their pre-intervention responses which were more focused on the end outcome of what a goal was attempting to achieve. Examples of pre-intervention outcome focused goals are:

> *"To provide the patient with an idea of a diagnosis and a management plan, including pain relief for his pain if appropriate".* (DC83- pre intervention)

> *"Find the cause of the pain"* (TL30- pre intervention)

Examples of post-intervention task-specific process goals are:

> *"Check there is no sinister cause for the knee pain, find the cause and find a management plan with patient agreement. I would do this by making sure I asked about any red flag symptoms and by taking a directed history and exam - then discuss management with the patient".* (TL30- post intervention)

> *"A step by step approach to take a history, and examine, then make a diagnosis. I would make sure the patient understood each step and I would be careful not to let any elements in the history influence my decision".* (CM24- post intervention)

The medical trainees were asked to report how they planned to achieve their goals. This identified what processes they employed. Pre-PFM intervention, the medical trainees mostly reported setting task-general processes, or non-task strategy plans; these were quite vague and most just focused on the end outcome they wanted to achieve. After the PFM intervention most medical trainees focused on the task-specific processes they needed to employ. Nevertheless their reporting of these was still quite vague and general.

Examples of pre-intervention task-general processes and non-task strategy were:

> *"Systematic approach"* (CM24- pre-intervention)

> *"History taking"* (NB33- pre-intervention)

Examples of post-intervention task specific processes:

> *"Full history and examination, including a vaginal/ cervical exam"* (TL30- post-intervention)

The medical trainees reported that they were able to self-monitor their progression through the cases both pre-and-post the PFM intervention. However one participant did not appear to self-monitor in

case 1 and employed self-control strategies in cases 2 and 3, and another participant only used non-task strategies in cases 2 and 3 before the PFM intervention. After the PFM intervention, these two participants did self-monitor. Some trainees provided additional comments which described what they noticed from their self-monitoring and how they used this information to proceed with their DDM. A trainee who was not self-monitoring responded to the question 'Do you feel that you are on the right track? If yes, why?' with:

> *"Not sure"* (TL30- pre intervention)

TL30's answer to this question after the PFM intervention indicated that they were self-monitoring and were able to voice how they were determining whether they were on the right track:

> *"Yes - it seems like it is a problem that would be found by the msk knee exam. I am making sure the history and exam complement each other to make sure I am on the right track".* (TL30- post intervention)

> *"I think so, but would need further investigation in secondary care since post menopausal bleeding requires further investigation. Possibility of malignancy. I am checking that her symptoms match what I am thinking and using that to guide the rest of the consultation*". (CM24- post intervention)

In Case 1 (see Table D1.7) all five participants got the diagnosis correct both pre and post PFM intervention. In Case 2, two of the participants got the diagnosis correct and two did not. The latter two participants did achieve the correct diagnosis after the PFM intervention. None of the participants achieved the correct diagnosis for Case 3. However, despite this, the participants did appear to be more self-regulated in their approach to making a diagnosis. Overall, these findings suggest that the participants did employ more self-regulated learning strategies after the PFM intervention. It is not possible to identify the cause of this but it is possible that being provided with PFM intervention feedback encouraged the trainees to use more self-regulated learning strategies in their DDM. These strategies were then employed in the hypothetical consultations.

Question Focus		Pre-intervention	Post-intervention
Case 1			
Confidence Pre-consultation	TL30	3/10	5/10
	HB86	7/10	9/10
	CM24	4/10	5/10
	DC83	6/10	7/10
	NB33	6/10	7/10
Planning and Goal Setting	TL30	Outcome	Task-specific process
	HB86	Outcome	Task-specific process
	CM24	Task-general process	Task-specific process. Aware of contextual factors
	DC83	Task-specific process	Task-specific process
	NB33	Task-specific process	Task-specific process
Process used to Make a Diagnosis	TL30	Task-general process	Task-specific process
	HB86	Outcome	Task-general process
	CM24	Task-general process	Task-specific process
	DC83	Task-general process	Task-specific process
	NB33	Task-general process	Task-general process
Self-monitoring and Techniques used to Assess Self-monitoring	TL30	None reported	Yes- task-specific process
	HB86	Task-general process	Task-specific process
	CM24	Task-specific process	Task-specific process
	DC83	Task-specific process	Task-specific process
	NB33	Task-specific process	Task-specific process
Confidence Post-consultation	TL30	5/10	6/10
	HB86	8/10	8/10
	CM24	8/10	9/10
	DC83	9/10	9/10
	NB33	6/10	9/10
	TL30	Yes	Yes

Correct Diagnosis?	HB86	Yes	Yes
	CM24	Yes	Yes
	DC83	Yes	Yes
	NB33	Yes	Yes
Question Focus		Pre-intervention	Post-intervention
Case 2			
Confidence Pre-consultation	TL30	5/10	6/10
	HB86	7/10	8/10
	CM24	3/10	4/10
	DC83	4/10	5/10
	NB33	9/10	9/10
Planning and Goal Setting	TL30	Outcome	Task-specific process
	HB86	Outcome	Task-specific process
	CM24	Task-specific process	Task-specific process. Aware of contextual factors
	DC83	Outcome	Task-specific process
	NB33	Task-specific process	Task-specific process
Process used to Make a Diagnosis	TL30	Task-specific process	Task-specific process.
	HB86	Non-task strategies	Task-general process.
	CM24	Task-general process.	Task-specific process
		Task-general process	Task-specific process
		Non-task strategies	Non-task strategies
Self-monitoring and Techniques used to Assess Self-monitoring	TL30	Self-control	Task-specific process
	HB86	Non-task strategy	Task-general process
	CM24	Task-general process	Task-specific process
	DC83	Task-general process	Task-specific process
	NB33	Task-general process	Task-general process
	TL30	5/10	6/10

Confidence Post-consultation	HB86	8/10	9/10
	CM24	6/10	9/10
	DC83	5/10	8/10
	NB33	10/10	9/10
Correct Diagnosis?	TL30	No	No
	HB86	No	Yes
	CM24	No	Yes
	DC83	No	Yes
	NB33	Yes	Yes
Question Focus		Pre intervention	Post intervention
Case 3			
Confidence pre consultation	TL30	5/10	7/10
	HB86	7/10	9/10
	CM24	7/10	8/10
	DC83	6/10	7/10
	NB33	8/10	7/10
Planning and Goal Setting	TL30	Outcome	Task-specific process.
	HB86	Outcome	Task-specific process.
	CM24	Task-general process	Task-specific process. Aware of contextual factors
	DC83	Task-general process	Task-specific process.
	NB33	Task-general process	Task-specific process. Not very specific
Process used to Make a Diagnosis	TL30	Non-task strategy	Task-specific process. Not very specific
	HB86	Non-task strategy	Task-specific process.
	CM24	Task-general process	Task-specific process. Not very specific
	DC83	Yes- task-general process	Task-specific process. Not very specific
	NB33	Non-task strategy	Task-specific process

Self-monitoring and Techniques used to Assess Self-monitoring	TL30	Self-control	Task-specific process
	HB86	Non-task strategy	Task-specific process
	CM24	Task-specific process	Task-general process
	DC83	Task-specific process	Task-specific process
	NB33	Task-general process	None
Confidence Post-consultation	TL30	3/10	4/10
	HB86	6/10	8/10
	CM24	6/10	6/10
	DC83	4/10	4/10
	NB33	8/10	8/10
Correct Diagnosis?	TL30	No	No
	HB86	No	No
	CM24	No	No
	DC83	No	No
	NB33	No	No

Table D1.7. Medical trainees' approach to DDM in the hypothetical consultations pre and post the PFM intervention.

D1.3.6 Medical Trainees: Evaluation of the feedback

The medical trainees were asked to evaluate whether the feedback they were provided with had led to any perceived improvement in their skills. They were also asked whether the feedback was viewed as being effective and useful for their DDM. These responses were rated on a scale from 1 (strongly disagree) to 10 (strongly agree). One trainee (NB33) did not find the PFM intervention useful and did not value the feedback it provided as useful for improving their DDM. Due to the small number of participants, these responses greatly influenced the average perceived effectiveness and usefulness of the PFM intervention. This is one of the weaknesses of such a small sample size, since one set of responses can greatly influence the mean result. The average agreement with the statements ranged between 6 and 7. This suggest that there was modest agreement that the feedback was more structured and was effective in improving their DDM and for changing the approach they took to

making diagnostic decisions. The medical trainees agreed that their confidence had improved to some extent after being given feedback in line with the conceptual model and that feedback with a focus on confidence was somewhat useful. The trainees also agreed to some extent that the feedback had helped them to self-observe their DDM and modify their approach to DDM in the clinical interaction. There was also modest agreement that feedback which focuses on the influence of contextual factors, goal setting and their self-observation of their performance was useful.

This evaluation provides preliminary support for the importance of feedback on the contextual factors, confidence and SRL components of the conceptual model. This shows that 4 of the trainees valued the PFM intervention feedback; this is only a small number and is unlikely to be representative of all medical trainees. In the same way that learners prefer different methods of teaching and feedback, it is evident that not all learners' perceive PFM intervention feedback as useful and effective.

Post PFM Intervention Feedback Evaluation Statements	Rating Agreement (1= strongly disagree, 10= strongly agree) N=5
This new method has provided more structured feedback	6.4
Being provided with feedback in this way has changed the way in which I perform diagnostic decision making	6
Being provided with feedback in this way has been effective in improving my diagnostic decision making	6.8
I believe that my self-confidence has improved after being provided with feedback in this way	7
I find feedback that takes my confidence into account useful	6.8
I believe that the feedback has helped me to self-observe and modify my performance during the clinical interaction	6.8
I find feedback that takes the influence of the contextual factors on my diagnostic decision making into account useful	6.8
I find feedback that focuses on the goals I set myself and how I intended to achieve these goals useful	6.2
I find feedback that encourages me to self-observe my own performance and progress useful	6.6

Table D1.8. Agreement with statements regarding PFM intervention feedback provision

The medical trainees were asked how useful, usable and effective they find feedback on their DDM to be, as well as how useful and effective the PFM intervention was compared to the feedback they usually receive (Table D1.9). There was a slight increase in the perceived usefulness, effectiveness and usability of feedback post-PFM intervention; although these differences are quite small and usual feedback was perceived as being quite useful, effective and usable before participation. With this in mind, perceived effectiveness of the feedback and perceived usability of the feedback improved the most to a mean of 4.5 (5= very useful). The overall perceived usefulness and effectiveness of the PFM feedback in comparison to usual feedback was average. The evaluation of the usefulness of the PFM in comparison to usual feedback was rated as 3.4, suggesting that to some extent it was rated as

more useful than traditional feedback. The overall evaluation of the effectiveness of the PFM in comparison to usual feedback was rated as 3.6 suggesting that to some extent it was rated as more effective than traditional feedback.

Four of the five participants recognised an obvious difference in the way they were given feedback after the PFM intervention.

	Mean Pre-intervention N=5	Mean Post-intervention N=5	Mean Evaluation of PFM	N=5
Usefulness of Feedback 1= Not very useful, 5= Very useful	4	4.5	Perceived Usefulness of PFM Feedback compared to Usual Feedback 1= Not very useful, 5= Very useful	3.4
Effectiveness of Feedback 1= Not very effective, 5= Very effective	3.75	4.5	Perceived Effectiveness of PFM Feedback compared to Usual Feedback 1= Not very effective, 5= Very effective	3.6
Usability of Feedback 1= Not very usable, 5= Very usable	3.75	4.5		

Table D1.9. Medical trainees' perceived usefulness, usability and effectiveness of feedback pre and post the PFM intervention

The medical trainees were asked their views on the strengths and weaknesses of the conceptual model and the PFM intervention and if they could suggest how they could be improved. The main strengths reflected the comments from the clinical educators in that the PFM intervention provided feedback which was structured, focused and specific. The feedback was seen as being more thorough and

allowed thinking on a more conscious level. Participants also reported seeing the value in the elements that were emphasised in the PFM intervention:

> *"The feedback is more structured and is more focused in certain aspects of the consultation and my approach to making a diagnosis. It focused on aspects I often did not give as much thought to but can see how they are influential and important".* (TL30)

The specific focus of the feedback was also seen as a strength since it made the medical trainees more aware of the roles of contextual factors and how their approach to DDM influenced the decisions they made. The feedback was also seen as being more personal since it focused on their responses to the consultation questions.

> *"It has brought my awareness to the role of these factors on my decision making. In particular the focus on contextual factors and my self-monitoring and goal setting".* (CM24)

> *"It felt personal and took more thinking from both sides".* (HB86)

Another trainee stated that a focus on confidence could be useful but voiced a concern of feeling embarrassed if they performed worse than their confidence suggested.

The weaknesses that were identified focused on how the feedback was given. Three medical trainees felt that the feedback was more formal since it followed a set of criteria the educator had to provide:

"The feedback was more formal than usual since it had to be given in a private setting- it was just all more formal". (HB86)

Another weakness was the time it took for the feedback to be given. Two medical trainees found that this made it harder for them to stay engaged, but the majority of the trainees recognised the benefit of the lengthier feedback since they stated finding it more useful:

"It took a long time to give feedback- this made it harder to stay engaged- but on the other hand the feedback was much more useful". (DC83)

One of the medical trainees (NB33) disliked a focus on their self-observation and reported finding this difficult. NB33 also commented that the wording of the consultation questions was not clear to them and it took them a while to understand them.

D1.4 Analysis of the Barriers to Participation Questionnaire

The barriers to participation questionnaire was analysed using descriptive statistics to determine which were the most common reasons for deciding not to participate and the importance of these reasons in influencing that decision. Seventy one clinical educators completed this questionnaire (Appendix 5.4). No further demographic information was collected and it is not known how many people received the email but chose not to complete the questionnaire.

D1.5 Results from the Barriers to Participation Questionnaire

Descriptive statistics were used to determine the most common reasons why clinical educators chose not to participate in the PFM (Table D1.10, columns 2 and 3). The most common reason for not participating was being too busy to take part (76.1%). Being interested in taking part but being put off by the length of the questionnaire (64.8% of respondents), not having the time for the training (56.3% of respondents) and the lack of financial incentive (52.1% of respondents) were also important barriers to participation. The perceived length of time taken to use the model and a belief that it was too complicated acted as further barriers to participation (47.9%). Around a third of the respondents claimed their feedback did not need improving (38%). Only a small percentage of participants had unfavourable opinions on the PFM; 15.5% thought they would not gain anything from taking part, 5.6% thought it would not work and, 9.9% thought it was not a good approach to improving DDM.

Barrier to Participation	Percentage of Participants this Applied to. %	Number of Participants this Applied to N=	Mean Influence of this Barrier. 1= not very influential, 5= very influential	Number of Participants who Answered this Question N=
I am too busy	76.1	54	4.6	50
I was interested but did not have time to spare for the training	56.3	40	4.4	40
I was interested but the questionnaire was too long	64.8	46	4.2	42
I was interested but the model sounded as though it took too long to use in practice	47.9	34	4.	33
There was no financial incentive	52.1	37	4	41
I was interested but the model sounded complicated to use	47.9	34	4	33
My feedback does not need improving	38	27	3.9	28
I am too busy to take part in research which provided me with no obvious reward	16.9	12	3.6	14
I did not understand what I was being asked to do	26.8	19	3.3	22
I did not believe I would gain anything from taking part	15.5	11	3	10
I did not meet the criteria to take part	8.5	6	2.6	8
I did not think it would work	5.6	4	2.6	7
I did not think it was a good approach to improve diagnostic decision making	9.9	7	2.5	10

Table D1.10. The percentage and number of respondents who reported each barrier to participation and perceptions of the barriers to participation as influencing participation

The participants were also asked to rate the importance of each barrier in influencing their decision to not take part (Table D1.10, columns 4 and 5). The barriers to participation were rated on a scale

of 1 (not very influential) to 5 (very influential). The mean of the perceived influence for each barrier was calculated. The most influential barrier to participation was being too busy to participate (4.6), followed by not having time for the training (4.4) and the questionnaire being too long (4.2). The model taking too long to use in practice, no financial incentive and a perception of the model being too complicated were also highly influential barriers (4). A perception of feedback not needing to be improved upon was also quite influential (3.9) showing that these participants did not value any intervention to improve their feedback. The least influential barriers were the perception that they did not think the model would work (2.6) and thinking it was not a good approach to improving DDM (2.5).

The findings from the barriers to participation questionnaire revealed that the most reported barriers to participation were clinical educators being too busy to take part. This was further influenced by the length of time it took to complete the questionnaire, the time it took to be trained in using the PFM and the lack of financial incentive for this participation. These barriers to participation were mirrored in how influential these barriers were. Being too busy, not having time for the training and the questionnaire being too long were the most influential reasons to explain their decision not to participate. Few participants thought the PFM was not a good approach and would not work, and similarly these were less influential in deciding not to take part.

D1.6 Summary of Chapter

This chapter describes the results from the PFM intervention and the questionnaire which investigated barriers to participation. The questionnaires, video consultations and hypothetical clinical reasoning cases were analysed by comparing the responses given by each group of participants and comparing them before and after the PFM intervention. Due to the small sample size and the nature of the questionnaire, the analysis used descriptive statistics and a qualitative approach for the free-text responses. The barriers to participation questionnaire were analysed using descriptive statistics. From the findings I conclude that both groups of participants perceived the PFM to be a

useful, usable and effective method for providing feedback after DDM. Clinical educators did appear to provide more feedback in line with the PFM intervention. The medical trainees mostly viewed the feedback as useful and effective for improving their PFM strategies (SRL and contextual factors) and this led to an increase in the awareness of contextual factors on DDM. The PFM intervention also led to the medical trainees' improved use of SRL strategies in DDM on hypothetical clinical reasoning cases. Additionally the clinical educators approach to feedback on a recorded poor consultation became more SRL focused. However, the strength of these findings may be limited in terms of the low response rate, the clinical relevance of the differences in responses pre and post-PFM intervention, the reported barriers to participation, the inauthenticity of the hypothetical clinical reasoning cases and the recorded poor consultation. A lack of time, the time taken to use the model and the perceived length of time taken to learn the PFM intervention were major reasons that clinical educators did not take part. Despite these limitations, the small number of participants appeared to value the PFM intervention and benefited to some extent from its use. The implications of these findings in support of the conceptual model and the PFM intervention, and how they relate to previous research is discussed in Chapter D2.

CHAPTER D2: DISCUSSION OF THE CONCEPTUAL MODEL AND THE PFM INTERVENTION

Following from the analysis of the results in Chapter D1, in this chapter I provide an overview of the results from the PFM intervention and provide a detailed evaluation of the main findings. These are discussed in terms of how the results provide support for the conceptual model and the PFM intervention, and how previous research supports these current findings. The contribution of this research is discussed in relation to what it offers practically for the medical curriculum and for the professional development of the clinical educators. The contribution is further discussed in relation to its theoretical contribution to SRL, feedback, DDM, contextual factors and barriers to participation.

D2.1 Summary and Discussion of the Main Findings

After identifying the need for improved feedback on DDM this research aimed to develop a model for clinical educators to use to provide feedback to medical trainees on their DDM. The conceptual model focused on the importance of internal and external feedback on confidence, goal setting, strategic planning, self-monitoring and the influence of contextual factors to trainees after being observed in the authentic clinical setting. Of the four levels of feedback identified by Hattie and Timperley (2007), the self-regulated learning (SRL) level of feedback was encouraged in the conceptual model (via the focus on their confidence, goal setting and strategic planning, and self-monitoring) since this is the level of feedback least received by medical trainees. As suggested by Hattie and Timperley (2007) and supported by the results from Chapter B5 the other three levels of feedback (self, task and process) are usually given within clinical educators' traditional approach to feedback. This conceptual model was implemented via an intervention and was used by clinical educators in the authentic clinical setting to give feedback to trainees after observing them make diagnostic decisions. The results provide preliminary support for the effectiveness of the conceptual model and the PFM intervention and suggest that further research is required to further investigate this.

The results showed that both clinical educators and medical trainees perceived more feedback was given on the trainees' medical knowledge, goal setting and planning, use of processes, self-monitoring, confidence and the influence of contextual factors by those who used the PFM intervention. Medical trainees perceived more feedback was given on their medical knowledge and the overall outcome of the consultation; clinical educators also perceived they provided more feedback on the trainees' use of techniques to make a diagnosis and on their ability to adapt their approach to DDM. Medical trainees and clinical educators additionally reported a greater awareness of the role of contextual factors influencing DDM and more feedback was reported as being provided on these. Furthermore, the medical students and clinical educators perceived feedback on DDM to be more effective and useful after the PFM intervention. The clinical educators and medical trainees viewed the conceptual model of feedback as being effective and useful for improving DDM in comparison to the

effectiveness of usual feedback. In addition, the medical trainees valued elements of the conceptual model and PFM intervention such as: being given more structured feedback, and the usefulness of feedback on confidence, contextual factors, goal setting and self-observation. They also agreed that their DDM had improved, their self-confidence had improved and that the PFM intervention had helped them to self-observe and modify their approach to making a diagnosis during the clinical interaction. As a result, the medical trainees employed a more self-regulatory approach to making diagnostic decisions in the hypothetical consultations. The clinical educators showed some signs of providing feedback in line with the PFM on a recorded poor consultation after participation in the PFM intervention. This suggests that the conceptual model provided a focus of feedback which was able to promote and encourage the trainees' SRL and an awareness of contextual factors on their DDM in situations in addition to the one in which it was given.

It was not appropriate to conduct inferential statistics on this sample due to its small size. Consequently, it is possible that the differences are not statistically significant or clinically relevant. The validity and reliability of these findings may be threatened by this small sample size, the authenticity of the hypothetical consultation cases and the video based consultation, and the need for authentic educator-trainee interaction when making diagnostic decisions in order to provide PFM feedback.

Reported strengths of the PFM intervention were the individualised and specific feedback, the structure it provided and the focus on contextual factors. Additionally, the interaction it enabled between the educator and the trainee was valued by both parties as it made the feedback more personal. The participants viewed the weaknesses of the PFM intervention to be the time taken to use the model, as well as the focus of the PFM intervention on only DDM. In addition, one clinical educator disliked the structure of the consultation questions, believing they were too time consuming. One medical trainee disliked a focus on their self-observation and found the feedback approach cumbersome and time consuming. Other medical trainees also stated that the feedback could

sometimes feel more formal since it was more structured. Additional evaluation revealed that clinical educators' reasons for not participating were that they were too busy, they did not have time for the training, the questionnaire was too long and they thought the PFM would take too long to use in the authentic clinical setting. Lack of financial reward was also a barrier to participation. Very few participants did not take part because they considered the PFM would not work or was not a good approach.

D2.1.1 More Feedback on Goal Setting and Planning, Self-monitoring and Confidence

The results provide support for the ability of the PFM intervention to encourage feedback to be provided on the 'learner internal elements' in the conceptual model. The findings from the evaluation suggest that clinical educators can be helped and encouraged to provide feedback which focuses on the learner's internal elements. After participation in the PFM intervention the participants reported providing and receiving more feedback on: goal setting, strategic planning, the process followed to achieve the diagnosis (as highlighted by planning), the ability to adapt DDM accordingly, self-monitoring and the outcome of the clinical interaction. These learner internal elements are all important elements of self-regulated learning (SRL). Consequently, when the term SRL is used it is referring to the learner internal elements. Feedback on these elements should make the trainees more aware of their SRL and enable its further improvement.

Previous research has shown that SRL focused interventions have been successful in improving one's ability to focus on SRL. Kindergarten teachers in Germany underwent self-regulation training which focused on their own self-regulation and ways to foster the self-regulation of pre-school children (Perels et al., 2009). The training focused on each phase of self-regulation and teaching the teachers' self-regulatory strategies for their own learning and for supporting pre-schoolers. They found that the self-regulation of both the teachers and the pre-school children improved significantly after the teachers followed the training programme. Perry et al. (2006) found that student teachers could be

mentored by teachers experienced in SRL to design and develop educational practices which promote students' own SRL. The approach to improving clinical educators' ability to focus on SRL adopted by the PFM intervention was much simpler than the approaches used by Perels et al. (2009) and Perry et al. (2006). Although the PFM intervention is less likely to have prompted a deep learning and understanding of SRL, it does provide support for the success and value of simpler interventions where a focus is on SRL feedback. Previous research has also shown that feedback on SRL has beneficial outcomes for the learner. Tsai (2012) found that students who engaged in SRL strategies and online collaborative learning and were given feedback on an assignment (feedback was given on specific areas of SRL only if necessary) achieved the highest grades. However it is not clear whether this led to any improvements in SRL skills.

In summary, it appears that an intervention based on a conceptual model of providing feedback was successful in encouraging and enabling the clinical educators to provide feedback in accordance with the SRL elements highlighted in the conceptual model. This suggests that the clinical educators were able to engage with the PFM intervention and used it to provide feedback on SRL. This provides support for the importance and application of the conceptual model to a practical model of implementation.

D2.1.2 The Importance of Focusing on SRL

The findings from the questionnaire study in Chapter B5 suggested that medical students find feedback on their goal setting and planning, use of processes, and their self-monitoring to be the most useful types of feedback after DDM. The findings from the evaluation of the PFM intervention support the value placed on this feedback (Chapter D1). These findings suggest that the feedback was effective in improving the medical trainees' SRL. However, further research is required to determine the extent to which these skills improved, whether any components are more effective than others and whether this leads to improved DDM.

The perceived usefulness and effectiveness of the SRL related feedback is supported by previous research which highlights the importance of facilitating learners' SRL skills. Learners are usually expected to become more self-regulated as they gain expertise in their field. Indeed, Downing et al. (2009) showed evidence for improved SRL skills after 15 months on a University course which used a problem-based approach to learning. However, Lucieer et al. (2014) found that medical students became less self-regulated in terms of their planning, monitoring and evaluation during the pre-clinical stage of their medical degree (regardless of curriculum design). Although this could have been influenced by the timing of the assessments (2nd and 6th semester) and the population studied, this finding further highlights the potential usefulness of focusing feedback on SRL strategies in order to assist the development of these skills. Further support for the importance of aiding SRL comes from Endedijk et al. (2014). They found that providing postgraduate students with opportunities to direct their own learning was not sufficient in improving their self-regulation as they progressed through the programme. Thus, additional guidance and support for the medical students may be necessary to foster these skills.

SRL and Improved Performance

The association between the use of SRL strategies and better performance in clinical skills is demonstrated by Cleary and Sandars (2011). They found that medical students who achieved a successful venepuncture on their first attempt were more self-regulated than those who struggled with the task. Assessing the trainee's SRL is important since it informs the clinical educator of how the trainee approaches the task and their performance in that task. Analysing these together provides the clinical educator with a better understanding of how and why the trainee made the diagnostic decisions they did (Peters-Burton et al., 2015). If the clinical educator does not focus on understanding, observing or taking into account the trainee's SRL processes they would have to make inferences of how and why the trainee made that diagnostic decision. In such instances they would be guessing at the trainee's task and self-regulatory processes (Peters-Burton et al., 2015). By observing and taking into account how the trainee is making diagnostic decisions and whether they

are performing in a self-regulated manner, the clinical educator is more informed about the trainee's needs and can provide more effective and individualised feedback.

Feedback on SRL

In the current study, the medical trainees agreed that feedback on goal setting and planning was useful. In support, Artino et al. (2014) demonstrated the importance of a focus on the learners' pre-performance self-regulatory processes. They found that those who set themselves strategic plans in relation to task goals and plans for achieving the task, achieved better outcomes. This provides support for the practical importance of goal setting and planning during a consultation and for the importance placed on these tasks in the conceptual model. In other evidence, Brydges et al. (2009) encouraged medical trainees to learn wound closure skills for the first time in a self-guided manner. Those who watched instructional videos and set goals which were focused on the mechanisms required for successful performance (task-specific process goals), showed greater skill retention compared to those who set goals which were focused on the performance end product (outcome focused) (Brydges et al., 2009). In addition, individual feedback, performance benchmarks and guidelines on learning goals assisted most high performing senior medical students in setting specific, clinical skills learning goals (Chang et al., 2011). Low performing students were less likely to set learning goals which focused on their area of weakness (Chang et al., 2011). This provides support for the importance of feedback on goal setting to encourage learners to set task-specific goals and suggests that more specific goal setting feedback may be beneficial for underperforming medical trainees.

Feedback on Self-monitoring

The medical trainees agreed that the PFM feedback on self-monitoring was useful. This suggests that self-monitoring was viewed to be a valuable tool for making diagnostic decisions. They also viewed the feedback as being effective in helping them to improve their self-monitoring and their ability to modify their approach to DDM. In support of the importance of self-monitoring on performance,

some research has investigated the association of self-monitoring with performance ability, as well as the successfulness of interventions to improve self-monitoring and improve performance. Birjandi and Rahimi (2012) and Rahimirad (2014) have shown that focused strategy instruction on the listening performance of students (for whom English is a second language) can improve their ability to strategically plan, monitor and evaluate their learning. These students had improved scores on a listening test after the intervention; this suggests that these SRL strategies can be improved and lead to improved performance. Additionally, Leggett et al. (2012) used workbooks to investigate the effect of self-monitoring exercises on calibration accuracy and exam performance in medical students. The findings showed that the workbooks could be used to improve calibration accuracy, satisfaction with performance and self-efficacy. The students also improved their score on the exam for the same module suggesting that self-monitoring skills can be improved and are associated with improved academic performance (Leggett et al., 2012). This mirrors earlier findings by Lan et al. (1993) who demonstrated that students who self-monitored their learning and self-efficacy had higher levels of performance on course examinations. Here, self-monitoring was indirectly encouraged via a worksheet where students had to monitor their SRL usage including the time spent on activities needed to master particular concepts, the number of times they participated in each activity and their self-efficacy (Lan et al., 1993). These students valued this method of recording SRL usage since they felt it aided and enhanced their learning. Bloom (2013) advocates the use of self-reflection and action planning to encourage learner's self-monitoring and goal setting in addition to providing individual feedback on goals and the learner's progress toward these. This approach is similar to that of the reflection and action plan forms completed in the PFM intervention.

Informing learners of the advantages of SRL is not sufficient for acquiring such skills (Garavalia & Gredler, 2002). In order to improve learners' use of SRL strategies, techniques should be used which combine instruction about SRL along with the chance to engage in SRL strategies such as goal setting and self-monitoring (Bloom, 2013). Such approaches help learners to internalise the use of SRL strategies rather than using them because they are being instructed to do so (Bloom, 2013). Bloom (2013) asserts that a learners' SRL is enhanced more if it is encouraged within authentic exercises,

and if prompts are given where the learner can set goals, strategically plan, and then self-monitor their progress in light of their goal setting and planning. This provides support for the similar approach taken by the PFM intervention.

The Importance of Self-awareness

It could be argued that the current PFM intervention aids self-awareness, since by asking the trainee to answer the consultation questions, their awareness of the importance of these factors is being brought to the fore. Research supports the importance of self-awareness in learning. Cook (1999) claims that experiential learning strategies such as role play and structured exercises are vital for promoting self-awareness. This can be related to the clinical setting where medical trainees use their DDM skills with patients. Delany et al. (2015) suggest that positive coping strategies can be taught to health science students to help them overcome stressful challenges. These strategies can further improve the learners' self-efficacy, cognitive control and self-awareness. Engin and Cam (2009) agree that self-awareness can increase self-efficacy. Qadir (2015) lists seven broad learning impediments and concludes that self-awareness is important in overcoming these impediments. Such findings suggest that self-awareness is vital for effective performance, but that it may need to be encouraged in learners. Berkhout et al. (2015) found that students' SRL in authentic clinical settings is affected by their personal, contextual and social attributes and is supported or hindered by the influence of their goals, their autonomy, their learning opportunities and their perceived outcomes of an activity. Berkhout et al. (2015) used these results to suggest that students' awareness about their learning and their learning processes may aid their use of different learning strategies (Zimmerman, 1998). This can be achieved by improving the learners' awareness of metacognition and cognition (Schraw, 1998). Learning may be aided by a personalised and tailored learning experience which could be offered to some extent by the current PFM intervention. Although the learning task itself is not personalised to the student, the focus of the feedback is. Thus, the feedback provided is focused on the specific areas of SRL necessary to aid that trainee's improvement.

The current PFM intervention does encourage a focus on the trainees' SRL via providing feedback on goal setting, planning, self-monitoring and confidence; this approach is considered to be successful in providing feedback which is perceived as useful and effective for improving DDM. Future research should build on this to determine the process by which this feedback influences the learners' goal setting, planning and their self-monitoring, whether any of the feedback components are more effective than others at improving SRL, and whether SRL is improved in this context.

D2.1.3 Improved SRL on Hypothetical Consultations

The findings from the hypothetical consultations pre-and post-PFM intervention indicate that the medical trainees did become more self-regulated in their approach to making a diagnosis. In particular the medical trainees' goal setting became more process focused rather than outcome-focused. They were also more likely to report task-specific processes rather than task-general, self-control or non-task strategies to meet their goals. Additionally, self-monitoring improved post-PFM intervention in those who did not self-monitor pre-intervention, and confidence in correct diagnoses also improved. This suggests that the PFM intervention feedback was focused on the trainees' self-regulation and this focus enabled the trainees to improve their self-regulation in making diagnostic decisions on these hypothetical cases. This provides preliminary support for the ability of SRL focused feedback to improve trainee's self-regulation skills. Interestingly, despite all five trainees giving incorrect diagnoses for Case 3 they did become more self-regulated in their approach to this case. This suggests that the trainees were still employing self-regulated learning strategies in a more challenging consultation. This also evidences that whilst self-regulation can assist medical trainees in how they approach and perform a task, these skills complement and support existing understanding and are not a replacement for medical knowledge.

Previous research has demonstrated the importance of improving leaners' use of SRL to aid learning and performance. Larsen (2015) asked students on a neurology clerkship to think of two to three specific learning goals, with specific plans for how they would implement the goal and track their

progress each week. These were shared with the residents and the students were given feedback on these. Seventy-seven percent of students reported that setting learning goals had helped them to improve clinically, 85% stated that the goals had led to their increased awareness of their own thoughts and actions and 56% stated that setting learning goals resulted in an increased focus on patient care. Importantly, the students reported that feedback from their team was a significant factor in helping them to learn from their goals; this further supports the importance of goal setting and feedback on improved learning given in the PFM intervention. Further support for the use of SRL to improve performance comes from training in sport performance. Cleary et al., (2006) found that training college students in the three phases of SRL improved the accuracy of their free throws in basketball and their ability to self-correct their shooting form after missed shots. Training the students in any one of the three phases led to improved performance and adaptation, however training in two and three SRL phases led to the most improvement. This included their ability to make strategic attributions and adaptive inferences regarding their performance and how they could improve (Cleary et al., 2006). The current findings and the studies identified lend support to the conceptual model's focus on assessing trainees' SRL when making diagnostic decisions, and using this information to provide them with feedback on their SRL in order to improve these skills and consequently, future DDM.

D2.1.4 More Feedback on Contextual Factors

The findings from the preliminary research (Chapter B5) suggested that feedback on contextual factors was perceived as useful by medical trainees, but that feedback on their influence was not always given. The current findings (Chapter D1) provide support for the PFM intervention to encourage feedback which is focused on the influence of contextual factors on DDM. The findings suggest that clinical educators can be encouraged to help the medical trainees focus on which contextual factors may be influencing their DDM and provide them with feedback which takes this into account. The clinical educators also valued this focus on contextual factors; they had not previously realised the extent of its importance. The findings from the clinical educators show that after participation in the PFM there was some increase in the frequency with which feedback was

provided on these contextual factors. This increase was also perceived by the medical trainees. An increase in feedback on contextual factors indicates that the clinical educators were using the PFM intervention to provide feedback to their medical trainees. This provides support for the ability of the conceptual model and PFM intervention to highlight the importance of contextual factors and encourage feedback on them.

D2.1.5 Importance of Feedback on Contextual Factors

The current findings (Chapter D1) suggest that the PFM intervention was able to increase the participants' perceived influence of contextual factors on DDM. This provides support for the focus of the conceptual model on contextual factors since it implies that by providing trainees with such feedback and focusing the clinical educators' attention to these factors that the important role of contextual factors on DDM is more likely to be recognised and taken into consideration. In addition, the medical trainees agreed that they found feedback on the role of contextual factors useful. Thus, for these participants the conceptual model is effective in encouraging contextual factor focused feedback which is perceived to be useful for improvement.

Several consequences have been found to occur in clinical encounters as a result of the contextual factors present. These include: emotional reactions to the contextual factors, making behavioural inferences in response to the contextual factor, and difficulty with closing the consultation as evidenced by diagnostic uncertainty, needing additional history, physical examination information and requiring a broad diagnostic investigation (McBee et al., 2015). Once becoming aware of the existence of the contextual factor, some participants in McBee et al. (2015) also used mechanisms to cope with it. Furthermore, the presence of contextual factors has been suggested to lead to increased cognitive load and can create difficulties in diagnosing even in cases that are ultimately quite straightforward (McBee et al., 2015). In addition, Durning et al. (2012) found that the presence of contextual factors influenced the diagnostic reasoning of even expert physicians. This can be explained by situated cognition and the role of the complex interactions between the patient, clinician

and the environment in influencing the outcome of a clinical encounter. In terms of context specificity, this could explain why different diagnostic decisions could be made on the same clinical complaint when environmental or patient characteristics were modified (Torre & Durning, 2015). Consequently, when being taught DDM in authentic clinical settings, trainees need to be made aware of the role of contextual factors in influencing their DDM so they can learn to lessen their impact and develop strategies to cope with them. This realisation was the driving point of the focus on contextual factors in this research and has also been recently acknowledged by McBee et al. (2015).

The influence of contextual factors on decision making is dependent on the specific context of the decision making at that time, thus the influence of contextual factors is not a fixed entity; different contextual factors will be more or less influential on different occasions (Smith et al., 2008). This suggests that learners cannot be taught how to deal with contextual factors or how to stop them from negatively influencing their DDM. However, what is more likely to be beneficial is bringing the existence of these factors and their influence on DDM into the learners' awareness and providing them with feedback on how these are influencing their DDM. In support of this, Torre and Durning (2015) suggest that situated cognition and its implications for the influence of contextual factors on DDM should be made explicit to medical educators so that they can consider how the environment may influence trainees' DDM and how it could be altered to create a more positive outcome for DDM. The current PFM intervention addresses this to some extent with its focus on feedback on contextual factors. Improving awareness of the contextual factors and providing feedback on them was achieved by the PFM intervention. To strengthen these findings, future research should aim to determine whether more feedback on contextual factors leads to an increase in the perceived influence of these factors, and subsequent strategies taken by the trainee to manage them.

D2.1.6 Addressing DDM

The PFM intervention was developed with a generic focus on using performance information to improve medical trainees' DDM. The conceptual model and the PFM intervention focused on the use of feedback on contextual factors, confidence, knowledge and SRL in relation to the medical trainees' DDM. Although the feedback focuses on DDM, the PFM intervention and the conceptual model do not include any reference to the dual processing theory (Croskerry, 2009) and the learners' use of System 1 (heuristic, intuitive) and System 2 (analytical, systematic) reasoning. As justified in Chapter B1.4 this was because there is no one definitive method of how to teach medical trainees how to make diagnostic decisions (Mehdizadeh, 2011; Norman, 2005). This is a debate for future research. However, feedback on performance has been evidenced as key to improving performance and is one agreed upon element of teaching DDM (Mehdizadeh, 2011; Van de Ridder et al., 2008; Norman, 2005; Ende, 1983). An advantage of the PFM intervention approach to giving feedback is that it suggests that DDM can be addressed without a specific focus on theories of DDM such as the dual processing theory or the clinical educators' approach to teaching DDM.

The increase in the participants' perceived awareness of the influence of contextual factors on DDM and the increased amount of feedback provided on these suggests that methods other than cognitive debiasing may serve to reduce the incidence of diagnostic errors. Cognitive debiasing strategies are techniques which may work to debias the individual to a cognitive bias (see Croskerry et al., 2013 Croskerry, 2003; for a discussion of these). However, novice learners are less likely to be aware of their biases (Tversky & Kahneman, 1973) and are more likely to struggle with cognitive debiasing. Therefore, it was anticipated that contextual factors which can actually be linked to cognitive biases (see Table B1.2), would be more recognisable as influencers to medical trainees. In addition, the focus on contextual factors allows for some cognitive debiasing strategies to be employed, such as feedback, awareness and metacognition (Croskerry, 2003b). The PFM intervention used feedback to enhance the medical trainee's awareness of the contextual factors and metacognition was employed when the trainee was encouraged to self-monitor their progression through the clinical interaction and to reflect on their performance. It is possible that by making the trainee more aware of these factors it gives

them a greater insight into a bias. This strategy could be viewed as a precursor to debiasing strategies (Croskerry et al., 2013) and researchers have used these strategies to aid trainee's insight into their DDM (Hogarth, 2001; Fischhoff, 1982) by using educational interventions to foster a trainee's intuition.

The findings from the PFM intervention provide support for the role of contextual factors as important influencers of DDM. This shows that by being made more aware of these, medical trainees and clinical educators can provide more feedback on these factors, and medical trainees can better recognise the influence of these factors on their DDM. An awareness of the role of the contextual factors is more likely to enable the trainee to be less influenced by these factors when making diagnostic decisions. Furthermore, the increased perception of the influence of contextual factors and the increased feedback given on these does provide some support for situativity theory in the recognition that a focus on contextual factors seems to be valued by the medical trainees and increases awareness of the influence of the factors. Future research needs to address the extent to which recognition of these factors and feedback on them does lead to a reduction in their influence on DDM and the means by which recognition of these factors leads to better DDM.

D2.1.7 The PFM Intervention as an 'Add On'

As highlighted in Chapter B1.4 there is not one best recognised method of teaching DDM and there is no one uniform method by which clinical educators provide their trainees with feedback (Mehdizadeh 2011; Norman, 2005). It was unlikely therefore to expect the clinical educators to modify their entire approach to feedback provision. Consequently, the PFM intervention was developed to be an envelope of feedback, to be used as an 'add on' to the existing feedback the clinical educator usually provides. This means that although the PFM intervention focuses on giving feedback on DDM, the medical trainee is still given feedback on other important areas of the clinical interaction such as their history taking and examination skills as they usually would be. The current findings provide support that an intervention developed as an 'add on' to existing provision can be

used to encourage clinical educators to provide more feedback on the influence of contextual factors and SRL. The strength of the PFM may be in its focus as a detailed, structured 'add on' to existing feedback, rather than as a generic guide of feedback (Ramani & Krackov, 2012; Vickery & Lake, 2005). Thus, it provides an approach to follow to provide feedback in a structured manner, whilst not attempting to modify the feedback the clinical educator usually provides. The PFM intervention therefore may be a potential strategy to get clinical educators to improve the feedback they provide without requiring them to re-train or modify their overall approach to feedback provision. In a profession where time is precious, this approach could offer a relatively simple way to improve feedback.

D2.1.8 Barriers to Behaviour Change

The response rate of the participants was lower than expected. However, low response rates are not unusual in research involving health professionals. Interventions such as randomised control trials involving health professionals often face issues with recruitment (Raftery et al., 2008; Wilson et al., 2000; Easterbrook & Matthews, 1992). The main barriers to participation in the PFM intervention were: the clinicians being too busy to take part, the length of time it took to complete the questionnaire, the time required for the training and a lack financial reward. Due to a lack of similar research it is difficult to ascertain whether the issues with recruitment are commonplace among clinical educators or whether it was a reflection of participants' lack of interest in taking part in this particular research. The research received wide interest in the initial stages with many clinical educators commenting on the importance of improvement in this area. Only a small number believed that the PFM was not a good approach to providing feedback on DDM and was unlikely to work. Clearly then, there is a distinction between those who can recognise the potential benefit of the PFM and those who judged it to be of sufficient benefit to participate. There is little research which discusses recruitment rates of clinical educators, although Asch et al. (2000) reported response rates ranging from 2.5%-91% across 16 studies which identifies that response rates are extremely variable.

In support of the current findings, common barriers to participation in health research generally include the additional time of participation, concern about the impact on the doctor-patient relationship, loss of professional autonomy, lack of rewards or financial incentive, inadequate research experience or training, recognition and a lack of interest in the research area (Rahman et al., 2011; Ross et al., 1999). Bower et al. (2009) emphasise the importance of the clinicians' attitudes to research and their attitudes to that particular research, their relationship with academics, practical and logistical issues, incentives to participate and effects on the doctor-patient relationship.

Strategies to aid recruitment have been outlined by Bower et al. (2009) and Rahman et al. (2011). These include financial incentives, focusing on clinicians with a special interest, focusing on clinicians who show a readiness to change, involving the clinicians in the design, providing skill development incentives, giving specific training, employing educational incentives and advertising projects with clear benefit to patient care or the clinician's development (Rahman et al., 2011; Bower et al., 2009;). Asch et al. (2000) claimed that recruitment rates are often improved by personal contact with the clinicians and by using friendship networks. However, this may lead to sample bias (Asch et al., 2000). This research is not alone in its struggle to recruit; Sanders et al. (2011) concluded that even interventions developed in collaboration with participants may still struggle to be integrated into authentic daily practice (Sanders et al., 2011). Based on their difficulties in implementing a new tool for the treatment of back pain in general practice, Sanders et al. (2011) suggest that in order for an innovation to be accepted, it is important to understand how it may affect current work patterns, the impact its use may have on interactions with peers and its impact on the current stability of routine medical work. This last point is relevant to my research since one perceived barrier to participation was the integration of using the PFM into the routine observation of medical trainees. The most salient factors reported to have negatively impacted participation in this research are discussed below.

Busy Schedules

Clinicians, particularly those in general practice, lead busy lives. This leaves little time for participation in research which could improve their clinical practice or teaching skills (Rosemann & Szecsenyi, 2004). Previous research has found that a lack of time is the most common barrier to participating in research (Jowet et al., 2000). Those who do participate are often those who are involved in teaching and have protected time to partake in research (Soler-Gonazalez et al., 2011; Jones et al., 2003; Jowet et al., 2000).

Time Commitment: Questionnaire and Training

Participation in this research did require a significant amount of time commitment from the clinical educators. The time commitment for the questionnaire may have been too lengthy and this is reflected in the response rate to them. Thirty-three participants visited the first page of the questionnaire but only 7 completed it, although it is possible that the 23 visits to the first page of the questionnaire may not have been unique participants. The evaluation questions revealed that the time taken to complete the questionnaire and to complete the training were the second and third respectively most reported reasons for not participating. As recognised by Asch et al. (2000) the burden of the research may negatively impact recruitment when participation extends beyond simple survey completion.

Time Taken to Provide Feedback and Ease of Understanding the PFM Intervention

The time commitment of using the PFM intervention may have made the clinicians less likely to participate. Clinicians are busy, clinics often run behind schedule and there is little time to provide feedback between patients. The PFM intervention takes up clinicians' valuable time in the training and practice required to use it, and in the extra time involved in giving the feedback. The intervention does little to address the time issues reported surrounding effective feedback provision (Chapter B5.5.3). Time for adequate observation and feedback is an issue which needs addressing within medical education in general and is difficult to tackle here. Nevertheless, future development of the

conceptual model and the PFM intervention could explore how to reduce the time taken to use the PFM intervention to provide feedback.

Lack of financial reward

Busy clinicians are more likely to prioritise extra work which offers them an incentive. A financial incentive has been viewed as essential by GPs due to the extra time and work involved in research participation (Rosemann & Szecsenyi, 2004). The provision of a financial incentive was not appropriate in this research although it is likely that it would have improved recruitment response rate. However, a balance must be reached between financial incentives aiding the desirability of the research and encouraging recruitment where participation may negatively impact the usefulness of the results.

Feedback Provision as a Sensitive Subject

The psychological burden of participation may also have influenced recruitment. Clinicians may be less likely to take part in research which places a focus on a skill they feel weaker in, or struggle with (Asch et al., 2000). This seems counterintuitive since participation may offer clinicians the opportunity to improve these skills. It is widely recognised within medical education that feedback on performance is a required facet, but it is one that is not always given often, or in a manner that is deemed most effective by medical trainees (Jensen et al., 2012; Sostok et al., 2002). Consequently, clinicians may have been reluctant to participate in case it drew attention to any poor feedback provision or feedback provision techniques. Asch et al. (2000) suggests that ameliorating the fears of evaluation and adverse effects of participation may reduce this burden for potential participants. These concerns were addressed in this research by ensuring the participants that participation would not have any negative effect on their employment with Leeds Medical School and that their participation and any results would be kept anonymous.

D2.1.9 Difficulties with Changing Behaviour

It has been suggested that interventions which aim to change clinicians' behaviour have limited success (Vollmar et al., 2010; Post et al., 2009). This was one of the reasons why the PFM intervention sought to provide feedback in addition to what is already provided rather than change the way feedback was given *per se*. An important influence on affecting change is having an understanding of what the clinicians deem 'effective' feedback to be. Despite the discrepancies between medical trainees' and clinical educators' perceptions of feedback, some may view their feedback as effective. For change to be more likely to occur, the new ways of working need to be perceived as more effective than the current ways of working (Vogt et al., 2010). Since this intervention provided an 'add on*'* to how feedback was already provided, the need to target behaviour change was not a main concern of the design and recruitment process. However, based on the low recruitment levels, it appears that despite recognising the importance of the intervention, clinical educators were reluctant to take part. In order to address this, it is necessary to understand what encourages participation and behaviour change. As widely stated throughout behavioural change literature, key to ensuring interventions are effective in bringing about behaviour change is identifying, targeting and remediating the specific barriers to behaviour change (Chisholm et al., 2011; Hanbury et al., 2011; Hakkennes & Dodd, 2008). One strategy is to identify the constructs which need changing, identify the domain of that construct and map these onto appropriate behavioural change techniques (Francis et al., 2005; Michie et al., 2005). It appears that the role of behaviour change, from the perspective of encouraging the target sample to change their feedback behaviour and participate in the intervention, was not adequately addressed in the design and the development of this intervention.

In terms of barriers to behaviour change it is likely that perception of responsibility to change, a lack of time, a lack of experience using the PFM and the continued effort of behaviour change, negatively impacted participation. Furthermore, a lack of engagement with, or ownership of the PFM intervention may have negatively impacted their participation. Consequently, future research needs to address these issues and should encourage the clinical educators to use the PFM in a way that works best for them.

D2.1.10 The Theory of Planned Behaviour

In order to more fully explain individuals' reluctance to change their behaviour a number of behaviour change theories and models such as the Theory of Reasoned Action (Fishbein & Ajzen 1975), the Health Belief Model (Becker, 1974), the Stages of Change Model (Prochaska & DiClemente, 1983; Prochaska, 1979), the Health Action Process Approach (Schwarzer, 2001, 1992) and the Theory of Planned Behaviour (Ajzen, 1991,1985; Ajzen & Madden 1986) have been developed to attempt to account for and explain what influences behaviour change and provide avenues for how this can be addressed. The majority of these models were developed to explain health behaviour change in patients, however, more recently models such as the Theory of Planned Behaviour and the Stages of Change Model have been applied to behavioural changes in healthcare professionals.

A lack of participation in the PFM intervention could be explained by the Theory of Planned Behaviour (TPB) (Ajzen, 1991). For this intervention, the TPB appears to be the most appropriate to attempt to explain and understand barriers to behaviour change. The TPB assesses individuals' intention to perform the behaviour in question; this intention is then used as a predictor of behaviour (Figure D2.1). According to the TPB, intention can be influenced by one's attitude towards the behaviour, subjective norms and perceived behavioural control. Attitude toward the behaviour is influenced by the individuals' perceptions of the consequences of performing the behaviour (behavioural beliefs) and the evaluation of these outcomes. Subjective norm is influenced by the beliefs held by important others regarding performing the behaviour and the individual's motivation to comply with these, to create a perception of social pressures regarding performing the behaviour. Perceived behavioural control is influenced by the presence of factors which will aid or hinder performing the behaviour and their control over these factors in order to create the individuals' perceived ease or difficulty in performing the behaviour (Azjen, 1991). These beliefs will influence the individuals' intention to perform the behaviour and thus influence whether or not the behaviour is performed. These variables can also influence and interact with each other to influence intention to perform the behaviour. Furthermore, perceived behavioural control can have a direct impact on

the behaviour, without being mediated by intention. Perceived behavioural control consists of one's belief about their confidence and how much control they have over the behaviour and may be viewed as congruent to self-efficacy (Ajzen, 1991). Using the TPB to identify what may aid or hinder the performance of specific behaviours seems practicable since intention can be shown to be a proxy measure for actual behaviour (Eccles et al., 2005).

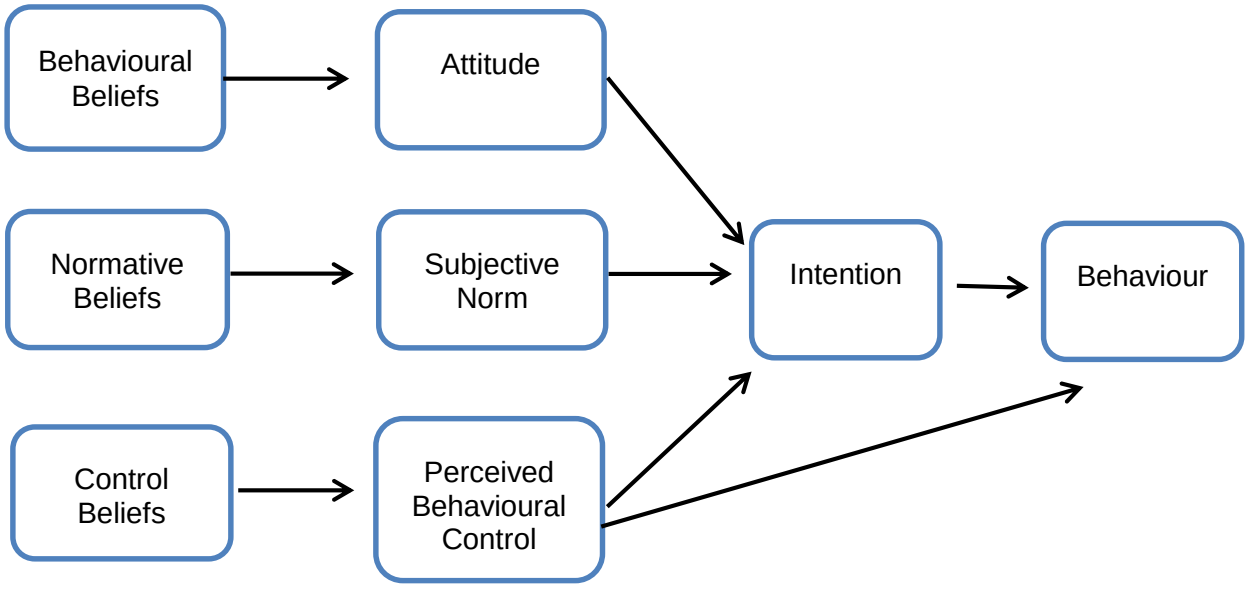

Figure D2.1. The Theory of Planned Behaviour.
Taken from Azjen (1985)

Whilst the current research did not evaluate participants' opinions of the PFM intervention in a way which would allow for the direct use of the TPB to investigate the low recruitment, some suppositions can be made to link the lack of participation with the elements of the TPB. In this context *'intention'* refers to the clinical educator who agreed to take part in the intervention; those who completed the barriers to participation questionnaire were those who did not meet this criterion of 'intention'. It is apparent from the responses to this questionnaire that individuals' attitudes toward the behaviour and their beliefs about their control over the behaviour (factors that hinder or aid performance) may have influenced intention to participate in the PFM intervention. In terms of behavioural beliefs and attitude the majority of participants had a positive attitude toward the behaviour, viewing the PFM intervention to be useful in improving feedback provision on DDM. In terms of beliefs, most individuals viewed the consequences of the behaviour to be positive, that is, they thought the model

could be used to aid feedback on DDM. Since the evaluation questionnaire was to assess why clinical educators chose not to participate, the evaluation statements had a negative focus (see Table D1.10). The low levels of response to these negative behavioural beliefs suggest that the participants had few negative attitudes toward intention to participate and consequently, it is unlikely that negative attitudes were the cause of the poor intention to participate.

The role of normative beliefs and the subjective norm are unlikely to have played a significant role in influencing intention to participate and were not assessed in the questionnaire. Most of the clinical educators taught alone, or were the only Doctor in that practice who supervised a student. Consequently, they were less likely to value others' opinions of participation or to feel motivated to comply.

The largest influence on intention to participate was likely to have been participants' perceived behavioural control regarding the extent to which they felt able to participate. The most common variables influencing participation were the clinicians' workload, not understanding how to enact the behaviour and the perceived amount of time participation would entail (see Table D1.10). The high evaluation scores on these variables indicate that these reasons were highly indicative of a lack of intention to participate. Time and workload are likely to be the biggest hindrance to performance since the individual has little control over these factors.

These findings can be used to summarise two key points about the poor recruitment for participation in the PFM intervention. Firstly, participants had positive and favourable behavioural attitudes towards the PFM intervention using the conceptual model to provide feedback on DDM. The majority of respondents thought the model could be useful for improving feedback on DDM and agreed that this was an area of medical education which warranted further investigation. Secondly, the main factors which hindered participation in the research were the clinical educators' perceived ability to be able to participate and use the PFM to provide feedback. In particular they reported that

their workload and the time taken to participate negatively impacted on their perceived ability to participate.

The reported influences on participation can be used to determine how the PFM intervention can be improved to encourage participation in the future. Previous research has found support for using the TPB to achieve this. The TPB has been used to some extent to modify individuals' intention and behaviour by targeting the attitudes, subjective norms and perceived behavioural control negatively impacting intention (Hardeman et al., 2002). In this instance then, it is necessary to address the clinical educators' perceived behavioural control over participation; this could lead to an increase in participation in the research. This approach could also be aided by the strategy advocated by Francis et al. (2005) and Michie et al. (2005). Importantly, the main barrier to participation of time, is likely to reflect current disquiet within the medical workforce rather than their issue with the PFM intervention.

D2.2 The Contribution of the Conceptual Model and the PFM Intervention

It is important to identify and discuss the contribution of the conceptual model and the PFM intervention to the current theory and understanding of feedback and DDM in medical education, the practical contribution to medical education and the professional development of the participants.

D2.2.1 A Practical Model of Feedback Provision and Contribution to Medical Education

As outlined in Chapter A2.5 EDR must offer a practical contribution to the setting in which it is conducted. The practical contribution usually refers to the intervention developed and can also refer to what this contribution offers in terms of educational products, processes or programs, as well as educational policies. Whilst this research does not offer a new educational policy or program it does deliver an intervention which can be viewed as an educational product. The findings from this research have the potential to offer ideas of how a new model could be designed to offer clinical

educators a way of providing more effective feedback to medical trainees on their DDM. The current model may be limited in its ability to comprehensively provide this new approach. However, despite recruitment and methodological issues the findings do support the importance of the conceptual model and the PFM intervention. The conceptual model fills a void in the field since there are no detailed feedback models with a direct focus on enhancing feedback provision on DDM in authentic clinical settings; neither do any have a focus on the key elements promoted by the conceptual model. Addressing the limitations discussed in Chapter D3.3 could contribute to the development of a method which would provide clinical educators with detailed and specific techniques to assist them in providing medical trainees' with feedback on their DDM. In particular it would improve clinical educators' feedback on DDM and thus help to improve medical trainees' DDM, leading to fewer diagnostic errors. If further refinement and development of the conceptual model and the PFM intervention were successful it could be implemented at other institutions and regions of the UK. Furthermore, the costs of using the handbook plus additional online practice videos and materials to implement the PFM intervention would keep the costs low.

D2.2.2 Professional Development

The professional development of the participants refers to what the participants may have learned or gained from taking part and this is an important output. Professional development was experienced by myself and potentially by the participants during this research. My professional development was in learning new skills and gaining a greater understanding of how to implement an intervention. In relation to skills, I have learnt how to conduct a systematic review, conduct and analyse interviews, and design questionnaires. The development of the conceptual model and the PFM intervention by reviewing the literature on DDM and feedback also gave me experience in researching and synthesising information and using it to tackle a specific research question. From conducting this research, and the problems encountered with recruitment and implementation, I have gained more valuable insight into important factors surrounding designing and implementing interventions for busy authentic clinical settings. Using this experience and understanding I would modify certain

aspects of the intervention to improve its future use in authentic clinical education settings (Chapter D3.4- D3.6).

It is a reasonable supposition that the clinical educators who took part in the PFM intervention, experienced professional development. Specifically, the skills developed were the ability to focus the feedback provided using the medical trainee's answers to the consultation questions and the ability to provide specific and detailed feedback on each of these areas. For those who found the model favourable it may have led to a continued change in their teaching approach. For the medical trainees, professional development may have been witnessed in the new skills learned and in improved DDM. This may have been the recognition of the importance of a focus on their self-monitoring their performance, their goal setting and their awareness of the influence of contextual factors on their DDM; this may have led to the enhanced management of these factors within a consultation.

D2.2.3 Theoretical Contribution

As explained in Chapter A2.10.3 it is important that EDR contributes to existing theory and contributes new theory and understanding beyond what is currently known. The preliminary research of this EDR and the findings of the PFM intervention have provided new theoretical insight into feedback on DDM. The theoretical contribution of this research is at the local and middle level of theoretical contribution and is descriptive and prescriptive in nature (McKenney & Reeves, 2012). It is descriptive since the theoretical contribution describes the role of SRL and contextual factors in feedback on DDM. There is also contribution in terms of greater understanding of barriers to participation in EDR and the PFM intervention. The theoretical contribution is also prescriptive since it was used to inform the design principles modified after iteration 2 (Chapter D3.4). The local level contribution of this research refers to the contribution that is limited to the context in which it was conducted. This was discussed in Chapter D2.1 and also focused on how the findings related to and are supported by previous theory. The contribution is also at the middle level since the findings

from this research can contribute to existing theory on feedback, SRL, contextual factors and barriers to participation. The middle level contribution is discussed below.

Self-regulated Learning

The questionnaire study (Chapter B5) provided support for the claims made by Hattie and Timperley (2007) that learners prefer feedback on their self-regulated learning and their approach to the task (use of processes) but that they are not always likely to receive this. The claims made by Butler and Winne (1995), that feedback will be enhanced if it is tightly coupled with SRL, and aids the learners' ability to self-monitor and provide their own internal feedback were also supported by the questionnaire since feedback with this focus was perceived as useful. The findings from the PFM intervention have contributed to existing research on SRL by demonstrating that it can be used as a guide for the provision of feedback. This builds on existing theory by Butler and Winne (1995) by suggesting that a focus on SRL can aid feedback on learners' SRL strategies and that this feedback is viewed as useful and effective for improving performance. Furthermore, it also suggests that feedback on SRL leads to some enhancement in the use of these skills during performance. These findings also provide support for Hattie and Timperley's (2007) suggestion that feedback on SRL is useful for improvement.

The findings provide a new direction to existing theory on SRL by indicating that a modified approach to SRL microanalysis is sensitive to changes in learners' SRL. Previous research has emphasised the need for microanalysis to be conducted before, during and after performance and for the microanalytic questions to be focused on all the SRL elements at each phase (Cleary et al., 2012). The learner consultation questions were a form of micro-analysis. However, this approach was modified since it focused only on confidence, goal setting, strategic planning and self-monitoring. The responses were also written by the trainee rather than spoken aloud as is the usual protocol. Furthermore, only confidence was asked about before performance and the other factors were asked about retrospectively. Researchers advise against retrospective microanalysis for fear that responses

will be biased by performance. However, prospective microanalysis of goal setting, strategic planning and self-monitoring during the task is not always feasible in the authentic clinical setting. This research shows that focusing on SRL strategies before and after the consultation still led to improvement in SRL skills and to the generation of feedback which was viewed as effective and useful for the participants. This could be viewed as reflecting the adaptability of SRL and SRL focused feedback for use in the authentic setting where it is not always feasible to assess SRL before, during and after performance.

Contextual Factors

The questionnaire study (Chapter B5) provided support for the supposition of situated cognition that contextual factors may impact cognitive load and influence the decisions clinicians make (Durning et al., 2012; Durning & Artino, 2011). These findings provide new insight into feedback on contextual factors since medical students reported usually receiving very little feedback on their influence. The findings from the PFM intervention also support the recognition that contextual factors influence decision making as they demonstrate that the trainees who participated became more aware of the influence of these factors. This supports the theory of situated cognition and shows that with prompting, medical trainees and clinical educators can be made more aware of the influence of these factors. However, future research should identify the means by which the feedback brought about this awareness. In addition, the findings add to current theory on feedback and contextual factors by showing that clinical educators can be encouraged to provide more feedback on the influence of these factors. Future research should investigate whether feedback on contextual factors plays a role in reducing the subsequent influence of the contextual factors on trainees' DDM in authentic clinical settings.

Feedback provision

The findings from the questionnaire study (Chapter B5) contribute to existing theory surrounding feedback provision. The findings identify the existence of a discrepancy between feedback provided

by the educator and feedback received by the trainee. The findings from the conceptual model and the PFM intervention (Chapter D1- D2) provide new insight into the theory and understanding of how feedback can be used to improve performance. This research informs current understanding of feedback provision by demonstrating the potential effectiveness of a conceptual model and an intervention which was structured and specific in its targeted approach to providing feedback rather than offering a generic model of how to improve feedback skills. This suggests that feedback interventions to improve feedback provision do not need to alter the educator's whole approach to feedback provision. The PFM intervention also provides a more tailored and specific approach compared with many feedback advice articles and models of feedback. These tend to provide generic advice on the approach to feedback as a whole and how to rigidly structure the feedback with little specific advice to the trainee about how to improve (Brukner et al., 1999; Hewson & Little, 1998; Silverman et al., 1998; Pendleton et al., 1984; Ende, 1983). For example, Pendleton's rules (Pendleton et al., 1984) focus vaguely on what the learner did well, not well and how they can improve with little specific focus in the guidelines on what should be focused on and how. Brukner et al's. (1999) feedback strategies are not very focused and the points are not developed sufficiently. In contrast to these models and approaches which address feedback provision on the clinical interaction as a whole, the PFM intervention seeks to train clinical educators in how to provide PFM intervention feedback in addition to the feedback they already provide. This means that the PFM intervention can offer more structured and specific feedback since it is not focusing on the entire clinical interaction. Furthermore, the design of the PFM intervention means that it has the potential to be used on any area of performance not just DDM. This adds to current theory surrounding feedback models as it means that the PFM can be used to provide specific, structured and focused feedback on an area of performance a trainee is struggling with in addition to any other feedback they usually receive.

Barriers to Behaviour Change

In terms of barriers to behaviour change the limited uptake of the PFM intervention contributes to our recognition of the role of barriers on behaviour change in health professionals. The current research highlights the negative impact of a busy clinical schedule and perceived difficulty of using

the PFM intervention as barriers to participation. These findings can be interpreted using the TPB (Ajzen, 1991) and provide some support for the use of the TPB in understanding barriers to health professionals taking part in research. This supports previous research which has used the TPB to identify barriers to participation in continuing professional development programs (Allaire et al., 2012), professionalism (Archer et al., 2008) and the use of clinical guidelines and research evidence in the health professions (Cote et al., 2012; Korttesito et al., 2010). This furthers existing theory by highlighting the value of the TPB in identifying barriers to research participation in clinical education. Further research could build on this by more thoroughly identifying barriers to participation and determining how these could be addressed.

D2.3 Implications for Future Feedback on DDM

The findings from this research have provided preliminary evidence for a new approach of giving feedback on learners' DDM. As an implication for future research and feedback provision the findings indicate the usefulness and effectiveness of a structured and targeted approach to providing feedback on DDM that can be given in addition to the feedback that clinical educators usually provide. The findings provide support for focusing feedback on SRL and contextual factors. The findings also support the relatively simple approach of the conceptual model to assist clinical educators in giving focused and structured feedback to medical trainees on their DDM. Consequently, the PFM intervention could be seen as offering a usable intervention which could make future feedback provision easier.

Additionally, the conceptual model and the PFM intervention are not specific to any one area of performance. Consequently, the conceptual model and the PFM can offer a structured and focused approach to identifying and providing feedback on any element of performance since the questions can be focused on any skill where the learner is observed. The implication of this for future feedback is significant. With additional research, the PFM intervention has the potential to enable educators to provide structured and focused feedback on specific areas of performance without compromising

the feedback they usually provide. The current findings are restricted to feedback on DDM and are limited by the evaluation methods and the small sample size. Nevertheless, they do offer provisional support for the effectiveness, usefulness and usability of the PFM intervention and highlight the need for further research so that this approach may be developed further.

D2.4 Conclusion

Overall this research has provided proof of concept support for a new conceptual model of feedback and an intervention to implement this feedback in the authentic clinical setting. The conceptual model focused on the medical trainees' confidence, SRL and the influence of contextual factors, and the PFM intervention provided feedback which focused on these areas of performance. For these participants the PFM intervention was able to support clinical educators in providing the feedback it proposes. Furthermore, medical trainees agreed that the feedback was useful and effective at improving their DDM and helping them to improve their SRL. The medical trainees also placed more emphasis on the influence of contextual factors on DDM and employed more self-regulatory strategies after the PFM intervention. These findings indicate that the medical trainees who participated were able to apply and benefit from the PFM intervention feedback. The implementation of the PFM intervention also offered important insights regarding how feedback can be given (as an 'add on'), its focus (on SRL and contextual factors) and the detrimental impact of barriers to participation. The following chapter will reflect on these findings and the EDR employed. Ways to build on these findings will be addressed and possible avenues for future research will be discussed.

CHAPTER D3: EVALUATION OF THE FINDINGS AND THE METHODOLOGY

In this chapter the method employed to conduct this EDR is reflected upon. The limitations and strengths of the conceptual model, the PFM intervention and the EDR approach are also discussed. The design principles are reflected upon and possible modifications for the third iteration of the conceptual model and PFM intervention are outlined and their possible improvements are discussed.

D3.1 Reflections on the Method

Reflection is an important element of EDR. It involves the active and thoughtful consideration of the design, development and implementation of the intervention. Here, the theoretical inputs, the qualitative and quantitative findings, as well as participants' subjective reactions are reflected upon together to produce new theoretical understanding. Reflection is particularly important for the development of new theories since they do not often present themselves in the research findings, instead they are developed through reflection. In EDR, structured reflection can provide a useful focus on the challenge represented by the design and aspects of the development and research process (Reymen et al., 2006). Throughout this research, I have reflected on the development of the research and the methods used to achieve this development. This reflection helped me to consider the findings from the research process and how these could be used to develop the next phase of the research. The outcomes of these reflections are imbedded in this thesis and are evidenced in the discussions in Chapter D2. Reflections on the methodology are also discussed below.

D3.1.1 Reflections on the Educational Design Research Methodology

This research was conducted using an EDR approach as outlined in Chapter A2 and as shown throughout each phase of this research. The information in Chapter A2 aimed to provide clarity to the reader regarding what constituted EDR, and to demonstrate how each piece of research fitted in to my EDR approach, how this led to the next piece of research and how this influenced the development of the conceptual model and the PFM intervention. Despite the numerous strengths of EDR and the advantages it held for this research, there were a number of challenges common to EDR that I faced throughout the research process.

Generalisability of the Findings

Generalisability refers to the ability of research findings from one setting to be reliable and replicable in other contexts. Like most EDR research, this research took place in natural settings where

uncontrolled variables inherently exist and was limited to a small sample size and a specific context. Despite the ecological validity of this approach, it is possible that these findings are not generalisable to other populations and research contexts (McKenney & Reeves, 2014; van den Akker, 1999). One way of addressing this is to be explicit about the design of the research and what was done; this is invaluable to other researchers who may wish to conduct a similar study. This clarity enables them to reproduce the intervention in a different context, thus enhancing the generalisability of the findings. One technique I employed to aid generalisability was to base the design on theories and employ theories to explain the findings (Dolmans & Tigelaar, 2012 (evidenced in Chapter C1.1 and C1.3). Another approach was to provide an in-depth description of the context in which the study was conducted (evidenced in Chapters C2 and C3).

Adaptability of the Research

In light of the changeability and messiness of real world research settings, adaptability is essential for effective EDR. EDR needs to be able to adapt to changes within the contextual environment and respond to findings from previous research cycles (McKenney et al., 2006). Throughout my research I followed three methods proposed by van den Akker (2005) in order to maximise adaptability within the research design. Firstly, I was prepared to act as researcher, designer, implementer, facilitator and evaluator. I prepared myself for this by ensuring I had sufficient skills and knowledge to perform in the multiple roles. Where I was lacking I sought extra training and assistance. Secondly, I was prepared for the numerous roles which ensured I was not panicked if I felt as though these were blurred. Thirdly, I allowed the research to be modified by the users of the model since they have a greater understanding of the provision of feedback in the clinical setting. If they felt that the model was unusable without their suggested modifications they would not have used it.

Reflections on the Researcher's Role

Due to the nature of EDR the researcher adopts the multiple roles of designer-developer, facilitator, implementer and evaluator. Such close involvement with all aspects of the research is both beneficial

yet problematic. I remained closely involved with the research which allowed me to interact with those whom the intervention aimed to help. This ensured the participants' input into the development of the conceptual model and intervention. However, a close involvement can cause researcher bias and the close involvement of the participants may lead to all parties being less critical of the design since they are deeply invested in its success (Dolmans & Tigelaar, 2012). One example of this may have been in the development process of the intervention. During the pilot study few limitations arose and the issue of time commitment was not voiced as a major concern. However, when the intervention was implemented this seemed to be a large limiting factor on recruitment. It could have been that due to their involvement and their knowledge that the interviewer had designed the research, the participants were reluctant to be too negative during the pilot interviews. Furthermore, it is possible that those who did complete the intervention responded in a more positive way since they knew they were being evaluated (Krathwohl, 1988).

To address these issues, a triangulation of data sources and data methods was employed to ensure that the inferences made from the data were reliable and valid, and to check that the evidence was consistent (McKenney et al., 2006). This was achieved using mixed methods which allowed for the use of more than one method of data collection and sources of data in order to provide a stronger evidence base. Through this, I ensured the systematic recording, analysis and reflection of the entire design, development, evaluation and implementation process (Chapters C1-D3, Plomp, 2013).

The Authentic Setting

A strength of this research is that it was conducted in naturally occurring authentic settings. As a result, the feedback provided should be more useful and more comprehensive since the medical trainees' interactions with the clinical educator and the patient were true to real life. The findings are also more likely to be transferrable to other real life settings. This is in contrast to controlled, experimental settings where educational interventions may not offer the same results in the authentic settings. Conducting research in the real world provides less control over the rigor of the study and

the factors influencing the intervention, however the potential influence or interference of uncontrolled real world factors on the intervention in authentic settings is a component of EDR. The interaction of these factors within the intervention is to a great extent the focus and point of EDR and allows for the more realistic implementation of research interventions.

D3.1.2 Reflections on the Conceptual Model of Feedback and the PFM

The conceptual model of feedback and the PFM intervention (see Figures C1.1 and C1.2 in Chapter C1) draw heavily on the previous theoretical contribution made by Hattie and Timperley (2007) and Butler and Winne (1995). A feature of constructivist learning theories is the requirement of the "active engagement of learners and is determined by what goes on in their minds" (James, 2006, p.55). This is a feature of the conceptual model and from this perspective it can be viewed as drawing upon constructivist learning theories. The ability of the PFM intervention to improve feedback on SRL, confidence and contextual factors suggests that the design of the PFM intervention does follow the conceptual model as depicted in Chapter C1.3. This is important since if there was not a clear association between the conceptual model and the PFM intervention this would call into question the validity of the former and the usefulness and applicability of the latter. Reflecting on the impact of the PFM intervention, it reaches impact level 2 on the Kirkpatrick model (Kirkpatrick, 1994). The findings demonstrate that the participants react favourably to the intervention, although they do recognise the need for improvement its usability. The participants also appear to acquire the intended knowledge and skills after participating in the PFM intervention. This is because the clinical educators appear to provide more feedback as required by the PFM intervention and the medical trainees agree that this feedback is useful and effective for improving their DDM. Future research needs to address the extent to which the feedback continues to be given after the end of the intervention and whether it leads to improved long term DDM. In-depth reflections on the design and implementation of the conceptual model and the PFM intervention led to the identification of strengths and limitations as well as modifications for the third iteration of the PFM intervention. These are discussed in the following sections of this chapter.

D3.2 Strengths

There are a number of salient strengths of the conceptual model and the PFM intervention developed using EDR.

D3.2.1 Unique Focus and Methodological Approach

This research was unique in its focus. To my knowledge no previous research has specifically, investigated feedback provided on DDM and how this can be improved. The focus of EDR encouraged the close incorporation of current theory and practice, participant input and research design. This helped to provide a novel methodological toolkit for researching feedback on DDM in authentic settings. Furthermore, the use of EDR to conduct this research provides support for its applicability to the medical educational setting and stresses the importance of conducting research which involves the participants in real world settings. This highlights the potential use of EDR in other clinical settings and offers researchers a structure and approach to researching issues within medical education in the authentic setting. It also highlights the vital role the participants can play in the design of the intervention and the importance of undertaking numerous iterations of the intervention. Furthermore, it demonstrates how research can help to bridge the gap between theory and practice by offering theoretical and practical advancements based on findings from research in the authentic clinical setting.

D3.2.2 Set in the Authentic Clinical Setting

This research was set in the authentic clinical setting of medical trainees on placements or GP registrars in general practice. This is advantageous since it is in these environments where medical trainees will find DDM most challenging and where effective feedback is most beneficial. By conducting research in the authentic clinical setting, the impact of any naturally occurring variables are evident. Conducting the research in the authentic setting also informs how well the intervention will work in real life and as found here, issues may arise regarding the perceived usability and the attractiveness of using the PFM in authentic clinical settings. Implementing the intervention in the

authentic setting also helped to develop existing theory of feedback, SRL and contextual factors. Furthermore, using EDR encouraged my research to have a practical contribution to education since it led to the implementation of an intervention in the authentic educational setting. This approach to research and the findings from the PFM intervention go some way to begin to bridge the gap between theory and practice in medical education.

D3.2.3 Individualised and Focused Feedback

The conceptual model and the PFM intervention promote the provision of individualised feedback which is specific, and focuses on self-regulatory and contextual factors which are key to the individual's progression. As discussed in Chapter D2.1 such feedback is valuable for helping the learner improve. Furthermore, the focus of this is unique. No previous research promotes the provision of feedback with a focus on SRL and contextual factors, or has developed a feedback intervention which is as individualised and focused as the PFM intervention.

D3.2.4 Structured for the Clinical Educators

The PFM intervention also provided the clinical educators with a structured approach to providing feedback. Whilst 'how to guides' of feedback do give some pointers to providing feedback they do not give a structured approach that enables the educator to provide specific feedback. The PFM does this and furthermore, it ensures that the relevant information is elicited from the trainee, with further guidance on how these responses influence what feedback is necessary. There are a number of workshop interventions which have been designed for medical education which describe approaches to training the educator in how to provide feedback (Baroffio et al., 2007; Steinert et al, 2006; Stone et al., 2003; Brukner et al., 1999). Whilst the training in these workshops offers the clinical educators a structure, the feedback itself is less structured. The conceptual model and the PFM intervention offer a structured approach to giving feedback which may alleviate clinical educators' fears of providing feedback (in particular negative feedback) and may improve their ability to provide detailed and specific feedback. This structured feedback may aid trainees' recognition of the feedback and

help to reduce the discrepancy between medical trainees' and clinical educators' perception of the feedback provided. Future research is necessary to assess the ideas given above.

D3.2.5 The Broad Application of the PFM Intervention

A significant strength of the design of the conceptual model and the PFM intervention is its potential application to many fields of education and professional practice. In this current research the PFM was designed to provide feedback on DDM. However, the three phase approach of the PFM intervention can be used in any situation where an individual is observed performing a task and then provided with feedback on their performance in that task. The PFM emphasises feedback on the trainee's self-regulated learning, the influence of contextual factors and the trainee's confidence as key to providing feedback the trainee would perceive as useful and effective. These elements are universally important to performance and thus could potentially be used to give feedback in many settings.

D3.3 Limitations

There are a number of limitations of this research, however these are a useful base from which future research can be developed. The limitations are discussed, with suggestions on how these can be addressed.

D3.3.1 The Method Used to Evaluate the PFM Intervention

Questionnaires were used to evaluate the feedback model and the PFM intervention. However, it is possible that this design negatively impacted participation since the questionnaire was lengthy and may not have been that interesting to complete. Responses to the barriers to participation questionnaire also suggest this; 64.8% of participants reported that the questionnaire was too long. It was not evident before implementation that the questionnaire was too long and this was not voiced as a concern in the piloting of the questionnaires. The evaluation of the PFM intervention and the

conceptual model depended mainly on the participants' views of this approach to providing feedback after DDM. Whilst perceptions are important in providing participants' viewpoints on the topic of interest it could be reasoned that they may be influenced by a number of factors and may not always be reflective of performance or use of a tool in the real world. Since the perceptions evaluated were from using the PFM intervention in the real world, this is less likely to be true. Another limitation of the evaluation methods is that the participants may not have responded to the questionnaire honestly due to researcher bias (Fraenkel et al., 1993). However, the clinical educators were encouraged to discuss issues and weaknesses they found inherent in the PFM. Furthermore, I did not meet with the medical trainees so they may have been less likely to feel inclined to respond positively. Despite this lack of contact their responses were largely positive and favourable of the PFM intervention. The materials used to assess improvement were a video consultation to evaluate the clinical educators' feedback and hypothetical consultations to evaluate medical trainees' SRL and DDM. Whilst I believed these measures were appropriate at the time, reflection on this process has given me insight into their use. The evaluation methods need to be better developed to measure each particular element of the PFM intervention and conceptual model in a more robust manner. Consequently, methods which more closely reflect the structure of the PFM intervention would most likely provide more relevant finings. In addition the evaluation materials need to be thoroughly piloted before use in the intervention.

D3.3.2 Methodological Issues of the Pilot Study

The pilot study gave the participants the opportunity to voice their opinions on the PFM intervention. It was made clear to the participants that even negative comments regarding the conceptual model and the PFM intervention were welcomed. Although the issue of time was identified in the pilot study most participants gave reasons or strategies they could adopt which would limit this issue. Subsequently, it was interesting to discover that time was a major barrier to participation. This calls into question the effectiveness of a single, small scale, qualitative pilot study and warns against reliance on these results. It may be that the pilot study recruited those with a keen interest in feedback who would be willing to overcome the time issues. It is worth noting that of the 12 pilot study participants

only two participated in the PFM intervention. This was due to a number of reasons such as being too busy, no longer in the same role and not having any trainees on placement. It is possible that using a less personal method such as questionnaires for the pilot study may have provided more honest responses and could have reached a larger number of participants. However, the personal interaction and the depth of discussion afforded by the interviews allowed for the identification of issues that were unlikely to have been identified without the personal interaction.

D3.3.3 Small Sample Size

There were significant issues with recruitment during this research. Whilst a small sample size had always been anticipated, the final number of six clinical educators and five medical trainees was lower than expected. The lack of participation was unexpected since the pilot study had supported the perceived usefulness of the PFM intervention, as had informal discussions with various clinical educators. It appeared that most individuals voiced a desire to improve their feedback, but few were willing to act upon this. As shown in Chapter C3.4 numerous approaches to sending the recruitment email to potential participants were used. However, these emails are unlikely to have been as engaging as face to face introductions to the study. The small sample size threatens the generalisability of the research findings beyond these participants. Whilst these findings are a true representation of these participants' experiences of the PFM, this may not hold true for other individuals from the University of Leeds involved in the MBChB course since study participants are likely to be those with a greater interest in improving their feedback. However, in EDR an emphasis is not placed solely on generalisability but also on enriching our understanding of the situation or problem being investigated (Design-Based Research Collective, 2003). Gravemeijer and Cobb (2006) suggest that it is the constructs and the design principles developed, and the contribution to theory which form the generalisability of EDR rather than the participants.

The small sample size also limited the clinical relevance of the findings. Mean differences on responses to the likert scale questions pre- and post-PFM intervention improved between 0.5-2

points on the scale. This suggests that although perceptions of the feedback improved, and more feedback was given on SRL, confidence and contextual factors, this improvement and increase in feedback was not overly large. However, as stated above, EDR research is less concerned with generalisability and more with the experiences of the participants. In this case, the participants did find the PFM useful, usable and effective, and did improve the feedback they provide. More research with a larger sample size is necessary to strengthen these findings and aid generalisability, in order to provide more support for the PFM intervention and to determine whether this would increase the difference in perceptions.

D3.3.4 Time

Time was a bigger drawback to participation than indicated in the pilot study and was most likely the biggest limiting factor of participation and use of the PFM intervention. All six clinical educators who used the PFM stated that they found it too time consuming to use in the busy clinical setting more than a few times over the course of a month. Despite this, the clinical educators did value the PFM intervention and thought it was effective, useful and easy to use.

D3.4 Changes made to the Design Principles for Iteration Three

Although numerous iterations to refine the intervention were not possible, prescriptive theoretical contributions in the form of design principles after iteration 2 are highlighted. These could be used to further refine the intervention. The evaluation did not directly assess some of the design principles as this was not the aim of the research. However, the findings can give some indication as to whether these design principles were met or were necessary in order for the PFM intervention to be used. These are listed in Table D3.1 below. The findings also provided some insight into the specific design requirements of the learning environment which impacted the adoption of the PFM intervention. These included time, a desire to improve feedback, the students desire to improve and opportunities to observe DDM. One design requirement not recognised by the PFM intervention was the time taken to provide feedback. A requirement of the learning environment is that the clinical educator

has sufficient spare time to use the PFM intervention effectively. Another design requirement is for the clinical educator to have a desire to improve the feedback they usually provide since without this, the clinical educator is unlikely to spend the extra time using the PFM intervention. An interest in improving their performance is also an important design requirement for the medical trainees. If they are not motivated or interested in improving, they are less likely to be receptive to the feedback and use it effectively. The medical trainees must also have adequate opportunities to make diagnostic decisions in the authentic clinical setting so that they can be observed and given feedback. Without these conditions the learning environment is not suitable for the PFM intervention to be used.

Based on the findings relevant to the design principles summarised in Table D3.1, most of the design principles pertaining to the features of the PFM will remain the same. Modified and new design principles are shown in red (Table D3.1). One design principle was modified; this is how often the PFM should be used. This was modified to once a week, but only when the clinical educator has enough time to use the PFM to provide the feedback properly. Three design principles were added. The first is improving understanding of the PFM intervention. By giving the participants more information which explains what the PFM is, why this feedback is important, and how it can help them, they may be more engaged with the PFM. This would also assist the clinical educators' use of the PFM intervention. The second is the use of training videos to demonstrate to the clinical educator how the model is used. This also allows them to practise using the model. It is envisaged that by including these the clinical educators would find it easier to provide the medical trainee with feedback in the authentic setting and thus the use of the PFM may be less time consuming. The third design principle added requires modification of the design of the PFM intervention to make it less time consuming to use. This can be achieved by training the participants more effectively so the feedback is easier to give, by making the flow diagrams in the PFM intervention handbook less complex and by allowing the clinical educator to only focus the feedback on elements of the PFM intervention they view as relevant for that trainee's DDM performance. A number of the design principles were not assessed by the evaluation and this will be addressed in future iterations.

Design Principles	Characteristics	Evidence from the Findings	Consequences for Designing the Conceptual Model and the PFM Intervention
An 'add on' to existing feedback provision	The feedback is provided in addition to the usual feedback provided to medical trainees in authentic clinical settings.	The findings as a whole provide support for the use of feedback to be provided as an 'add on' to that which the clinical educator usually provides.	The feedback model will be designed so that it can be easily provided in addition to the regular feedback given. This means it must not be too time consuming and must be able to tie in to the regular feedback.
Provided frequently	The feedback must be provided relatively frequently such as once a week. It should be provided when the clinical educator has the time necessary to provide the PFM feedback properly.	Reports from the clinical educators suggest that frequency may be an issue if they are very busy and the PFM intervention was time consuming.	The model needs to be a tool that can be used frequently and easily by the clinical educators.
Observation	The feedback must be given as soon as possible after a clinical interaction has been observed by the clinical educator.	No information on this from the findings; none of the participants voice a concern about having to observe the clinical interaction.	The model must be developed to aid and assist the observation of medical trainees making diagnostic decisions.
Duration and setting of feedback	The feedback will be provided immediately and provided individually in authentic clinical settings.	No information on this from the findings; none of the participants voice a concern about having to provide feedback immediately and individually after the clinical interaction.	The model must be usable in authentic clinical settings and be designed in a manner so that the provision of the additional feedback is not too time consuming.
*Direct involvement of the learners so that feedback is personalised.	Request the student to complete the consultation questions before and after the consultation.	One clinical educator queried whether there was an easier way to obtain this information.	The model must be designed in a way which incorporates the involvement of the medical trainee.
Focus of the feedback	Using the medical trainees' answers to the consultation questions and the clinical educators' perceptions of the diagnostic decision making:	No participants reported any difficulty using the consultation questions to provide feedback. The participants reported providing or receiving more feedback which focused on all these	The model must be designed in a manner which encourages and emphasises a focus of feedback on the most relevant areas of

	-Focus the feedback on goal setting, strategic planning and the processes used in these plans and self-observations -Focus the feedback on an awareness of contextual factors -Focus feedback on self-efficacy beliefs -Encourage the clinical educators to provide detailed and specific feedback	elements. The medical trainees also agreed that this feedback was useful and effective for improving DDM. Participants valued the specific and detailed feedback. The feedback also led to some improvement in the medical trainees' use of SRL in DDM.	feedback provision (as identified in the characteristics section).
Takes the role of contextual factors into account	The medical trainee is asked whether they perceive these factors to be influencing their diagnostic decision making. Feedback is given on the influence of these based on their responses to the questions and the clinical educators' perceptions of whether they were influenced by these factors.	Participants became more aware of the frequency of contextual factors influencing DDM and clinical educators provided more feedback on the influence of these factors. Medical trainees agreed that feedback on contextual factors was useful for helping them improve their DDM.	The model is designed in a way which encourages a focus on the influence of contextual factors on diagnostic decision making from the perspective of the medical trainee and the clinical educator.
Reflection	This is encouraged by the medical trainee answering the 5 consultation questions and also by their involvement in developing an action plan.	The evaluation did not assess medical trainees' reflection and none of the participants made any comments about the reflection.	The model is designed to encourage the medical trainee to reflect on their DDM. The feedback session must encourage the learner to reflect on what they did well and not so well, why this may have been the case and how this can be improved in the future.
Action plan	The medical trainee is asked to write down the feedback they were provided with and then develop a plan of action based on this.	The evaluation did not assess medical trainee's use of the action plan and none of the participants made any comments about the action plan.	The model includes an action plan that must be written by the medical trainees after they have been provided with feedback.

Medical trainees' and clinical educators' understanding of the PFM	The medical trainee and the clinical educator will be given considerable training and information to help them use and understand the PFM.	NA	Before using the PFM the clinical educator must understand how it is used and be practiced in its use. This will reduce the time taken to use it. The medical trainee will be given information about the PFM so that they understand what is being asked of them and how this feedback can be helpful to them. This should make the trainee more engaged with the PFM process and make the feedback easier for the clinical educator to provide.
Use of training videos	The clinical educator will watch videos of the PFM to show them how it is used in practice.	NA	This allows the clinical educators to have more practice using the PFM intervention before using it with medical trainees and complements the above comment regarding making the PFM easier and less time consuming for the clinical educators. It may be more feasible to only provide feedback on the elements the learner is struggling with eg. provide feedback on their confidence or self-monitoring but not on their goal setting.
Quick to use	The clinical educator must be able to use the PFM intervention quickly and efficiently to provide feedback.	NA	This would be addressed with more training in how to use the PFM intervention, less complex flow diagrams and a choice of which PFM elements the feedback focused on.

Table D3.1. The design principles and the findings from the PFM intervention and the modifications made for iteration 3

Note: New design principles are shown in red

D3.5 The Third Iteration of the PFM

It is not possible to conduct a third iteration of the PFM intervention within the timescale of this PhD. However, there are a number of modifications that could be made to the current PFM intervention if a third iteration was implemented.

D3.5.1 Interviews and Questionnaires

Interviews and questionnaires would be conducted prior to implementing the PFM intervention for the third iteration. These would be used to further understand how the PFM intervention could be improved to make it easier for it to be used in practice and to gain clinical educators' opinions on how it could be less time consuming. Questionnaires would be used in addition to interviews since the pilot interviews conducted in Chapter C2 failed to elicit that time would be such a detrimental barrier to participation.

D3.5.2 Does using the PFM lead to Improved DDM?

Future research needs to determine whether this feedback can lead to both short and long term improvement in medical trainees' DDM. Demonstrating the improvement of DDM based on PFM intervention feedback would provide support for the effectiveness of feedback which is individualised and specific with a focus on self-regulation, confidence and the role of contextual factors. To evaluate this, the PFM could be used in one placement setting such as 4th year GP placements. This would allow for the comparison of trainees who were given feedback using the PFM and those who were not so that participants' scores in an end of year summative exam for DDM could then be compared. There is an ethical concern of students not receiving feedback that other students do. However, the clinical educators would be volunteers and the control group would be those who chose not to take part. Again, there may be bias here since those who volunteer may have a more vested interest in providing good feedback and may already provide better feedback. These issues are inherent to EDR research and would be acknowledged in the analysis of the findings.

D3.5.3 Removal of the pre and post questionnaires

The current pre-and post-questionnaires would be removed as they were viewed as too time consuming by potential participants and it is likely that the completion of them was detrimental to participation in the PFM intervention. The perceived usefulness, usability and effectiveness of the PFM and perceptions of the focus of feedback on the PFM elements will be assessed by a shorter, more tailored questionnaire.

D3.5.4 Training Videos

In order to improve the clinical educators' confidence in using the PFM intervention, training videos would be developed for the third iteration. Here the clinical educators would view videos of other clinicians using the PFM intervention to provide feedback. This would provide them with examples of how to use the PFM intervention and enable them to practise using it themselves. Also with regards to training, it may be useful to use a variety of different training methods such as online tools, reading materials and face-to-face workshops (Jones et al., 2003). This variety may target different individuals who have a preference for one training method over another. One drawback to this approach is that it moves away from an intervention which can be learnt using the PFM handbook and limited additional support.

D3.5.5 Making the PFM Intervention less Time Consuming

Participants appear to value the current PFM intervention and view it as effective and useful for providing feedback on DDM. However, the time taken to use the PFM intervention made it less usable for the clinical educators. The current balance of time versus value of use may be tipped more towards the time element for some clinical educators which limits the use of the PFM intervention in its current form. Further discussions with the participants would be required to address this sufficiently, however there are a few approaches which could address this. Firstly, training the clinical educators more effectively in how to use the PFM intervention before they use it in authentic clinical practice may reduce the time it takes them to provide the feedback. Secondly, a medical trainee may

not require feedback on all of the areas focused on by the PFM intervention. Thus, the clinical educator should be allowed to decide which areas to focus the feedback on as determined by the medical trainee's need. Lastly, the flow diagrams in the PFM intervention handbook could be made less complex and easier to follow quickly. Discussions with the participants and adoption of these changes may work to tip the time versus value balance in favour of the value of using the PFM intervention to provide feedback on DDM. In addition, the provision of free time to use the PFM intervention in clinical practice with medical trainees may promote its use. For this to occur there would need to be an organisational buy in and acceptance of the PFM intervention from the University and the relevant NHS bodies. This would require additional discussions and refining of the PFM intervention. This support could lead to the clinical educators being given additional protected teaching time to use the PFM intervention with medical trainees.

C3.5.6 Improving Understanding

It is important to ensure that the medical trainees understand the PFM intervention. The medical trainee will be given more information about the PFM so that they understand what is being asked of them and how this feedback can be helpful to them. This should make the trainee more engaged with the PFM process and make the feedback easier for the clinical educator to provide. In the 2nd iteration of the PFM intervention clinical educators were given materials to give to their trainees about the PFM intervention. However, it is not clear whether this information was given or how well the medical trainees understood the PFM intervention approach to feedback. A more structured method is required to ensure that all the trainees receive this information and understand it.

D3.6 Future Research Ideas

There are a number of modifications which may address some of the limitations of the conceptual model and the PFM intervention, and the issues with recruitment. These potential solutions arose from the evaluation and reflection of this current research. These are not modifications for the 3rd

iteration since further research and consideration is required to determine the feasibility of these suggestions.

D3.6.2 Addressing Recruitment Issues

The paucity of GP interaction with primary care research is a concern and will cause further decline in enquiry-led research (Glynn et al., 2009; O'Dowd, 1995). It is important to understand what the barriers to participation are and how these can be addressed. As identified by the target sample themselves, a lack of time and their perception of being too busy greatly hindered their ability to participate. Consequently, it is essential to identify how clinical educators can be encouraged to partake in research interventions despite their busy schedule.

D3.6.3 Addressing Barriers to Behaviour Change

Addressing barriers to behaviour change may also improve recruitment rates. It is suggested that intervention implementation strategies are only effective if they manage to address barriers to change (NHS Centre for Reviews and Dissemination, 1999). In support of this, Hakkennes and Dodd (2008) found that only one study out of fourteen included in their systematic review developed an implementation strategy which was based on barriers to change (Bekkering et al., 2005) and was the only one which was successful in enhancing compliance with guideline recommendations. Consequently, further investigation is necessary into the role of barriers to behaviour change and how these can be overcome.

D3.6.4 Time

The issue of time is a difficult problem to address; time constraints in clinical settings are a nationwide healthcare issue rather than an issue with medical schools and the medical curriculum. One way in which this could be addressed is by making the placements longer, but this would cause disruption to the medical curriculum and would require extensive planning and collaboration of the healthcare workforce and the medical school. Both medical students and nurses have voiced their desires for

longer clinical placements (Porter et al., 2013) which would increase the opportunities for practice (Löfmark & Wikblad, 2001). This is not an issue that can be easily addressed but is worth further investigation to determine how the PFM intervention can be used in the authentic clinical setting.

One potential solution to the issue of time is using the PFM as an 'App' on a smartphone. This was suggested during the piloting of the PFM but was not implemented due to the time needed to develop it and the variation in clinical educators' and medical trainees' opinions on the use of these (results from Chapter B5). Smartphones are given to clinical educators and medical students in years 4 and 5 at the University of Leeds. Currently the clinical educators are required to observe and provide feedback to the trainee using the 'App' on a set number of observations. The PFM intervention could be modified to be used on an 'App'. The consultation questions could be completed by the trainee on their smartphone during and after the consultation being observed and these could be made available to the clinical educator. Using their own opinions from the observation and the trainee's completed questions the clinical educators could provide feedback via the 'App' on the areas focused on by the PFM intervention. An algorithm could be developed similar to the flow diagrams in the PFM handbook whereby responses to the PFM consultation questions lead to the correct feedback. This approach would be limited however in that the feedback may end up being quite generic if the clinical educator did not expand on the generated feedback. There are also mixed responses to the use of these 'Apps' in the medial curriculum with both medical trainees and clinical educators viewing them as tick box exercises rather than useful learning opportunities (results from Chapter B5). Although an 'App' approach is likely to gain interest in our digital era, these issues would need to be addressed before this application of the PFM intervention was considered further.

Another solution may be to implement the PFM intervention in an OSCE style training setting. Here the medical trainee could take their time completing the PFM consultation questions and the clinical educator would have more time to provide detailed feedback. This setting would limit the influence of contextual factors on DDM, however it is likely that they would still influence trainees' DDM to some extent.

D3.6.5 Understanding How the PFM Intervention Integrates with Existing Feedback Provision

The PFM intervention was designed for clinical educators to use to give feedback to medical trainees in addition to the feedback they normally provide; the intervention is not trying to change the clinical educators' overall approach to giving feedback. However, the current evaluation of the intervention did not attempt to understand how clinical educators usually provide feedback. Future research therefore, needs to address (1) whether certain approaches to feedback and the teaching of DDM are associated with the clinical educator using the PFM intervention more or less effectively and (2) whether any forms of feedback and approach to teaching DDM coupled with the PFM intervention lead to better DDM in comparison to other approaches. Future research should aim to determine the impact of the PFM intervention in different areas of medicine. Furthermore, research should investigate the ability of the PFM intervention to highlight and provide feedback on DDM in comparison to other strategies such as cognitive debiasing (Croskerry et al., 2013) and concept mapping (Patel et al., 1989; Patel & Groen, 1986).

D3.7 Summary of Chapter

In this chapter I reflected upon my use of EDR as a methodology as well as upon the use of the conceptual model of feedback and the PFM intervention. I also considered the limitations and key strengths of both the findings and my approach to designing the conceptual model and implementing the PFM intervention. The design principles were modified accordingly and suggestions for the third iteration of the conceptual model and the PFM intervention have been made. Building on this, possible future avenues of research were discussed which may have the potential to improve the usefulness, usability, effectiveness, impact and generalizability of the conceptual model and the PFM intervention. There are a number of key messages from this reflection. Firstly, EDR appears to be a useful method by which problems can be investigated in the authentic setting, using the opinions and experience of the participants, yet remaining structured and methodological. Secondly, the conceptual model and the PFM intervention provide a unique approach to feedback and focus on feedback provision in an area of medical education which is key to competent clinical practice. Thirdly, the

PFM intervention was viewed to be a useful and effective approach to giving feedback on DDM and was reported to be easy to use by the limited number of participants who took part. Fourthly, limitations surrounding the design of the PFM intervention meant its evaluation and its use in the authentic clinical setting was time consuming for the participants. Fifthly, future research should seek to modify the conceptual model and the PFM intervention to ensure it is easily usable in the authentic clinical setting. Measures would also be taken to ensure more effective training in how to use the PFM intervention. A more reliable assessment of its use and whether this led to long term changes in feedback provision and DDM should also be made.

CHAPTER D4: CONCLUSION

This Chapter provides an overview of the work conducted in this thesis, and offers a summary of the findings and their implications for this research and future research.

The research discussed in this thesis centred around the design, development and implementation of a conceptual model of feedback which aimed to provide medical trainees with effective feedback on their DDM in authentic clinical settings. The research adopted an educational design research approach to address this. Preliminary research identified the need for improvement to feedback provided after DDM in authentic clinical settings. Subsequently, a conceptual model of feedback and a Personalised Model of Feedback intervention to implement the model were developed which drew on a number of key areas. These included: the theoretical contributions to the feedback literature by Hattie and Timperley (2007) and Butler and Winne (1995), the contribution of situated cognition to the area of decision making (Robbins & Aydede, 2009; Wilson & Myers, 1999), the importance of the theory of self-regulated learning (Zimmerman, 2001), and the role of the development of this skill in DDM. Clinical educators were recruited and taught how to use the model to provide feedback to their medical trainees. Despite a positive response to the PFM intervention, recruitment was poor. This highlights issues using the PFM intervention regarding barriers to behaviour change such as perceived behavioural control over participation (e.g. busy schedules, time constraints and not understanding how to use the PFM intervention), as well as issues in the recruitment, involvement and training of clinical educators in the current medical curriculum and NHS healthcare structure. Six clinical educators and five medical trainees completed the PFM intervention. Evaluation revealed that participants found the PFM intervention useful, usable and effective for providing feedback on DDM. The findings indicated that the participants' perceived importance of feedback on contextual factors increased and the amount of feedback provided on goal setting, strategic planning, self-monitoring (SRL) and confidence also increased. The medical trainees viewed the feedback to be useful and effective for improving their DDM, and showed improved use of SRL skills on the hypothetical consultations after the PFM intervention. The recruitment issues highlight the necessity for educational interventions to fully address potential barriers to participation.

This research has contributed to current understanding on the use of SRL to provide feedback and is the first research to specifically address how feedback can be better provided to medical trainees on their DDM. This research has also demonstrated that a feedback intervention which aimed to

encourage a focus specifically on confidence, goal setting, strategic planning, self-monitoring and contextual factors was successful in leading to more feedback on these factors and is viewed by medical trainees and clinical educators to be useful, usable and effective for improving DDM to some extent. The improved use of self-regulation skills in the hypothetical consultations suggests that the medical trainees had internalised the feedback to modify their self-regulation skills after the PFM intervention. The increased awareness and feedback on contextual factors lends support to the role of contextual factors and the theory of situated cognition. The findings also lend weight to the use of a structured, focused feedback 'add on' to improving feedback provision rather than a broad approach of modifying educators' feedback provision. The current findings are limited by the barriers to participation and the small sample size, and as such are not generalisable to other clinical educators and medical trainees. Further research is therefore necessary with a larger and broader sample to understand how to make the PFM intervention easier to use and how to improve clinical educators' receptivity of its use. To increase its practical use in the authentic clinical setting, further research should address how the PFM intervention can be made less time consuming. To improve the generalisability, further research is necessary with larger sample sizes across multiple medical schools and across multiple areas of clinical medical education. Future research also needs to identify the effective components of the intervention, how these work to improve feedback and whether this leads to improved DDM performance. The feedback as an 'add on', the design of the conceptual model, and the PFM intervention together lend support to the application of this approach to numerous areas of performance. Thus, additional research is necessary to understand the potentially broad application of the conceptual model and the PFM intervention. A significant contribution of this research is the creation of a conceptual model of feedback provision and the application of EDR in medical education.

SECTION D: SUMMARY OF THE ASSESSMENT PHASE

On the whole, this phase has enabled the structured and methodological approach to analysing the findings of this research, addressing the strengths and limitations of these findings, reflecting on the use of EDR for this task and identifying ways in which the conceptual model and PFM intervention could be improved. Overall, the use of EDR to conduct this research has given recognition to its feasibility and usefulness in conducting medical education research in the authentic clinical setting.

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APPENDICES

APPENDIX 1. NARRATIVE REVIEW OF THE MOST EFFECTIVE METHODS IN GIVING FEEDBACK

Ap1.1 Search Strategy and Selection Criteria

I searched the following databases for meta-analyses and systematic reviews on feedback in education; Web of Science, PsychINFO, DARE, Scopus, Medline, the COCHRANE library, the British Education Index (BEI), the Australian Education Index (AEI) and the Education Resources Information Centre (ERIC). The search used a mixture of keywords and employed MESH headings where appropriate. The following terms were searched: "Feedback" or "Feedback, psychological" AND "Education" or "Learning". In all of the databases except DARE and the COCHRANE library the search was further combined with the search terms "meta-analy*" or "systematic review". Additional search limits were also used in Medline and PsychInfo to limit the articles to systematic reviews and meta-analyses. The search retrieved three reviews which were specific to medicine and the clinical setting (Ivers et al., 2012a, Davis and TaylorVaisey, 1997, Jamtvedt et al., 2006a).

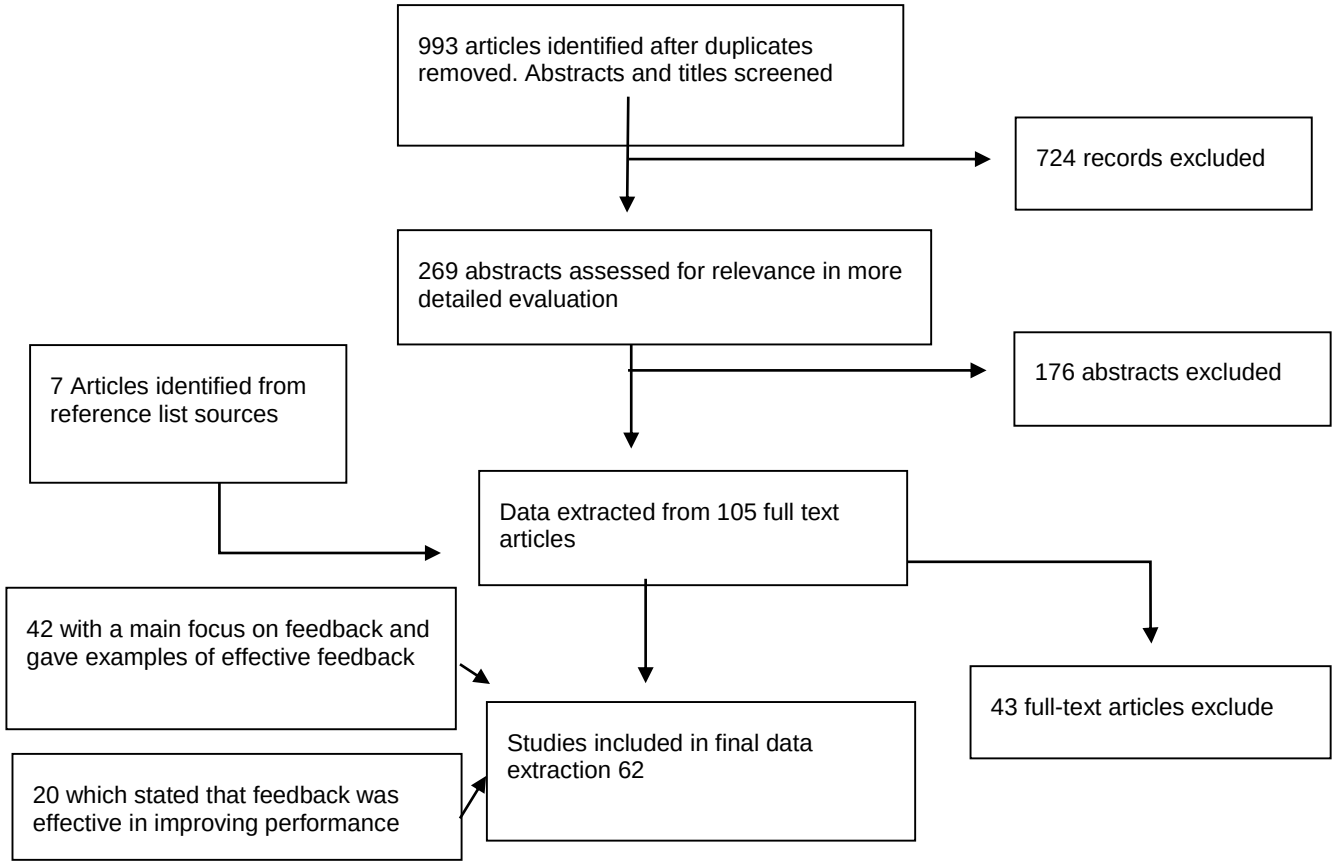


Figure Ap1.1. Prisma diagram to illustrate selection process for the articles retrieved after searching the literature

Ap1.2 Results and interpretation

Searching the databases identified 993 articles. These were screened based on their titles and abstracts to leave 269 articles. The abstracts of these articles were read in more detail which lead to the exclusion of 164 articles. The full text of the remaining 105 articles was then retrieved and the articles were read through to determine suitability. During this stage 7 additional articles were retrieved and were added to the review. These were identified from the reference lists of other articles. This process highlighted 43 articles which were not relevant and these were removed. This left 62 relevant articles. Due to the nature of the articles found (systematic reviews and meta-analyses) some of the more recent reviews included reviews which were also retrieved independently in the search strategy. For example, Shute (2008) and Hattie and Timperley's (2007) articles included a number of reviews retrieved in the search.

The articles were read thoroughly for information relating to what constitutes effective feedback or ineffective feedback. This information was extracted from the article and coded according to what it was suggesting. Once all the articles had been read, there were many codes highlighting effective and ineffective feedback strategies. Since many of the codes were similar they were grouped together under overarching themes. Tables Ap.1.1- Ap1.4 show the most and least effective characteristics of feedback within each of the four main themes and Table Ap.1.5 shows the importance of providing feedback in various areas of education, learning and work.

Ap1.3 Tables showing effective and less effective feedback characteristics for four areas of feedback provision.

Ap1.3.1 Focus of the Feedback

Style of how the feedback is presented	Articles in support of this
FEEDBACK SHOULD	
Focus on the importance of goal setting and selecting targets	Beesley & Apthorp, 2010; Coe, 2006; Ivers et al., 2012; Kluger & DeNisi, 1996; Penny & Coe, 2004; Shute, 2008; Smither et al., 2005
Focus on the task	Coe, 2006; Higgins et al., 2007; Shute 2008; Sims-Knight & Upchurch, 2001
Focus on the processes and strategies the individual has used	Graham et al, 2011; Hatala et al., 2014; Hattie & Timperley, 2007; Stecker et al., 2005
Provide a specific message and have a specific focus.	Agius & Wilkinson, 2014; Coe, 2006; Hysong, 2009; Kao, 2013; Sachdeva, 1996; Jonsson, 2013; Graham et al., 2011; Scheeler et al., 2004; Steinert et al., 2006
Be elaborated style feedback (the feedback should describe the what, how and or why of the problem)	Bangert-Drowns et al., 1991; Beesley & Apthorp, 2010; Jaehnig & Miller, 2007; Merchant et al., 2014 (after simulation based testing on declarative tasks)
Provide and justify the correct answer. Be corrective	Bangert-Drowns et al., 1991; Beesley & Apthorp, 2010; Heubusch & Lloyd, 1998; Kao 2013; Kluger & DeNisi, 1996; Li, 2010; Lysakowski and Walberg, 1982; Lyster & Saito, 2010; Merchant et al., 2014 (simulation based testing on proceedural tasks); Sachdeva, 1996; Schimmel, 1983; Scheeler et al., 2004; Shute, 2008; Tenenbaum and Goldring, 1989;
Need to strike a balance between positive and negative feedback. This will depend on learner and task. Likely to be influenced by how it is appraised in relation to the individuals goals	Agius & Wilkinson , 2014; Coe, 2006; Jonsson, 2013 (Positive comments. These are recognized more quickly and accurately); Scheeler, Ruhl & McAfee, 2004 (positive); Smither et al., 2005 (positive feedback orientation); Van Dijk & Kluger, 2011 (Promotion task= pos feedback; prevention task, neg feedback).
Need to strike a balance between positive and negative feedback. This will depend on learner and task. Likely to be influenced by	Agius & Wilkinson , 2014; Coe, 2006; Smither et al., 2005 (positive feedback orientation); Jonsson, 2013 (Positive comments. These are recognized more quickly and accurately); Scheeler et al., 2004 (positive); Van Dijk & Kluger, 2011 (Promotion task= pos feedback; prevention task, neg feedback).

how it is appraised in relation to the individuals goals	
Signal a gap between current and desired behaviour and then reduce the uncertainty between performance goals so that learners know what they need to do to achieve the goal.	Bangert-Drowns et al., 1991; Beesley & Apthorp, 2010; Hattie & Timperley, 2007; Shute, 2008
Diagnostic feedback	Crommelinck & Anseel, 2013 (particulary in goal orientated learners); Higgins et al., 2007; Yeany & Miller, 1983
FEEDBACK SHOULD NOT	
Provide overtly negative comments as they might be damaging to students with low self-esteem	Jonsson, 2013
Provide solely positive comments as they lead to less change	Jonsson, 2013
Use normative comparisons	Crooks, 1988; DeNisi & Kluger, 2000; Shute, 2008
Use tangible or extrinsic rewards	Rummel & Feinberg, 1988; Tenenbaum & Goldring, 1989
Only report on whether correct or incorrect without explaining why	Bangert-Drowns et al., 1991
Include grades. Low grades may be detrimental to those with low self esteem	Hepplestone, et al., 2011; Jonsson, 2013

Table Ap1.1. The focus of the feedback

Ap1.3.2 Style of the Feedback

Style of how the feedback is presented	Articles in support of this
FEEDBACK SHOULD	
Individualised, detailed and clear	Agius & Wilkinson 2014; Hepplestone, et al., 2011; Jonsson, 2013; Skiba, 1986
Credible or high quality feedback	Miller & Archer, 2010; Penny & Coe, 2004
Be provided as soon as possible in most situations.	Agius & Wilkinson 2014; Azevedo & Bernard, 1995; Coe 2006; Beesley & Apthorp, 2010; Davis & Taylor Vaisey, 1997; Heubusch & Lloyd, 1998; Higgins et al., 2007; Jamtvedt et al., 2006; Kulik & Kulik, 1988; Scheeler et al., 2004; Shute, 2008;
Verbal (oral or audio taped)	Colthart et al., 2008; Hepplestone et al., 2011; Jonsson, 2013; Lyster & Saito, 2010; Savin-Baden et al., 2006
Video feedback	Colthart et al., 2008
Feedback which incorporates advice for improvement which can be used in the near future	Agius & Wilkinson , 2013; Jonsson, 2013; Steinert et al., 2006
Provide feedback alone rather than as part of another intervention or strategy	Wensing et al., 1998
Written feedback	Hysong, 2009
Short term or brief feedback interventions are the most effective	Li, 2010; Lyster & Saito, 2010
FEEDBACK SHOULD NOT	
Not be personal or evaluative	Beesley & Apthorp, 2010
Be discouraging	Kluger and DeNisi, 1996

Table Ap1.2. The style of the feedback

Ap1.3.3 Approach to Providing Feedback to the Learner

Approach to providing feedback	Articles in support of this
FEEDBACK SHOULD	
Be on direct observation	Ramani and Krackov, 2012
Be provided frequently from a trusted or credible source	Hysong, 2009; Ivers et al., 2012; Jamtvedt et al., 2006; McGaghie et al., 2009; Veloski et al., 2006
Get the learners to repeat the test or required response	Heubusch & Lloyd, 1998; Kulik & Kulik, 1988; Sims-Knight & Upchurch, 2001
Use-mutli source feedback, including peers	Hatala et al., 2014; Hepplestone et al., 2011; McGaghie, et al, 2009; Penny & Coe, 2004;
Actively involves the learner and supports the learners feelings of autonomy rather than being seen as controlling	Coe, 2006; Deci et al., 1999; Hattie & Timpereley 2007; Jonsson, 2013; Penny & Coe, 2004;
Feedback should be referenced to the task and used in situations where the learner has the opportunity to use the feedback	Beesley & Apthorp, 2010; Jonsson, 2013
Encourage learner self-assessment of strengths and weaknesses, self-reflection and self-monitoring and development	Beesley & Apthorp, 2010; Butler & Winne, 1995; Graham et al.,, 2011; Hattie & Timperley, 2007; Higgins et al., 2007; Miller & Archer, 2010; Sims-Knight & Upchurch, 2001; Ramani & Krackov, 2012
Promote a learning goal orientation via feedback to the learner	Hoska, 1993; Shute, 2008

Table Ap1.3. Approach to providing feedback

Ap1.3.4 Factors within the Learner that May Influence the Feedback Given

Factors within the learner that may influence the feedback given	Articles in support of this
FEEDBACK SHOULD	
Take into account the role of affective states and emotions	Evans, 2013
Feedback timing may be mediated by task type and learner style.	Li, 2010 (explicit feedback-immediate and implicit feedback-delay); Jaehnig & Miller, 2007 (Delay if allows additional exposure to material)
Take into account the learners self-efficacy beliefs, their self- concept and calibration accuracy	Butler & Winne, 1995; Bangert-Downs et al., 1991; Black & William, 1988; Coe 2006; Crooks, 1988; Evans, 2013; Hattie & Timperley, 2007; Kulhavy & Stock, 1989
Feedback should take into account the learners attributions for success/failure.	Black & William, 1998; Crooks, 1988; Evans, 2013; Hattie & Timperley, 2007
It should encourage learners to make attributions to their own efforts and to attribute success to their ability and failure to specific strategies	Coe, 2006
Need to take the learners motivation into account	Bangert-Downs et al., 1991; Black and William, 1998; Crooks, 1988; Deci et al., 1999; DeNisi & Kulger, 2000; Evans, 2013; Hattie & Timperley, 2007; Narciss, 2004; Nelson & Schunn, 2008; Rummel & Feinberg, 1988; Shute, 2008
Feedback is effective if it indicates a change is necessary and the learners perceive that change is necessary	Smither et al., 2005
Assess whether the trainee is learner or performance orientated and provide feedback in conjunction with this	Black & William, 1998; Hattie & Timperley 2007; Shute, 2008
	FEEDBACK SHOULD NOT
Focus on the self or self-concept, praise or threaten the learners' ego.	DeNisi & Kluger, 2000; Hattie & Timperley, 2007;Kluger & DeNisi, 1996; Shute, 2008

Table Ap1.4. Factors within the learner that may influence feedback

Ap1.3.5 Research conducted on feedback in various settings

Feedback is important in the following settings	Area	Author
Feedback had a positive effect on computer based learning both when the re-test was administered immediately (0.80) after the feedback and after a delayed interval (0.35).	Computer based learning	Azevedo, 1995
Feedback in terms of providing student with data (ES= 0.51) and concrete feedback to parents (0.43) improved maths skills.	Maths education	Baker et al., 2002
The effect of feedback in test-like situations improves performance (effect size, 0.26).	Education in schools	Bangert-Drowns et al., 1991
Feedback is important for outcomes with regard to making in-service training for continuing professional education effective	Health workers	Bluestone, 2013
Feedback had an effect size of 0.76 in improving student performance	Education in schools	Beesley & Apthorp, 2010
Feedback improved learning outcomes in training students using computerised virtual patients	Internet learning medical school	Cook et al., 2010
Feedback as part of debriefing led to improved process and patient focused outcomes. It enhanced technical and non-technical performance and patient focused outcomes.	Intensive care training	Couper et al., 2013
Positive feedback enhances free choice behaviour (0.33) and self-reported interest (0.31)	Motivation	Deci, Ryan & Koestner, 1999
Video feedback improved the parenting behaviour of parents (0.47), parental attitude (0.37) and on children's behaviour (0.33)	Parenting	Fukkink., 2008
Video feedback improved professionals' interaction skills-. Effect size, 0.40	Professionals	Fukknik et al., 2011
Reward and punishment feedback is the most effective in improving children's discrimination learning.	Children's learning	Getsie et al., 1985
Formative feedback provided to learners on their writing had an effect size of 0.77.	High school education	Graham et al., 2011
Feedback is somewhat effect when training students in procedural skills (0.74). Student's tended to learn better with feedback from multiple sources rather than one (0.43).	Medical Education	Hatala, 2014
Corrective feedback was shown to be effective in improving students word reading accuracy on words in lists and accuracy in reading words from longer paragraphs.	Reading	Huebusch & Lloyd, 1998
Audit and feedback had a modest but significantly positive effect on care quality outcomes when feedback was given frequently, in writing , with suggestions for improvement	Primary and secondary medical care	Hysong, 2009
Direct correction and metalinguistic explanation are effective in helping learners' acquisition of English articles.	SLA education	Kao, 2013
Feedback positively effective performance with a effect size of 0.41. However, a 1/3rd of interventions showed a negative influence of feedback on performance.	Performance	Kluger & DeNisi, 1996
The effectiveness of delayed or immediate feedback differs depending on the setting of the study. List learning experiments- immediate feedback Applied studies- immediate feedback Experiments on acquisition- delayed feedback	List learning experiments vs. applied studies vs experiments on acquisition of test content. Effect of feedback	Kulik & Kulik, 1988
Corrective feedback led to improvements in SLA	Second language acquisition in education – university level	Li 2010; Lyster & Saito, 2010

Elaborate expansion is more effective than visual clues for declarative tasks. Knowledge of correct response is more effective than visual clues for procedural tasks.	Learning via virtual reality based games	Merchant et al., 2014
Found that feedback is the most important factor in best practice for medical simulation	Medical education- University	McGaghie et al., 2009
Audit and Feedback are effective in improving prescribing practice	Primary care	Ostini et al., 2009
Praise and feedback are significant predictors of self-concept	Education- school	O'mara et al., 2006
Testing with feedback produces the strongest positive effect on achievement	Education	Pehlps , 2012
Feedback from patients improved consultation skills	Primary care	Reinders et al., 2011
Reinforcement and feedback are highly effective in the remediation of classroom behaviour problems across a variety of behaviours, settings and administrative arrangements.	Education- school	Skiba, 1986
Feedback has an important role in GPs continuing education	Primary care	Smith et al., 1998
Feedback is a useful strategy for teaching communication skills to medical students -effect size 0.88. The feedback was on a recorded student patient interview	Medical school- University	Smith et al., 2007
Direct report, peer and supervisor feedback positively influence performance- however the amount of improvement was small	Education	Smither et al., 2005
Promotion task focus= positive feedback increases intention to invest more effort. Prevention task= negative feedback increases intention to invest more effort	Task type, motivation an feedback sign	Van Dijk & Kluger, 2011
Feedback can change physicians clinical performance if it is provide in a systematic manner over multiple years both a credible and authoritative source	Continuing medical performance	Veloski et al., 2006
Feedback significantly improved science achievement	Education- school	Yeany & Miller, 1983

Table Ap1.5. Research conducted on feedback in various settings

APPENDIX 2: SYSTEMATIC LITERATURE REVIEW – FEEDBACK PROVIDED IN THE STUDIES

Ap 2.1. Detailed descriptions of the feedback provided in the studies from the systematic review

No.	Authors	Feedback Provided
1	Pelgrim, Krammer, Mokkink & van der Vleuten, 2012.	A modified mini-CEX was designed which included a form to evaluate trainees' competence during an observed clinical encounter in general practice. Additional space was provided for answers to questions which invited trainers to provide narrative feedback and trainees to provide narrative reflections on what went well and what could have been done better and for an action plan drawn up by the trainer and trainee. The action plain comprised learning goals, steps for improvement and ways of evaluating these. The format of the post grad training programme meant that such assessments must be conducted every 3 months. The trainer and trainee are instructed that each trainee should give a reflection on their performance after the observed consultation. The trainer then provides feedback and the reflection and the feedback is used to draw up an action plan.
2	Braend, Gran, Frich & Lindbaek, 2010	The authors developed questionnaires to be completed by the patient. Students were also asked to self-assess their performance based on the four main areas of the consultation: history, clinical exam, differential diagnostic judgement and plan. Teachers also used the same structure to assess the students and answered an additional question about the students consultation skills. The responses by the student, patient and teacher were then triangulated. The questionnaire completed by the patient focused on how the student interacted with the patient, whether they made them feel comfortable, and whether they understood, prepared and explained things well. The students were assessed by the teacher in 5 consultations. After these consultations the students filled in the studentPEP questionnaires and the students and the teachers wrote their evaluations.
3	Dewitt, Carline, Paauw & Pangaro, 2008	Feedback was provided to trainees using the RIME feedback tool when they were observed throughout the 5 month continuity clerkship experience. Feedback was provided on the trainees reporting, interpretation, management, education, interpersonal skills and professionalism. Under each category there were three levels of competency: needs improvement, competent and strength. The trainer was asked to circle the level attained by the student and then provide next steps for improvement. *Diagnostic decision making was commented on in the interpretation section.*
4	Richards, Paukert, Downing & Bordage, 2007	The medical students were provided with feedback on their clinical performance during a 3rd year surgical clerkship. They were provided with feedback using clinical encounter cards. The cards contained the following information: student's name, date, chief focus of the encounter. Student performance during the encounter was rated by the evaluator on a 6 point likert scale and there was the possibility for them to add extra comments. The students had to ask the evaluator to complete a card for them.

5	Fraser, 2007	Feedback was given to GP registrars using a new tool. Feedback was always given in person using a standardised, validated consultation feedback proforma which used a likert scale to assess components of a consultation including introduction, history, examination, diagnosis, management, close and global rating. There was also a space for comments to capture important parts in the consultation that might not be mentioned in the criteria. The form was used to assess registrars during external clinical teaching visits.
6	Al-Jarallah, Moussa, Shehab & Abdella, 2005	The trainees gave feedback cards to the evaluator. At the end of the encounter the evaluator assessed the trainee's performance in one or more of six areas of competence. The information was fed back to the trainee using immediate verbal and written feedback.
7	Lin, Chiu, Yen & Chong, 2012	After each encounter, preceptors were requested to give a brief (5-10 minutes) qualitative feedback to trainees, both verbally and in written form, in three sections: (1) positive feedback, (2) negative feedback, and (3) action plan. The feedback actually provided was qualitative, quantitative and was positive and negative, some of the feedback contained action plans. In 14.7% of cases no feedback was provided. The most feedback was provided on clinical judgement-including diagnostic ability. 1877 feedback items were recorded from 893 encounters. Of the 1877 items 487 were on clinical judgment. - 135 were positive, 165 were negative and 187 were action plans.
8	Sanson-Fisher, Rolfe, Jones, Ringland & Agrez, 2002	Feedback was provided after the student observed a doctor-patient encounter- deriving judgements and by time spent after the consultation with tutors giving students extra and specific constructive feedback and aiding them in setting learning tasks. Weekly contracts were made to ensure progress was made. Students set their own learning tasks derived as a consequence of the judgement errors they had made.
9	Fernando, Cleland, McKenzie & Cassar, 2008	The assessor was instructed to give feedback on strengths, areas for development and an action plan. They found that in 89 cases (22.7%) positive aspects of student performance were not identified; 111 cases (28.2%) no suggestions for development given and in 196 cases (49.7%) no plan of action was developed. Most feedback just identified the student's strengths. Action plans were most likely to be provided by academic trainees and were also more likely to identify positives and areas for improvement. More likely to record areas for student development on the paramedical training block
10	Hamburger et al., 2011	Feedback was given using the Structured Clinical Observation (SCO) form which also included a competency-based list of expected skills to guide specific feedback in the domains of data gathering, interpersonal skills, physical examination and information sharing. After each direct observation of a resident, the faculty member used the SCO form to write feedback comments and, checked off the relevant skills observed and discussed with these with the resident. Faculty had been instructed that the feedback should: include 1 to 3 key feedback points about specific skills observed, last 2 to 3 minutes and be completed shortly after the observation. They also planned that observation should take place repeatedly throughout the academic year.

11	Dorsfman & Wolfson, 2009	After observing several patient encounters without providing comments, the observer was to provide some immediate feedback regarding efficiency tools or decision-making, but specifically avoid giving feedback on data gathering, bedside manner, professional communications, or physical examination until the end of the observation shift. The observer compiled a data sheet on each resident during the patient encounters, and at the end of the 4- to 5-hour observation session spent 15–30 minutes in a private location with the resident, detailing observations made throughout the session and providing feedback. The resident could then provide feedback on the experience and ask questions. The feedback provided was based on the observations made throughout the session and included: communication skills, bedside manner, amount of detail in their physical exams, their efficiency, and how many times throughout the session they had introduced themselves or washed their hands.
12	Paukert, Richards & Olney, 2002	At the end of the encounter, the evaluator rated the student's performance on one or more of the eight domains: history taking, physical-examination skill, professional behaviour, technical skill, case presentation (verbal, written, or both), problem formulation (diagnosis), problem formulation (therapy) and other. They then checked off the appropriate global rating and gave verbal and written feedback to the student.
13	Yudkowsky, Otaki, Lowenstein, Riddle, Nishigori & Bordage, 2009	Before each encounter, the student receives a brief history and two plausible diagnoses. Before seeing the simulated patient (SP), the student was asked to anticipate in writing the positive findings for each diagnosis. Then they entered the room and elicited findings by selecting and executing the relevant physical examination (PE) manoeuvres for the complaint and differentiating between the two diagnoses. After this the student interpreted the clinical findings by expressing their working diagnosis to the SP. Specialised SPs portray the PE findings appropriate to one of the two diagnoses in each scenario and assess and teach the PE manoeuvres associated with the case. After the initial interpretation of the findings by the student, the SP provides immediate corrective feedback on the execution of the PE manoeuvres and prompts the student to redo any incorrectly performed manoeuvres and perform any omitted manoeuvres. The student is then asked by the SP to redo the incorrect or omitted manoeuvres and to revise his or her working diagnosis based on any additional findings.
14	Windish, Price, Clever, Magaziner & Thomas, 2005	The role-play was a structured experience using time-outs. Students not interviewing or playing the patient role observed the encounter for communication skills using the observation guide. The time-out involved a 6-step iterative reflective process with feedback by self-reflection, peers and faculty. Students also created a problem list and discussed strategies for gathering additional information to test hypotheses.
15	Holmboe, Yepes, Williams & Hout, 2004	Feedback was audiotaped and transcribed. The authors developed a taxonomy of feedback consisting of 4 types: recommendations, promoting learner reaction, action plans and self-assessment. In 107 encounters there were 204 recommendations, faculty enabled learner reaction in 65 sessions, self-assessment was used in 36 and 11 used an action plan.

		The feedback action plans could be directed by the faculty or intern and self-assessment could be spontaneous or prompted
16	Turnbull, MacFayden, Barneveld & Norman, 2000	Third year medical students on an 8 week internal medicine inpatient rotation. The medical students had to perform admission arrangements and assume the role of primary medical caregiver for their assigned patients. Evaluation forms were developed to assess the performance of students. These included an admission rating form relating to skills relating to the admission history and physical rating form. It assessed communication skills, physical examination skills, diagnostic acumen and management skills and a global rating of overall performance. Formative feedback on each performance was accommodated by a comments section on the form. Students were also evaluated by their attending faculty supervisor upon the bedside presentation of the patient which also provided the opportunity for verbal feedback. A word rating form was also developed to capture data on the students' performance in patient management which assessed: diagnostic strategies, communication skills, consultation skills, management skills, interpersonal behaviours, continued learning skills and health advocacy skills and a global rating of performance. Students again were evaluated by their supervisor at the time of the patient discharge and so could also be provided with verbal feedback on these. A multidisciplinary form was also used which assessed: diagnostic strategies used, communication skills, consultation skills with nurses and other providers, management of resources, discharge planning and interpersonal relations as well as an overall rating of performance. There was also a comments section for formative feedback. The patients also completed a form to assess the student on their communication skills, collaboration skills, health advocacy skills and professionalism. A comments section allowed for formative feedback.
17	Haffling, Beckman & Edgren, 2011.	Developed a new feedback tool based on the modified Leicester Assessment Package for medical students. Trainers and trainees were informed that the feedback should be provided as reflective feedback conversation and that goals and strategies for further training should be mutually agreed upon. The feedback was to be provided across two feedback sessions. The first session used feedback goals and the second session used feedback and feed forward. The domains assessed were: medical interview, history taking, physical examination, working diagnosis, problem solving, investigations into treatment, explanation and planning and relationship with patients. Identical assessment forms were used for students' self-assessments and for supervisors formative assessments. Feedback sheets, attached to the forms supplied detailed information on the assessment process and on how to differentiate between the scores of the rating form. The sheets also had space for narrative comments on agreed goals and feedback and contained questions to the students to evaluate the feedback they were provided with and to the supervisors to determine whether the assessment tool contributed to an improved structure in the assessment of the students' performance.
18	Troncon, Dantas & Figueiredo, 2000	The clinical competence of senior medical students is assessed using two 2 standardized, structured long-case examinations. Their performance is assessed on patient approach and the interview itself is assessed and graded using a 10item checklist covering five groups of clinical skills:

		history taking, physical examination, communication and interaction with the patient, case presentation and clinical reasoning ad patient management. They are rated as fully adequate, barely adequate, inadequate or poor. They are also asked 4 separate questions during the clerk interview regarding a summary of the main points from the history and physical examination, main diagnostic hypothesis, tests to confirm and therapeutic measures they would take. After completing the 25 minute encounter the student has 2 minutes to organize themselves and then they are interviewed by the examiner. They are then provided with immediate feedback on their performance in line with the areas mentioned above. They then move onto the next station.
19	Goss, 1996	One tutor describes how he teaches and provides feedback to 3rd year students on their clinical reasoning. Students are observed eliciting the chief complaint from a patient. They then have a briefing session where 15 minutes is spent discussing the case; thinking about the complaints, the pathophysiology of the potential diagnosis. Through this the students identify historical and physical-examination findings to look for when next at the bedside. The feedback given here aims to stimulate the students curiosity regarding the causes if primary problems give the students diagnostic tools to help them narrow the differential diagnosis as well as set goals. The students then perform a complete history and physical. They then spend 30 minutes organizing their thought. This is then followed by debriefing session where the students discuss their experiences and receive immediate feedback from the tutor about their interactions it the patients and their clinical skills. At the beside the student and the tutor review the ways the clinical information has helped to narrow the differential diagnosis and address issues brought to the tutors attention trough observation that could be improved upon. It is then discussed how a more experienced clinical may have dealt with the case. The students then write up their cases focusing on the history, the physical exam and the assessment. The tutor meets up with the students one week later to provide them with feedback on these.

Table Ap2.1. Final studies included and the feedback that they provided.

APPENDIX 3: QUESTIONNAIRE TO INVESTIGATE MEDICAL STUDENTS AND CLINICIANS PERCEPTIONS OF FEEDBACK

Ap3.1 Questionnaires to Medical Students

The provision of feedback on your Diagnostic Decision Making

This questionnaire is designed to understand how frequently you receive feedback on making a diagnosis in authentic clinical settings. An authentic clinical setting may be a ward round, a clinic setting or a GP consultation.

Please answer the questions in the context of feedback provided on diagnostic decision making only.

Please answer ALL of the following questions. There are no right or wrong answers. All replies are anonymous and confidential

1. Year of study

2. Gender

3. How often do you receive feedback on your diagnostic decision making whilst you are in an authentic clinical setting such as during ward rounds?

4. When receiving feedback on your diagnostic decision making, how often is this done in the following ways:

A. One-one basis: ○ Never ○ Rarely ○ Occasionally ○ Very Frequently ○ Always

B. Group setting: ○ Never ○ Rarely ○ Occasionally ○ Very Frequently ○ Always

C. Verbally: ○ Never ○ Rarely ○ Occasionally ○ Very Frequently ◉ Always

D. In a written format: ○ Never ○ Rarely ○ Occasionally ○ Very Frequently

Feedback after good performance

Please imagine that you are in a clinical setting and you receive the following feedback:

5. *"Very good" or " Well done" with no further comment*

How often- AFTER GOOD PERFORMANCE do you receive feedback like this?

○ Never ○ Rarely ○ Occasionally ○ Very Frequently ○ Always

To what extent do you think that this feedback would be useful for you to improve your performance?

○ Not v. useful ○ Somewhat useful ○ Not useful or un-useful ○ Useful ○ V. useful

6. "*Well done. This was a good consultation. You made an accurate diagnosis" With no further comment*.

How often- AFTER GOOD PERFORMANCE do you receive feedback like this?

Never Rarely Occasionally Very Frequently Always

To what extent do you think that this feedback would be useful for you to improve your performance?

Not v. useful Somewhat useful Not useful or un-useful Useful V. useful

7. *"Well done. Your focussed history identified the patient's concerns and your examination identified the cause of the patient's symptoms which allowed you to make an accurate diagnosis." With no further comment.*

How often- AFTER GOOD PERFORMANCE do you receive feedback like this?

Never Rarely Occasionally Very Frequently Always

To what extent do you think that this feedback would be useful for you to improve your performance?

Not v. useful Somewhat useful Not useful or un-useful Useful V. useful

8. "*Well done. This was a good consultation and you made an accurate diagnosis. You were able to do this because your approach to the history and examination was focused. It was clear that you had a plan for the consultation which you executed well as well as goals that you developed as soon as the patient provided the first symptoms. Of key importance was how well you were able to chunk the case into smaller problems which you then integrated well. Your examination was focused, only performing what was essential to prove or disprove your differential diagnosis."*

How often- AFTER GOOD PERFORMANCE do you receive feedback like this?

Never Rarely Occasionally Very Frequently Always

To what extent do you think that this feedback would be useful for you to improve?

Not v. useful Somewhat useful Not useful or un-useful Useful V. useful

9. "*Well done. This was a good consultation and you made an accurate diagnosis. During the consultation you quickly picked up on answers that did not appear to fit your initial management plan and you successfully changed your further questioning and your diagnostic decision making in response to this."*

How often- AFTER GOOD PERFORMANCE do you receive feedback like this?

Never Rarely Occasionally Very Frequently Always

To what extent do you think that this feedback would be useful for you to improve?

Not v. useful Somewhat useful Not useful or un-useful Useful V. useful

Feedback after poor performance

Please imagine that you are in a clinical setting and you receive the following feedback:

10. *"This consultation was not very good." With no further comment.*

How often- AFTER POOR PERFORMANCE do you receive feedback like this?

Never Rarely Occasionally Very Frequently Always

To what extent do you think that this feedback would be useful for you to improve?

Not v. useful Somewhat useful Not useful or un-useful Useful V. useful

11. *"You did not appear to be very confident and your diagnostic decision making was poorer than is expected at your current level". With no further comment.*

How often- AFTER POOR PERFORMANCE do you receive feedback like this?

Never Rarely Occasionally Very Frequently Always

To what extent do you think that this feedback would be useful for you to improve?

Not v. useful Somewhat useful Not useful or un-useful Useful V. useful

12. *"You need to work on your confidence. You need to take a more focussed history to identify the patient's concerns and also your examination needs to be more focussed to identify the cause of the patient's symptoms, this will help you to come to the correct diagnosis." You make no further comment.*

How often- AFTER POOR PERFORMANCE do you receive feedback like this?

Never Rarely Occasionally Very Frequently Always

To what extent do you think that this feedback would be useful for you to improve?

Not v. useful Somewhat useful Not useful or un-useful Useful V. useful

13. *"You did not appear to set yourself goals to achieve within the consultation or a clear management plan to follow through the consultation in order to come to an adequate diagnosis. At the beginning of the consultation it is important to set yourself goals that you aim to achieve to aid your diagnostic decision making".*

How often- AFTER POOR PERFORMANCE do you receive feedback like this?

Never Rarely Occasionally Very Frequently Always

To what extent do you think that this feedback would be useful for you to improve?

Not v. useful Somewhat useful Not useful or un-useful Useful V. useful

14. *"You appeared overwhelmed by the complexity of the case and were not able to separate out smaller individual problems within the case. You seemed unaware of the evolving/changing patient factors that should have influenced your diagnostic decision making. Consequently were not successful in your diagnostic decision making".*

How often- AFTER POOR PERFORMANCE do you receive feedback like this?

Never Rarely Occasionally Very Frequently Always

To what extent do you think that this feedback would be useful for you to improve?

Not v. useful Somewhat useful Not useful or un-useful Useful V. useful

Do you ever perceive your diagnostic decision making to be effected by the following factors and how often do you receive feedback that takes these into account?

15. **Environment**

	Affecting decision making					Feedback provision				
	Never	Rarely	Occasionally	Very Frequently	Always	Never	Rarely	Occasionally	Very Frequently	Always
Time										
Noise										
Setting										

16. Patient characteristics

	Affecting decision making					Feedback provision				
	Never	Rarely	Occasionally	Very Frequently	Always	Never	Rarely	Occasionally	Very Frequently	Always
Number of previous visits with the same presentations	○	○	○	○	○	○	○	○	○	○
Attitude toward the patient	○	○	○	○	○	○	○	○	○	○
Communication barriers	○	○	○	○	○	○	○	○	○	○

17. How you feel

	Affecting decision making					Feedback provision				
	Never	Rarely	Occasionally	Very Frequently	Always	Never	Rarely	Occasionally	Very Frequently	Always
Your confidence that they can make an accurate diagnosis	○	○	○	○	○	○	○	○	○	○
Your previous knowledge and experience	○	○	○	○	○	○	○	○	○	○

18. Do you find you are more likely to receive feedback after a very poor or very good clinical interaction? If so, which is more likely and why?

19. Do you feel as though there are any problems with the way you are currently given feedback?

20. Do you think there would be a more helpful method by which your clinicians and tutus could provide you with feedback on your diagnostic decision making? If so, what would this be?

Ap3.2 Questionnaires to Clinical Educators

The Provision of Feedback on Medical Student's Diagnostic Decision Making

This questionnaire is designed to understand the approach that you use to debrief medical students after observing and discussing a consultation or ward round that they have performed. Please answer ALL of the following questions. There are no right or wrong answers. All replies are anonymous and confidential.

Please answer the questions in the context of feedback provided on diagnostic decision making only.

Please answer ALL of the following questions. There are no right or wrong answers. All replies are anonymous and confidential

1. Please state how long you have been teaching medical students with the University of Leeds for?

2. Have you ever attended any CPD events, workshops or any further training courses to improve your feedback provision? If yes please expand.

3. Gender

4. When observing a medical student and providing them with feedback on their diagnostic decision making, how often is this done in the following ways:

A. One-one basis: Never Rarely Occasionally Very Frequently Always Other

If you selected Other, please specify:

B. Group setting: Never Rarely Occasionally Very Frequently Always Other

If you selected Other, please specify:

C. Verbally: Never Rarely Occasionally Very Frequently Always Other

If you selected Other, please specify:

D. In a written format: Never Rarely Occasionally Very Frequently Always Other

If you selected Other, please specify:

E. If feedback is provided in a group setting do you also allow peer feedback? Please expand on this: Yes No Other

Expand

For the following questions please imagine that you are debriefing a medical student after observing them in a consultation or ward round

Feedback after good performance

5. How often- AFTER GOOD PERFORMANCE do you provide the following type of feedback? *"Very good" or " Well done" with no further comment*

Never Rarely Occasionally Very Frequently Always

6. How often- AFTER GOOD PERFORMANCE do you provide the following type of feedback? *"Well done. This was a good consultation. You made an accurate diagnosis" You make no further comment*.

Never Rarely Occasionally Very Frequently Always

7. How often- AFTER GOOD PERFORMANCE do you provide the following type of feedback? *"Well done. Your focussed history identified the patient's concerns and your examination identified the cause of the patient's symptoms which allowed you to make an accurate diagnosis." You make no further comment.*

Never Rarely Occasionally Very Frequently Always

8. How often- AFTER GOOD PERFORMANCE do you provide the following type of feedback? *"Well done. This was a good consultation and you made an accurate diagnosis. You were able to do this because your approach to the history and examination was focused. It was clear that you had a plan for the consultation which you executed well as well as goals that you developed as soon as the patient provided the first symptoms. Of key importance was how well you were able to chunk the case into smaller problems which you then integrated well. Your examination was focused, only performing what was essential to prove or disprove your differential diagnosis."*

Never Rarely Occasionally Very Frequently Always

9. How often- AFTER GOOD PERFORMANCE do you provide the following type of feedback on their diagnostic decision making? *"Well done. This was a good consultation*

and you made an accurate diagnosis. During the consultation you quickly picked up on answers that did not appear to fit your initial management plan and you successfully changed your further questioning and your diagnostic decision making in response to this."

Never Rarely Occasionally Very Frequently Always

Feedback after poor performance

10. How often- AFTER POOR PERFORMANCE do you provide the following type of feedback? *"This consultation was not very good.". You make no further comment.*

Never Rarely Occasionally Very Frequently Always

11. How often- AFTER POOR PERFORMANCE do you provide the following type of feedback? *"You did not appear to be very confident and your diagnostic decision making was poorer than is expected at your current level". You make no further comment.*

Never Rarely Occasionally Very Frequently Always

12. How often- AFTER POOR PERFORMANCE do you provide the following type of feedback? *"You need to work on your confidence. You need to take a more focussed history to identify the patient's concerns and also your examination needs to be more focussed to identify the cause of the patient's symptoms, this will help you to come to the correct diagnosis." You make no further comment.*

Never Rarely Occasionally Very Frequently Always

13. How often- AFTER POOR PERFORMANCE do you provide the following type of feedback on their diagnostic decision making? *"You did not appear to set yourself goals to achieve within the consultation or a clear management plan to follow through the consultation in order to come to an adequate diagnosis. At the beginning of the consultation it is important to set yourself goals that you aim to achieve to aid your diagnostic decision making".*

Never Rarely Occasionally Very Frequently Always

14. How often- AFTER POOR PERFORMANCE do you provide the following type of feedback? *"You appeared overwhelmed by the complexity of the case and were not able to separate out smaller individual problems within the case. You seemed unaware of the evolving/changing patient factors that should have influenced your diagnostic decision making. Consequently were not successful in your diagnostic decision making".*

Never Rarely Occasionally Very Frequently Always

Do you ever perceive students diagnostic decision making to be effected by the following factors and how often do you provide feedback that takes these into account?

15. Environment

	Affecting decision making					Feedback provision				
	Never	Rarely	Occasionally	Very Frequently	Always	Never	Rarely	Occasionally	Very Frequently	Always
Time										
Noise										
Setting										

16. Characteristics of the patient

	Affecting decision making					Feedback provision				
	Never	Rarely	Occasionally	Very Frequently	Always	Never	Rarely	Occasionally	Very Frequently	Always
Number of previous visits with the same presentation										
Attitude toward the patient										
Communication barriers										

17. **How the student feels**

	Affecting decision making					Feedback provision				
	Never	Rarely	Occasionally	Very Frequently	Always	Never	Rarely	Occasionally	Very Frequently	Always
Their confidence that they can make an accurate diagnosis	○	○	○	○	○	○	○	○	○	○
Their previous knowledge and experience	○	○	○	○	○	○	○	○	○	○

Feedback provision

18. Please discuss how you give feedback to medical students on their diagnostic decision making

19. Specifically- what areas of the clinical interaction do you usually give them feedback on?

20. Do you find you are more likely to give students feedback after either a very poor or very good clinical interaction? If so, which is more likely and why?

21. Do you feel as though there are any problems with the way you currently give feedback?

22. Do you think there would be a more beneficial method of providing medical students with feedback? If so, what would this be?

Ap3.3 Ethical Approval

Faculty of Medicine and Health Research Office

School of Medicine Research Ethics Committee (SoMREC)

Dear Heather

Ref no: **SoMREC/13/004**

Title: **The provision of feedback on Clinical Diagnostic Decision Making**
Your research application has been reviewed by the School of Medicine Ethics Committee (SoMREC) and we can confirm that ethics approval is granted based on the documentation received at the date of this letter and subject to the following condition(s):

Trust R&D approval must be obtained prior to commencement of the research and confirmation of this approval sent to this committee once obtained.

Document	*Version*	*Date Submitted*
Ethical_Review_Form_questionnaires	1	25.09.13
Appendix A1 version 1. Questionnaire to GP trainers	1	25.09.13
Appendix A2 version 1. Questionnaire to university tutors	1	25.09.13
Appendix A3. Version 1. Questionnaire to GPregistrars	1	25.09.13
Appendix A4. Version 1. Questionnaire to medical students	1	25.09.13
Appendix B and C	1	25.09.13
Appendix A1 version 2. Questionnaire to GP trainers	2	18.10.13
Appendix A3. Version 2. Questionnaire to GPregistrars	2	18.10.13
Appendix B -K Version 2	2	18.10.13
SoMREC13004 Reviewer 2 comments – *(response)*	1	18.10.13
Appendix A2 version 2. Questionnaire to university tutors	2	18.10.13
Appendix A4. Version 2. Questionnaire to medical students	2	18.10.13
SoMREC13004 Reviewer 1 comments – *(response*)	1	18.10.13
Appendix B -K Version 3	3	12.11.13
responses to comments 30.10	1	12.11.13

Please notify the committee if you intend to make any amendments to the original research ethics application or documentation. All changes must receive ethics approval prior to implementation. Please contact the Faculty Research Ethics Administrator for further information (fmhuniethics@leeds.ac.uk)

Ethics approval does not infer you have the right of access to any member of staff or student or documents and the premises of the University of Leeds. Nor does it imply any right of access to the premises of any other organisation, including clinical areas. The committee takes no responsibility for you gaining access to staff, students and/or premises prior to, during or following your research activities.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited.

It is our policy to remind everyone that it is your responsibility to comply with Health and Safety, Data Protection and any other legal and/or professional guidelines there may be.

We wish you every success with the project.
Yours sincerely

Dr Roger Parslow

Co-Chair, **SoMREC**, **University of Leeds**

Dr John Sandars

Co-Chair, **SoMREC**, **University of Leeds**

APPENDIX 4: ETHICAL APPROVAL AND THE INTERVIEW STRUCTURE GUIDE FOR THE PILOT STUDY

Ap4.1 Ethical approval and Amendments

Faculty of Medicine and Health Research Office
School of Medicine Research Ethics Committee (SoMREC)

Dear Heather

Ref no: **SoMREC/13/088**

Title: **Pilot study investigating GPs opinions about usefulness and usability of the Personalised Feedback Model**

Your research application has been reviewed by the School of Medicine Ethics Committee (SoMREC) and we can confirm that ethics approval is granted based on the documentation received at the date of this letter and subject to the following condition(s):

Document	*Version*	*Date Submitted*
Email to be sent out to GPs	1	28/05/14
INFORMATION SHEET and consent forms	1	28/05/14
Outline of questions for semi structured interviews	1	28/05/14
UoL Ethics form. Heather Leggett. Pilot study	1	28/05/14
SoMREC13088 Reviewer 1 comments *(response)*	1	18/06/14
SoMREC13088 Reviewer 2 comments *(response)*	1	18/06/14

Please notify the committee if you intend to make any amendments to the original research ethics application or documentation. All changes must receive ethics approval prior to implementation. Please contact the Faculty Research Ethics Administrator for further information (fmhuniethics@leeds.ac.uk)

Ethics approval does not infer you have the right of access to any member of staff or student or documents and the premises of the University of Leeds. Nor does it imply any right of access to the premises of any other organisation, including clinical areas. The committee takes no responsibility for you gaining access to staff, students and/or premises prior to, during or following your research activities.
Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited.
It is our policy to remind everyone that it is your responsibility to comply with Health and Safety, Data Protection and any other legal and/or professional guidelines there may be.

We wish you every success with the project.

Yours sincerely

Dr Roger Parslow

Co-Chair, **SoMREC**, **University of Leeds**

Dr John Sandars

Co-Chair, **SoMREC**, **University of Leeds**

Amendment 1

Faculty of Medicine and Health Research Office
School of Medicine Research Ethics Committee (SoMREC)

Dear Ms Leggett
Ref no**: SoMREC/13/088 _ Amendment 1**
Title: **Pilot study investigating GPs opinions about usefulness and usability of the Personalised Feedback Model**

We are pleased to inform you that your amendment to your research ethics application has been reviewed by the School of Medicine Research Ethics Committee (SoMREC) and we can confirm that ethics approval is granted based on the following documents received from you:

Document	*Version*	*Date submitted*
Ethical review. Amendment (1)	1	20/08/14
Email to be sent out.Appendix c. v.2.doc20.08 x	2	20/08/14
20.08 info sheet	3	20/08/14

Please notify the committee if you intend to make any further amendments to the original research as submitted and approved to date. This includes recruitment methodology; all changes must receive ethical approval prior to implementation. Please contact the Faculty Research Ethics Administrator for further information (fmhuniethics@leeds.ac.uk)

Ethics approval does not infer you have the right of access to any member of staff or student or documents and the premises of the University of Leeds. Nor does it imply any right of access to the premises of any other organisation, including clinical areas. The committee takes no responsibility for you gaining access to staff, students and/or premises prior to, during or following your research activities.
Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited.
It is our policy to remind everyone that it is your responsibility to comply with Health and Safety, Data Protection and any other legal and/or professional guidelines there may be.

We wish you every success with the project.

Yours sincerely

Dr Roger Parslow
Chair, **SoMREC**, **University of Leeds**

Ap4.2 Interview Structure Guide

Main topic	Additional questions	Clarifying questions
USEFULNESS How useful do you think it would be to provide feedback in this manner?	Can you think of any negatives? Can you think of any ways this can be improved?	
EFFECTIVENESS How effective to you think the model will be in providing students with useful feedback?	Can you think of any negatives which will influence the effectiveness? Can you think of any ways this can be improved? Do you feel as though this would improve the feedback you are able to provide?	Can you expand on this please? Can you tell me anything else? Can you give me any examples?
USABILITY How usable do you this model will be in real practice?	Can you think of any elements or issues that may make it less feasible to use in practice? Can you think of any ways in which the model can be changed to make it more usable in real practice? Do you envisage there being any problems using the model in real practice with students? How do you think the model could be made easier to use in real practice?	
GENERAL QUESTIONS What extra information would you need to provide the PFM feedback effectively? Would you feel confident in analysing the students pre and post questions and working out what their answers meant and what their performance showed in the view of the PFM intervention and providing the appropriate feedback? Do you have any concerns about any element that is required of you? Time Student involvement Knowing what feedback to provide		

Table Ap4.1 Interview Structure Guide

APPENDIX 5: MATERIALS FOR THE IMPLEMENTATION OF THE PFM

AP5.1 The PFM Handbook

How to use the Personalised Feedback Model

A Model for Giving Effective Feedback to Medical Students on Their Diagnostic Decision Making

The Model

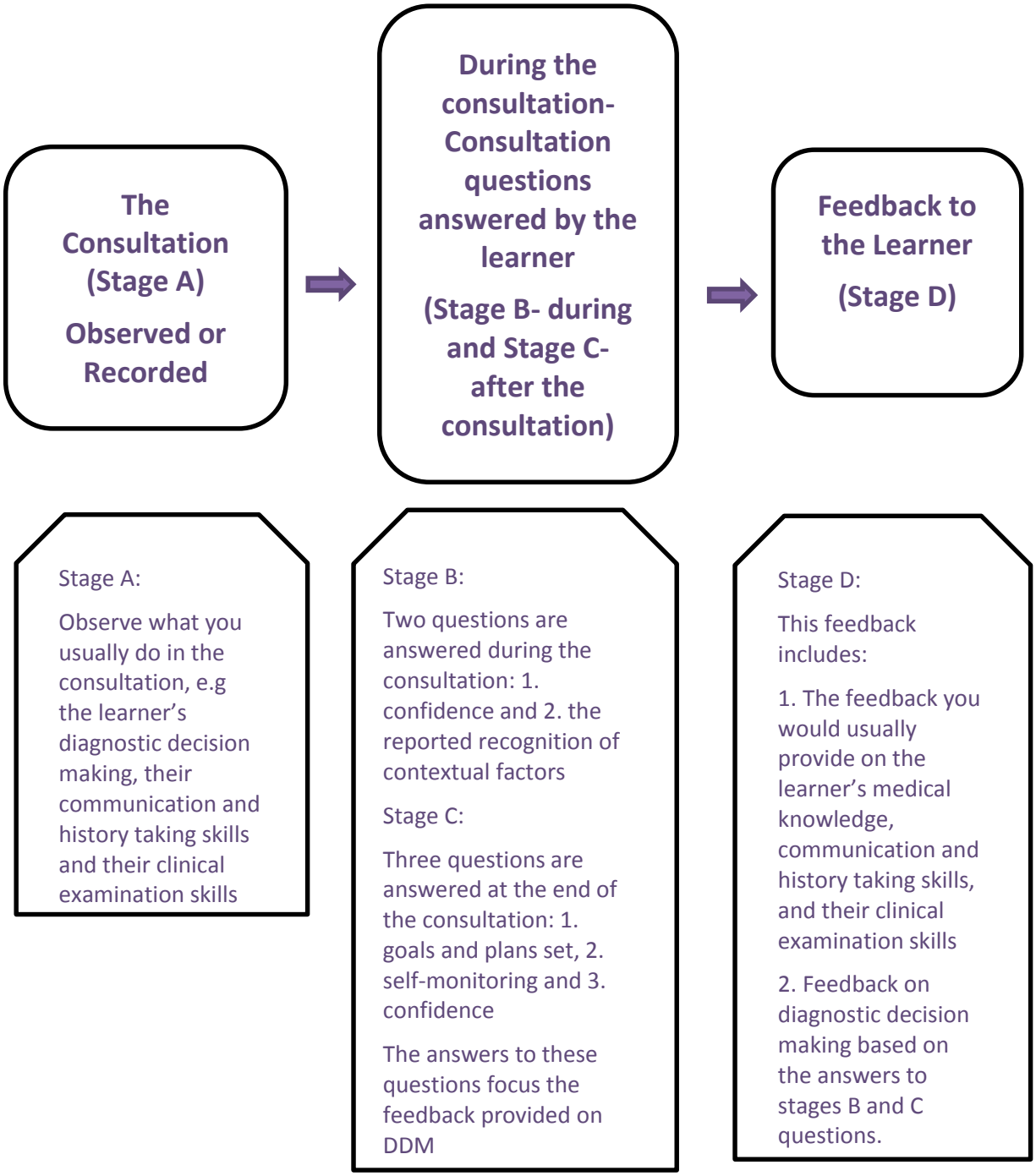
The Personalised Feedback Model is designed to equip you with a more structured and focused method of providing feedback to medical students after diagnostic decision making. It is designed to be utilized in line with your current methods and style of teaching and providing feedback. However, it adds an extra layer of detail and personal information for the learner. **The model does not promote a specific way of teaching diagnostic decision making and is to be used alongside your usual feedback provision but in relation to diagnostic decision making- not consultation skills in general**. It is suggested that using the model to provide feedback is employed at least once a week in a planned session where you can spend a few moments longer than usual feeding back to the learner. The diagram outlines the feedback model. It entails the following:

a. The consultation is observed by yourself (or recorded to be later observed by yourself).

b. At the beginning of the consultation after the learner has taken a brief history the learner will answer three questions regarding the consultation and their approach to diagnostic decision making (these are described below)

c. After the consultation, before you provide feedback the learner will answer two questions regarding the consultation and their diagnostic decision making (these are shown below)
The learners' answers to these questions will then influence what feedback is provided on their diagnostic decision making and where the focus of the feedback should lie.

d. You provide individualised feedback to the learner in a private setting. Invite them to reflect on their performance in the consultation as a whole, including their diagnostic decision making. Develop an action plan with them and ask them to write up the feedback you gave them including the action plan.



Collecting information from the trainee

The trainee should answer the five questions themselves on the form provided (see page 13-14). This is to limit the disruption between yourself and the learner to the consultation.

The trainee should answer three questions at the beginning of the consultation (stage b) and two questions after the consultation (stage c). The flow diagrams which follow demonstrate how the answers will then influence what information is fed back to the learner in terms of their diagnostic decision making.

The specific questions are shown in the worksheet at the end of this document (pages 13-15) but they are also outlined below:

Beginning consultation questions- to be answered after gathering a brief history from the patient. (stage b):

1. Confidence in ability to make a successful diagnostic decision in the consultation.
2. Awareness of any contextual factors in the environment, the patient or themselves that may influence diagnostic decision making in a positive or negative way.
3. In terms of diagnostic decision making-what they intended to achieve (goals) and how they intended to achieve this (plans).

Post consultation questions (stage c):

4. Awareness of ability to self-observe or keep track of their diagnostic decision making during the consultation.
5. Confidence in ability to make a successful diagnostic decision in similar cases.

Giving feedback

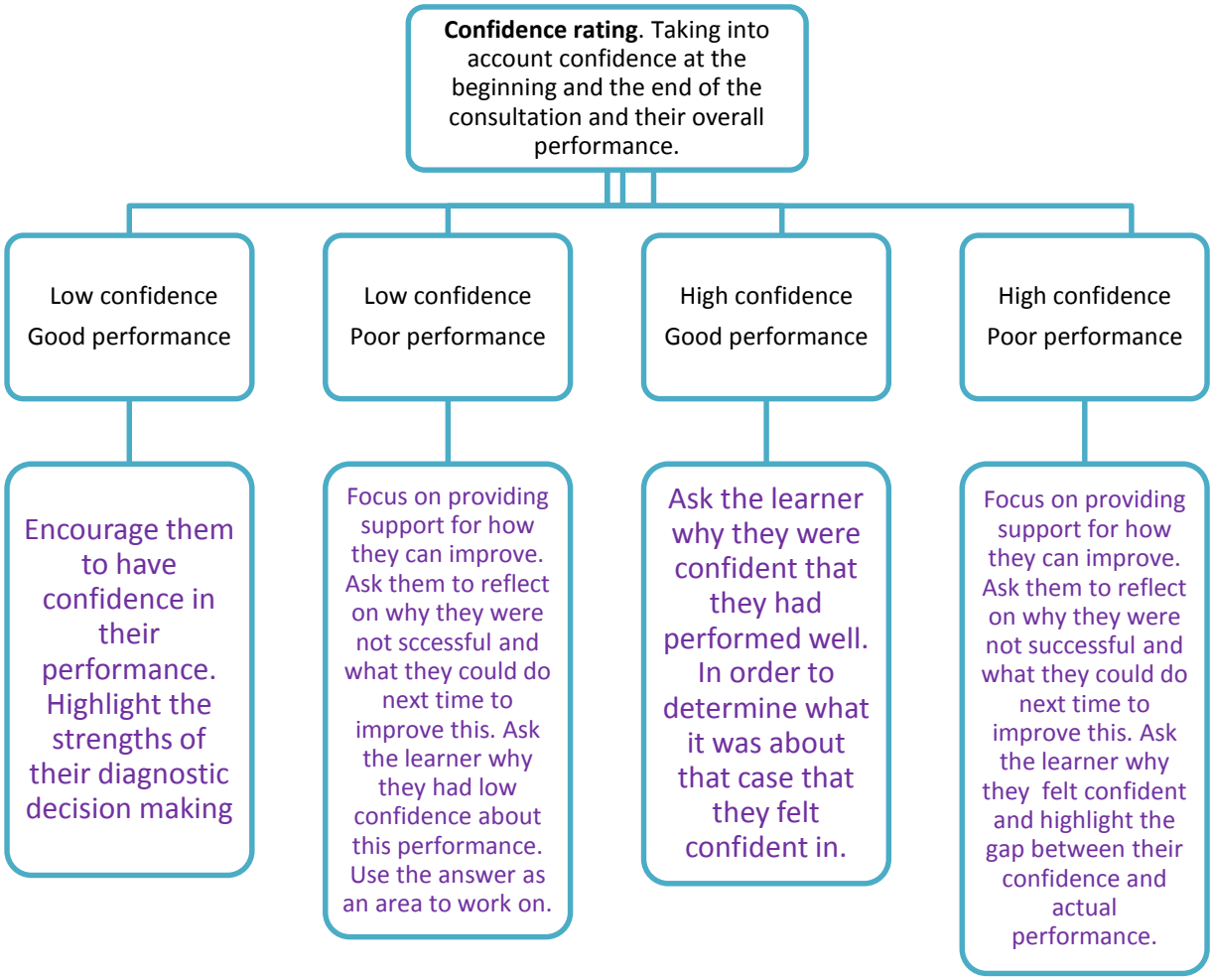
It would be a good idea for you to read through the learners' responses before providing feedback to them. If you wish, you could read through their answers to the first three questions whilst they continue the consultation.

It is important to note that **you should still give the learner feedback as you usually would. This includes their medical knowledge**, **their communication and history taking skills**, **their clinical examination skills and the extent to which their differential diagnosis is correct.** The Personalised Feedback Model can be viewed as providing envelope of additional feedback on diagnostic decision making.

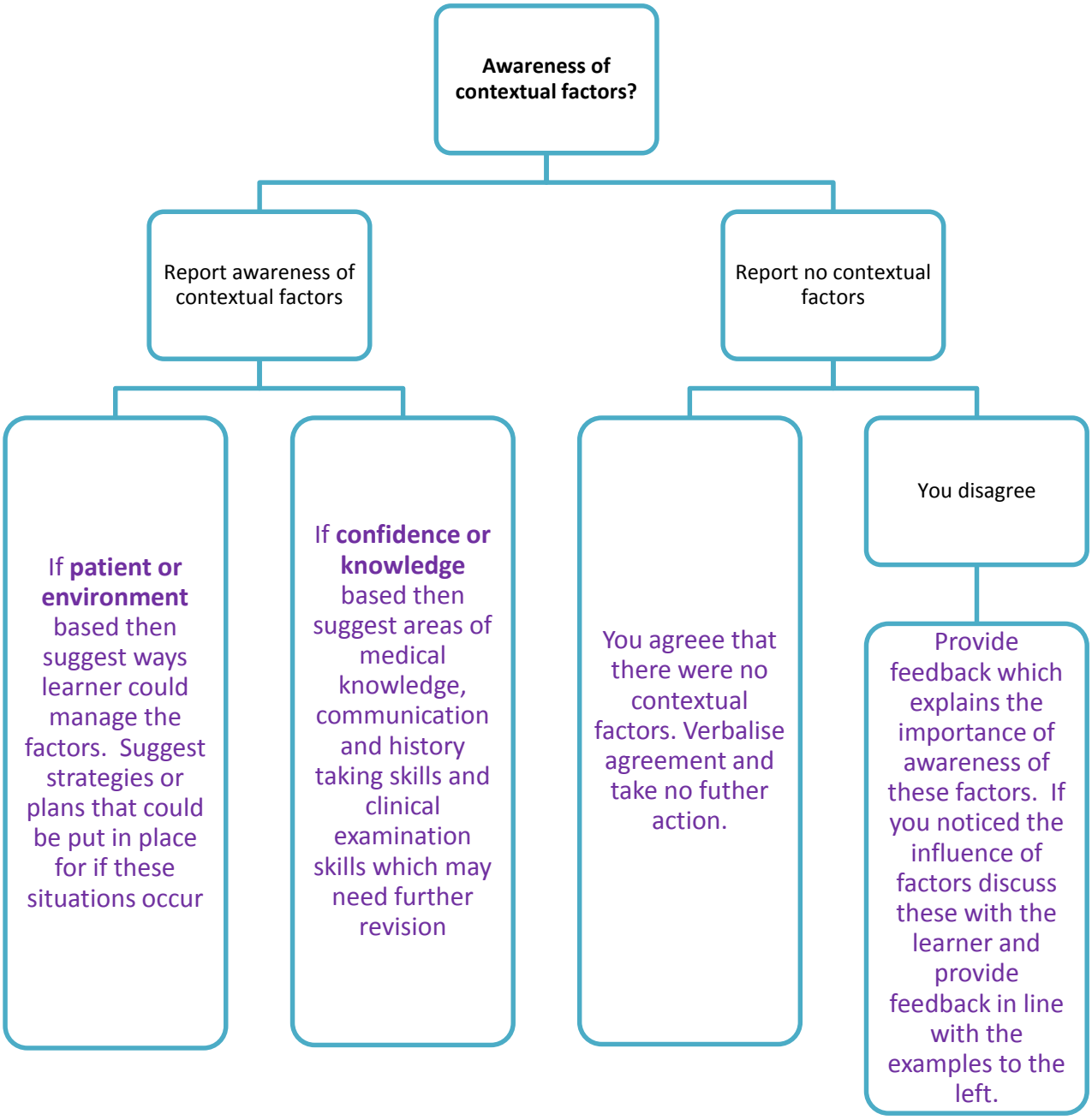
After providing feedback as you normally would, you can use the flowcharts as a guide to use the learners' answers to the questions (described above) to determine the focus of your feedback.

There is also a more detailed explanation behind the importance of each of the four areas which may help you in providing feedback. You may find this is a lot of information to take in; before you first use this model you may find it useful to read this booklet, in particular the flowcharts a few times.

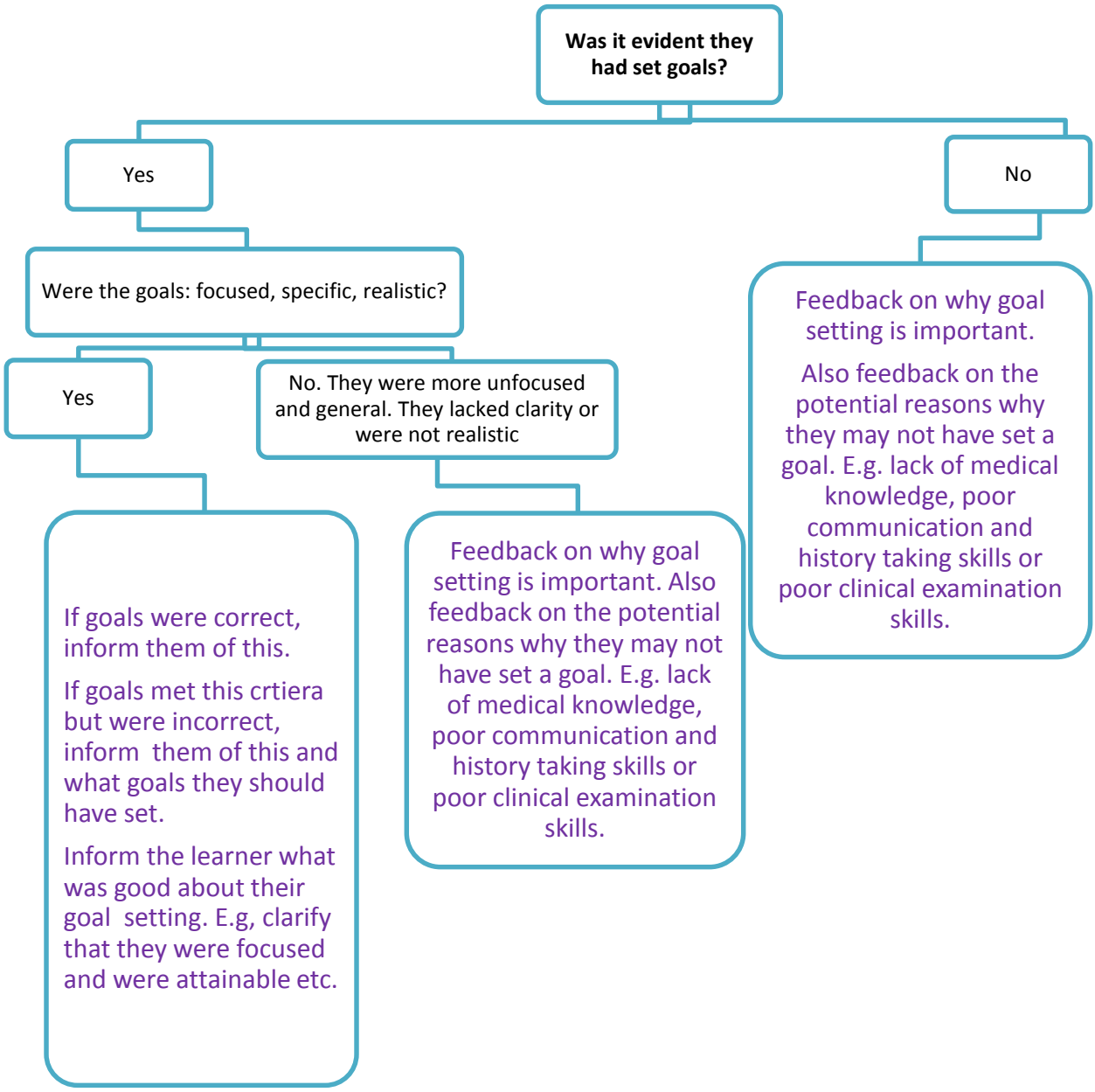
Questions 1 and 5: Assessing confidence and how it relates to actual performance

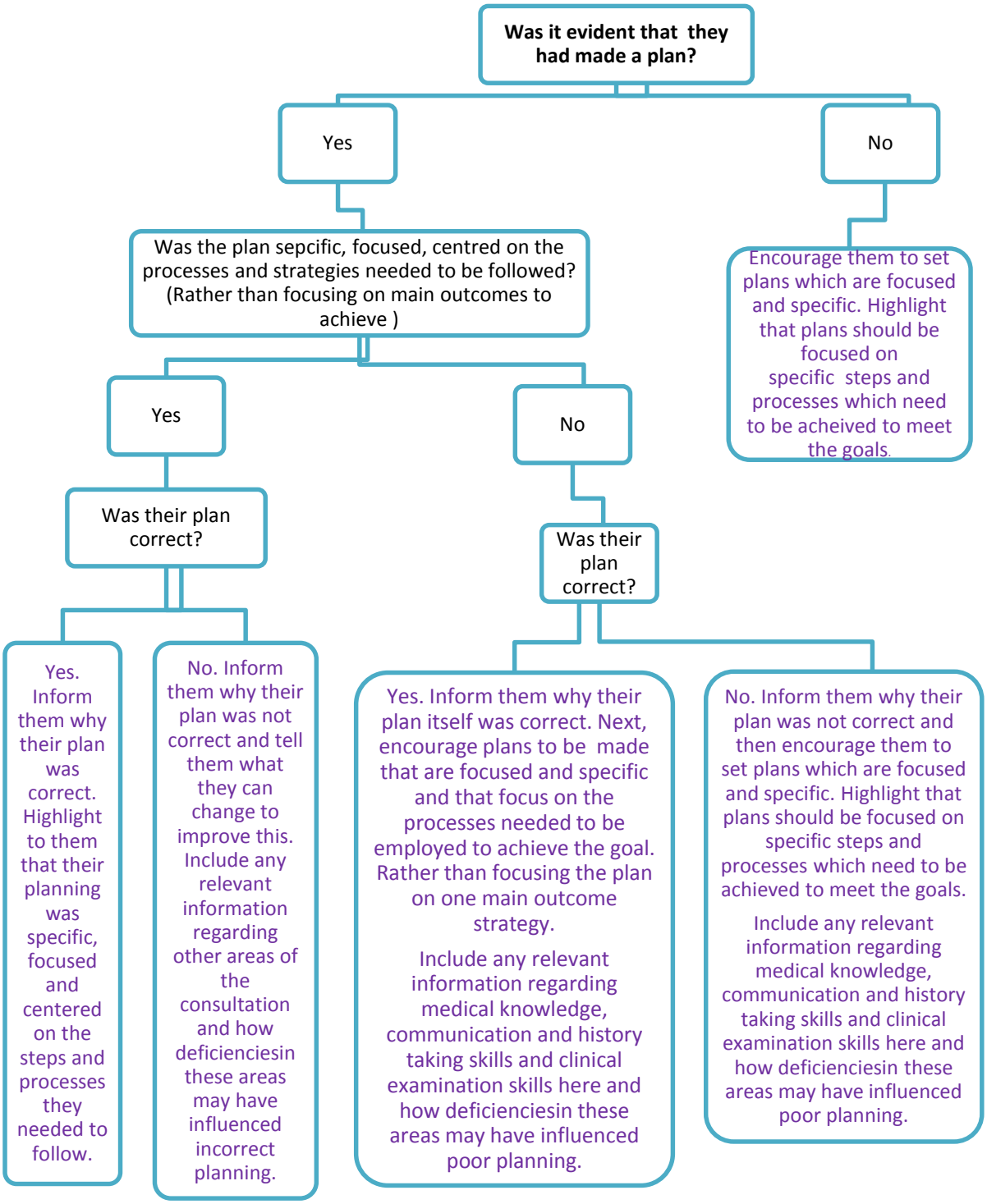


Question 2: Whether the learner is aware of any contextual factors that may influence their diagnostic decision making

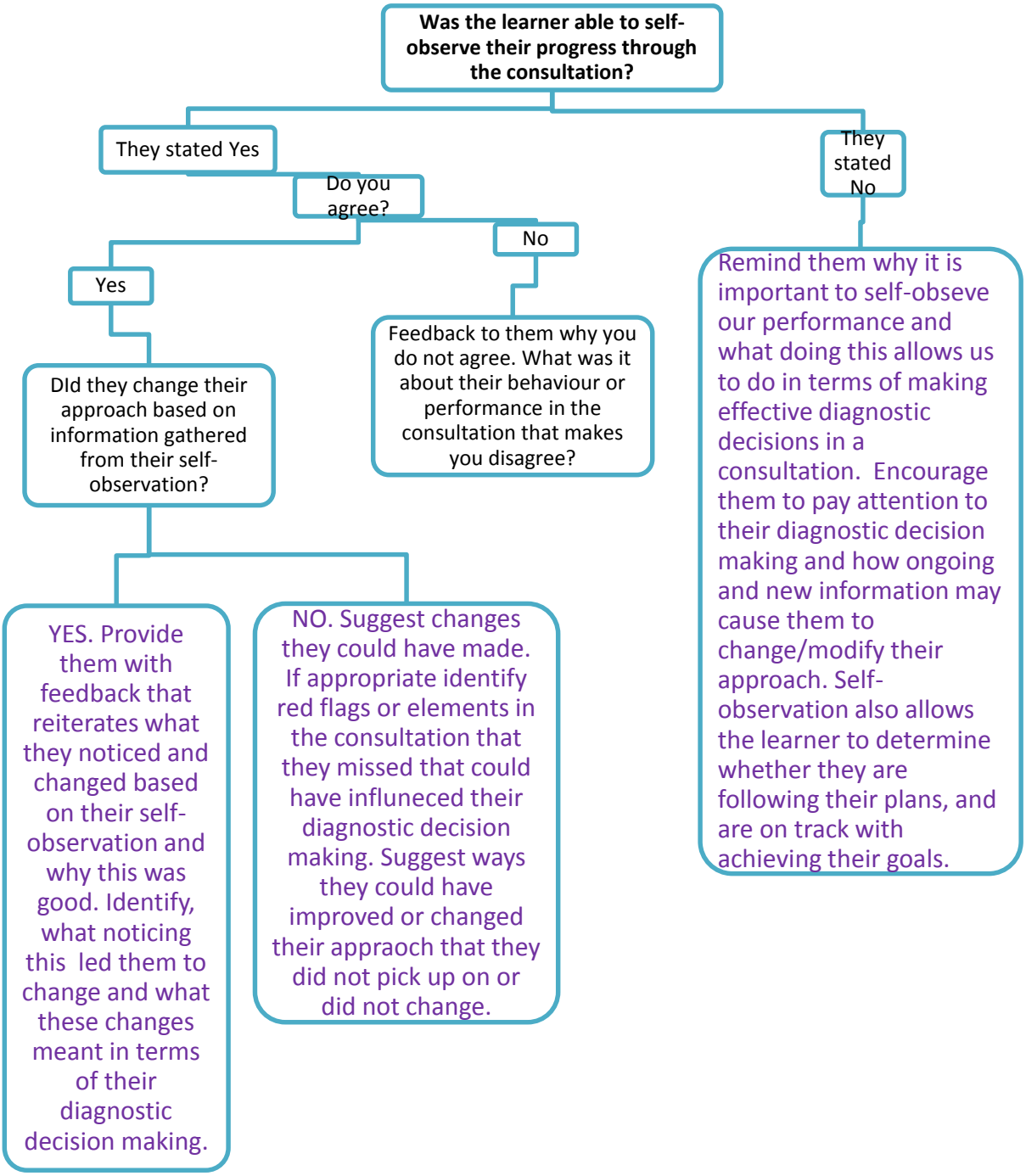


Question 3: Whether the learner set goals and plans




Was it evident that they had made a plan?
Yes
No
Encourage them to set plans which are focused and specific. Highlight that plans should be focused on specific steps and processes which need to be acheived to meet the goals.
Was the plan sepcific, focused, centred on the processes and strategies needed to be followed? (Rather than focusing on main outcomes to achieve)
Yes
No
Was their plan correct?
Was their plan correct?
Yes. Inform them why their plan was correct. Highlight to them that their planning was specific, focused and centered on the steps and processes they needed to follow.
No. Inform them why their plan was not correct and tell them what they can change to improve this. Include any relevant information regarding other areas of the consultation and how deficienciesin these areas may have influenced incorrect planning.
Yes. Inform them why their plan itself was correct. Next, encourage plans to be made that are focused and specific and that focus on the processes needed to be employed to achieve the goal. Rather than focusing the plan on one main outcome strategy.
Include any relevant information regarding medical knowledge, communication and history taking skills and clinical examination skills here and how deficienciesin these areas may have influenced poor planning.
No. Inform them why their plan was not correct and then encourage them to set plans which are focused and specific. Highlight that plans should be focused on specific steps and processes which need to be achieved to meet the goals.
Include any relevant information regarding medical knowledge, communication and history taking skills and clinical examination skills here and how deficienciesin these areas may have influenced poor planning.

Question 4: Whether the learner was able to self-observe their performance



Additional feedback points to remember

In addition to the above, the following factors are important in providing effective personalised feedback.

- You must provide feedback as you usually would on the learners' medical knowledge, communication and history taking skills, their clinical examination skills and the extent to which their differential diagnosis is correct.
- This feedback model provides an envelope of feedback provision in addition to the feedback you usually provide

- Feedback is provided on the plans and goals that the learner set themselves
- Feedback is provided that focuses on the strategies and processes that the learner employed in order to achieve the diagnostic decision making
- Feedback is provided on whether the learner was self-monitoring their performance and was able to adapt to any changes within the consultation
- Feedback corrects or clarifies any mistakes the learner may have made. Real life examples could be used to explain your points.
- Feedback takes into account how confident the learner is and whether they felt their diagnostic decision making was influenced by their knowledge or previous experience.
- Feedback is provided on the potential influence of the environment and the patients' characteristics on the diagnostic decision making.
- Feedback should be provided as soon after the event as possible in a private setting by an individual who has observed the learner
- Feedback should be specific so that the learner can reflect on it and develop an action plan to improve.

What is important about providing feedback with a focus on these points?

The following section explains why it is important to provide feedback on each of the four areas the learner is questioned on. This section explains why feedback with a focus on these areas will aid the individuals learning and performance. For each area the information helps to direct you toward knowing what feedback to provide and why this is important. The reasons and examples can be used in the feedback you provide.

Why is it important to set specific goals and plans?

- It is most advantageous if a learner sets specific, process orientated goals.
- It is also beneficial that they think and plan in terms of strategies during task preparation and goal setting.
- This encourages the learner to focus on the processes and sequence of their actions that they need to do rather than just focusing on the outcome that they are

aiming for. This stops them from being blinded by/or hampered by things that crop up/throw them in the consultation.

- It is important to set specific goals to achieve/meet at the beginning of a consultation. Goals will serve to motivate the learner by providing them with something to aim toward and provides them with standards that they can measure themselves against.

    - Example of a specific goal and plan- "*My goal is to develop a better idea of what may be causing Mrs Jones's chest pain. This will assist me in diagnosing her and developing a treatment management plan. To do this I will take a detailed history and listen to her chest, I will also take her blood pressure and measure her heart rate. Depending on the outcome of these examinations I may send her for an ECG*".

    - Example of a vague, outcome focused goal and plan-*"My goal is to diagnose the patient. I plan to do this by taking a history and using my medical knowledge".*

- However, deficiencies in the learners' medical knowledge may negatively influence their goal setting or planning despite their best efforts. Additionally, poor communication, history taking skills or clinical examination skills may also reduce the effectiveness of the learners' goals.

- If the learner has poor medical knowledge, poor communication and history taking skills or poor clinical examination skills then this may influence the processes and strategies they are able to plan for and the effectiveness of these. Consequently, these other areas of the consultation need to be taken into account when providing the learner with feedback on their goal setting. E.g. Is their goal setting and planning effective but let down by their lack of medical knowledge?

Why is it important to recognise the potential impact of contextual factors on diagnostic decision making?

-Contextual factors are evident in everyday life. They include various factors within the setting itself, the characteristics of the patient or how we feel about ourselves at that moment in time.

-These factors may act as distractors or influencers and potentially affect the learners thought patterns, their reasoning and their diagnostic decision making.

-Sometimes the learner may notice these, sometimes they may not. Sometimes they may realise they have influenced or affected their diagnostic decision making and other times they won't notice them.

-The learner needs to be encouraged to focus on these contextual factors when making diagnostic decisions so that they can recognise the affect they may have or be having on their diagnostic decision making and thus take steps to limit their influence.

- Sometimes this may result in a change in practice *e.g. (Noise in the setting)"I get distracted by the people outside if we leave the window open"- solution; shut the window*.

- Other times this may be a mental reminder to oneself to not let that factor (*patient presenting characteristics)* influence their decision making e.g. *This patient has presented each month for the past 4 months with a different complaint. BUT THIS DOESN'T mean that their chest pain on this occasion is not a sign of anything more serious.*

Why is it important to self-observe ones performance?

- Self- observation of one's performance enables the learner to be aware of their progress through the consultation, the processes involved and the outcomes of the consultation.

- This enables the learner to evaluate the effects of their progress and whether they need to make any modifications to the strategies/process/plan they are using/following. These may include the way in which they take a history from the patient, the way they examine them or the examination they perform.

- This enables the learner to make effective decisions in the consultation and for them to be aware of the mistakes that may have been made.

- If the learner does not monitor their progress they may not be aware of any modifications or changes they need to make to the strategies and processes they are using. This makes it more likely that their decisions will be less effective and they may be less aware of mistakes made since they have missed information and other pathways they could have taken.

- If they have not self-observed and are not aware of this information then any self-reflection on the consultation and their decision making will be less robust.

- Example of someone who was self-observing- "*The patient presented with a swollen left calf. My initial thoughts were a DVT. However, the patient has not been stationary for any long periods recently, or been on any long trips. When questioned they told me that they have been doing a lot more running recently. Based on this information I thought a DVT would be less likely and so steered the consultation toward a possible pulled muscle".*
  This student recognised the significance of no recent long periods of inactivity and so goes onto further question the patient to determine whether any other activities could have caused the swelling.

- Example of someone who was not self-observing- *"The patient presented with a swollen left calf. The calf was over 3cm larger than the left, it was tender to touch. The patient has not been on any long journeys recently. However, I still think a DVT is most likely".*
  Although this student rules out any recent long periods of being stationary they fail to integrate this information into their diagnostic reasoning and do not pursue any other potential causes of the swollen calf.

- Again, deficiencies in the learners' medical knowledge, communication or history taking skills or clinical examination skills may also reduce the learners' ability to effectively modify their use of processes and strategies. Consequently, these other areas of the consultation need to be taken into account when providing the learner with feedback on their self-observation.

Why is it important to have an accurate sense of self-confidence?

-It is important that the learner has the confidence in themselves that they have the knowledge to have gone through the correct processes in making diagnostic decisions, it is equally important however, for them to be cautious when making decisions in case they are over confident in their perceived knowledge and abilities.

- Low confidence can cause a learner to try less hard as they assume they cannot reach a set goal. This in turn may cause poorer performance thus confirming their low confidence.

-Individuals with low confidence and who underperform are also in danger of not noticing the extent of their underperformance if this lack of knowledge means they fail to understand why they are underperforming or how to improve.

-High confidence can be detrimental to a learner if their knowledge or skills are actually poorer than they perceive them to be. Consequently, they may be less likely to recognise when they have underperformed. Such individuals may ignore signs of underperformance or classify them as a one off. Thus failing to identify and improve on weaknesses.

Why is this an important area for medical education?

Making a diagnosis is the cornerstone of being a competent medical practitioner. Providing learners with feedback on their diagnostic decision making is an essential method by which this skill can be improved. However, the most effective methods by which to provide feedback are not clear.

Recent research has highlighted the importance of the focus of feedback in influencing whether it is effective in helping the learner improve their performance. This focus includes the specific aspects of the performance on which feedback is provided and the external factors in the authentic clinical setting that the feedback takes into account. Specifically, feedback with a focus on the following factors appears to be important in making feedback effective; feedback on the task itself, feedback on the goals set and plans made, feedback on the processes and strategies used to complete the task and feedback on the learners self-monitoring of their performance and reflection. The authentic clinical setting also influences decision making and feedback since there are numerous elements that may influence how the diagnosis and decision to act is made. These can derive from the patient, the environment or the learner themselves. Consequently it is important that feedback takes these contextual factors into account.

Question sheet for the medical trainee to complete in the consultation

PIN & Year of study:

INFORMATION ABOUT THE CLINICAL INTERACTION	
Task performed:	
Date:	

QUESTIONS BEFORE THE CLINICAL INTERACTION	
1. How confident do you feel in your ability to make a successful diagnostic decision in this case?	
1= Not very confident. 10= very confident. *1-2-3-4-5-6-7-8-9-10*	
2. Are you aware of any factors in the environment, the patient or yourself today that may influence your decision making in a positive or negative way?	
Yes: What are these? There are some areas of factors listed below. Circle any that are relevant to you and briefly note what the factor is. *Will you employ any techniques to help you manage these to aid your diagnostic decision making?* *Noise in the setting* *Time constraints* *Location of consultation* *No of previous patient visits* *Communication barriers* *Stereotype of patient* *Confidence* *Perceived lack of knowledge* *Other?(list)*	*No* *Why not?*

QUESTIONS AFTER THE CLINICAL INTERACTION
3. What did you aim to achieve (your goals) in terms of your diagnostic decision making in the clinical interaction and how did you intend to achieve this (your plans)?

4. Did you feel that you able to self-observe or keep track of your diagnostic decision making during the interaction? If so were you able to gauge whether you were on the right track?

Yes: ***Did you change your approach during the consultation based on this?*** *If yes: How?*	No: Why do you think this was? No: **Why did you not change your approach?**

5. How confident do you feel in your ability to make a successful diagnostic decision in similar cases to this one in the future?

1= Not very confident. 10= very confident. *1-2-3-4-5-6-7-8-9-10*

If your confidence has changed since the beginning of the consultation, either increased or decreased, why do think this change may have occurred? For example, what has made you more or less confident?

Feedback and action plan

Pin & Year of study:

INFORMATION ABOUT THE CLINICAL INTERACTION

Date:

Task performed:

SELF-REFLECTION

What do you think you performed well in this consultation- in relation to your diagnostic decision making and the consultation in general?

What did you think you performed less well in this consultation- in relation to your diagnostic decision making and the consultation in general?

FEEDBACK PROVIDED

Briefly outline the feedback you were provided with

ACTION PLAN

Based on your performance and the feedback provided list three things you will do to improve your diagnostic decision making.

List any other areas for improvement e.g clinical examination skills, communication or history taking skills

Ap5.2 Questionnaires to Assess the PFM: Clinical Educators

What feedback do you provide?

The following questionnaire is to help me understand what feedback you usually provide students with after a clinical interaction when they are on placement with you. In particular I am interested in feedback you provide after the student has made any diagnostic decisions or plans within the clinical interaction.

1. Please think about the feedback you provide to medical students after observing them engage in diagnostic decision making in the clinical setting. What areas of the clinical interaction do you usually give them feedback on?

2. How useful do you think students find the feedback you give them on their diagnostic decision making after a clinical interaction?

Please explain your answer.

1	*2*	*3*	*4*	*5*
Not very useful	*Somewhat useful*	*Indifferent*	*Useful*	*Very useful*

3. How effective do you think your feedback is at aiding students in improving their diagnostic decision making for future clinical interactions?

Please explain your answer.

1	*2*	*3*	*4*	*5*
Not very effective	*Somewhat effective*	*Indifferent*	*Effective*	*V.effective*

4. How often do you think students use the feedback you provide them with to improve their diagnostic decision making for future clinical interactions?

Please explain your answer.

1	*2*	*3*	*4*	*5*
Never	*Rarely*	*Occasionally*	*very Frequently*	*Always*

5. When giving the student feedback after diagnostic decision making in the clinical setting how often do you focus the feedback on the following aspects?

	How often do you provide feedback which focuses on this?				
	1	*2*	*3*	*4*	*5*
	Never	*Rarely*	*Occasionally*	*V.Freq*	*Always*
The overall outcome of the clinical interaction	1	2	3	4	5
The students medical knowledge	1	2	3	4	5
The techniques employed by the student to achieve the diagnostic decision making	1	2	3	4	5
The apparent goals the student set out to achieve	1	2	3	4	5
The apparent 'process' the student followed in the interaction to aid their diagnostic decision making	1	2	3	4	5
Whether the student is able to adapt their approach to diagnostic decision making in light of information gathered during the clinical interaction	1	2	3	4	5
The students ability to self-observe their progress or performance through the interaction	1	2	3	4	5

6. When giving the student feedback after DDM in the clinical setting do you ever perceive students DDM to be effected by the following factors and how often do you provide feedback that takes these into account?

A. The environment they are in

	Perception that this influences students diagnostic decision making *1 2 3 4 5* *Never Rarely Occasionally V.Freq Always*	How often do you provide feedback which takes this into account? *1 2 3 4 5* *Never Rarely Occasionally V.Freq Always*
Time constraints	1 2 3 4 5	1 2 3 4 5
Noise in the environment	1 2 3 4 5	1 2 3 4 5
The setting	1 2 3 4 5	1 2 3 4 5

B. Patient characteristics

	Perception that this influences students diagnostic decision making 1 2 3 4 5 Never Rarely Occasionally V.Freq Always	How often do you provide feedback which takes this into account? 1 2 3 4 5 Never Rarely Occasionally V.Freq Always
The no. of previous visits the patient has had with the same presentations	1 2 3 4 5	1 2 3 4 5
Attitude toward the patient	1 2 3 4 5	1 2 3 4 5
The attitude of the patient	1 2 3 4 5	1 2 3 4 5
Communication barriers	1 2 3 4 5	1 2 3 4 5

C. How they feel

	Perception that this influences students diagnostic decision making 1 2 3 4 5 Never Rarely Occasionally V.Freq Always	How often do you provide feedback which takes this into account? 1 2 3 4 5 Never Rarely Occasionally V.Freq Always
Their confidence that they can make an accurate diagnosis	1 2 3 4 5	1 2 3 4 5
Their medical knowledge and experience	1 2 3 4 5	1 2 3 4 5

Providing feedback after observing a consultation.

Please click on the link below. This will direct you to a YouTube video of a consultation.

https://www.youtube.com/watch?v=Ygv4UQssoh0

Please watch this consultation in full and then return to this webpage to complete the following questions.

1. What feedback would you provide if this was one of your students? Please provide at least three points.

-What three main areas of the consultation would you focus on and how would you do this?

-How would you involve the student?

-What might you suggest for improvement?

Feedback provided in line with the Personalised Feedback Model-
(QUESTIONNAIRE ANSWERED POST PFM ONLY)

1. Do you feel as there has been an obvious change in the way you provide feedback to your students after their diagnostic decision making? –This can be compared to how you were previously providing feedback to these students or other students. Please expand on your answer.

2. Do you feel as though providing feedback in this way has been more effective in helping the students improve their diagnostic decision making?

Please expand on your answer

1	*2*	*3*	*4*	*5*
Not very effective	*Somewhat effective*	*Not very effective or un-effective*	*Useful*	*Very useful*

3. Thinking back to how you usually provided feedback. Has this method been more useful in helping you provide the feedback?

1	*2*	*3*	*4*	*5*
Less useful	*Not at all more useful*	*No change*	*Useful*	*Very useful*

Please expand on your answer: for example, how has it been more useful, what specifically about this method has more useful?

4. How easy was it to feedback in line with the model in clinical practice?

1	*2*	*3*	*4*	*5*
Very difficult	*Difficult*	*Not particularly easy or difficult*	*Easy*	*Very easy*

Please expand on your answer: for example, how has it been more useful, what specifically about this method has more useful?

5. Thinking back to the feedback you provided in the clinical setting and the extra questions you asked the student at the beginning and the end of the clinical interaction can you think of any ways in which this method of providing feedback can be improved? Please expand on your answer

6. What do you think are the strengths and weaknesses of being providing feedback in this way?

Please expand on your answer

Ap5.3 Questionnaires to Assess the PFM: Medical trainees

What feedback do you receive?

The following questionnaire is to help me understand what feedback you are usually provided with after a clinical interaction on placements similar to this one. In particular I am interested in feedback you have received after making any diagnostic decisions or plans within the clinical interaction. If you have already had a placement in the same specialty as this one then please answer the questions with this in mind. If not, please base your answers on a similar clinical placement.

1. Please think about the feedback you are given after engaging in diagnostic decision making in the clinical setting. What areas of the clinical interaction are you usually given feedback on?

2. How useful do you find the feedback you are given on your diagnostic decision making after a clinical interaction?

Please explain your answer.

1	*2*	*3*	*4*	*5*
Not very useful	*Somewhat useful*	*Not very useful or un-useful*	*Useful*	*Very useful*

3. How effective do you find the feedback in improving your diagnostic decision making for future clinical interactions?

Please explain your answer.

1	2	3	4	5
Not very effective	*Somewhat effective*	*Indifferent*	*Effective*	*Very effective*

4. How often do you use the feedback you are provided with to improve your diagnostic decision making for future clinical interactions?

Please explain your answer

1	*2*	*3*	*4*	*5*
Never	*Rarely*	*Occasionally*	*Very Frequently*	*Always*

5. When given feedback after diagnostic decision making in the clinical setting how often does the feedback focus on the following aspects?

	How often are you provided with feedback which focuses on this?				
	1	*2*	*3*	*4*	*5*
	Never	*Rarely*	*Occasionally*	*V.Freq*	*Always*
The overall outcome of the clinical interaction	1	2	3	4	5
Your medical knowledge	1	2	3	4	5
The techniques you employed to achieve the diagnostic decision making	1	2	3	4	5
The goals you set out to achieve	1	2	3	4	5
The 'process' you followed in the interaction to aid your diagnostic decision making	1	2	3	4	5
Whether you were able to adapt your approach to diagnostic decision making in light of information gathered during the clinical interaction	1	2	3	4	5
Your ability to self-observe their progress or performance through the interaction	1	2	3	4	5

6. Do you ever perceive your diagnostic decision making to be effected by the following factors?

A. The environment you are in

	Perception that this influences your diagnostic decision making *1 2 3 4 5* *Never Rarely Occasionally V.Freq Always*	How often are you provided with feedback which takes this into account? *1 2 3 4 5* *Never Rarely Occasionally V.Freq Always*
Time constraints	1 2 3 4 5	1 2 3 4 5
Noise in the environment	1 2 3 4 5	1 2 3 4 5
The setting	1 2 3 4 5	1 2 3 4 5

B. The characteristics of the patient

	Perception that this influences your diagnostic decision making 1 2 3 4 5 Never Rarely Occasionally V.Freq Always	How often are you provided with feedback which takes this into account? 1 2 3 4 5 Never Rarely Occasionally V.Freq Always
The no. of previous visits the patient has had with the same presentations	1 2 3 4 5	1 2 3 4 5
Attitude toward the patient	1 2 3 4 5	1 2 3 4 5
The attitude of the patient	1 2 3 4 5	1 2 3 4 5
Communication barriers	1 2 3 4 5	1 2 3 4 5

C. How you feel

	Perception that this influences your diagnostic decision making					How often are you provided feedback which takes this into account?				
	1 Never	2 Rarely	3 Occasionally	4 V.Freq	5 Always	1 Never	2 Rarely	3 Occasionally	4 V.Freq	5 Always
Your confidence that you can make an accurate diagnosis	1	2	3	4	5	1	2	3	4	5
Your medical knowledge and experience	1	2	3	4	5	1	2	3	4	5

Hypothetical consultations

CASE 1.

Background:

30 year old male/female comes to the surgery and the receptionist have noted that they are complaining about knee pain. PMH nil significant. DH nkda

On a scale of 1- 10 how confident do you feel in your ability to adequately diagnose the patient ?

1= not very confident -10= very confident.

What goals do you have for this consultation and how do you intend to acheive these?

Is there a particular strategy or technique you will use to make a diagnosis in this case ?

History:

30 year old male – Jamie Anderson.

He was playing rugby on the beach when he was on holiday in Spain last week. He were tackled when his foot was caught in the sand, and noticed immediate pain in his right knee. He can't recall how what direction the person came at him from.

Thinks he heard a snap from his knee. He has put some ice on it but it really hasn't helped. Neither does ibuprofen. Unable to weight bear. He is worried that he may have damaged one of the ligaments in his knee. Non smoker. Drinks 30 units per week on average

Do you feel that you are on the right track? If yes, why? If no, will you change anything about your approach to the consultation?

Are you using any techniques to determine whether you are on the right track, if so, what are these?

How confident are you that you will be able to make a diagnosis in this case?

1= not very confident -10= very confident.

Examination:

Obviously finding it painful to walk on his right knee.

Obviously swollen knee with generalised decreased range of movement

No tenderness to palpation of joint line

Anterior draw test positive

What do you think the diagnosis is?

CASE 2.

Background:

A 59 year- old presents with a two month history of vaginal spotting.

On a scale of 1- 10 how confident do you feel in your ability to adequately diagnose the patient ?

1= not very confident -10= very confident

What goals do you have for this consultation and how do you intend to acheive these?

Is there a particular strategy or technique you will use to make a diagnosis in this case ?

History :

She thinks her last menstrual period was about 6 – 7 years ago. Two months ago she had a few days of vaginal bleeding which was like the end of period and since then she has continued to spot most days. This is dark red or brown and she has taken to wearing panty liners. She has no pain or any associated symptoms. Initially she thought that her periods had restarted but a friend told her that she should see her GP.

She has never been on hormone replacement therapy and she had regular smears with normal results until the age of 55 but she declined the last invitation to attend since she is no longer sexually active after the death of her husband when she was 52. She has had no children or miscarriages.

Do you feel that you are on the right track? If yes, why? If no, will you change anything about your approach to the consultation?

Are you using any techniques to determine whether you are on the right track, if so, what are these?

How confident are you that you will be able to make a diagnosis in this case?

1= not very confident -10= very confident.

Examination:

On examination, her vulva is normal and she has mild atrophic changes of her vagina and her cervix. She has some laxity of the vaginal walls but no significant prolapse. She has a small anteverted mobile uterus. You are unable to feel any adnexal masses.

What do you think the diagnosis is?

CASE 3.

Background:

A previously healthy 16-year-old girl was seen by another GP in the practice with a two-day history of sore throat, fatigue, fever, headache, and vomiting. She had not had a runny nose or a cough. On examination at this time, her temperature was 36.7°C. She had mild redness and white plaques on both of her tonsils, without lymphadenopathy. Viral pharyngitis was diagnosed. Treatment with analgesics and adequate fluid intake were advised.

On a scale of 1- 10 how confident do you feel in your ability to adequately diagnose the patient ?

1= not very confident -10= very confident.

What goals do you have for this consultation and how do you intend to acheive these?

Is there a particular strategy or technique you will use to make a diagnosis in this case ?

History:

Four days later she returns to see you with a worsening sore throat. She is having difficulty swallowing and feels lightheaded while standing. She continues to feel fatigued, chilled, and achy. She has a mild bifrontal headache and some mild stiffness of the neck. She has not vomited since the previous visit but she has some mild diarrhoa. She is taking ibuprofen for her sore throat.

Do you feel that you are on the right track? If yes, why? If no, will you change anything about your approach to the consultation?

Are you using any techniques to determine whether you are on the right track, if so, what are these?

How confident are you that you will be able to make a diagnosis in this case?

1= not very confident -10= very confident.

Examination:

On examination, she is pale and looks ill. Her temperature is 36.3°C, her blood pressure 93/64 mm Hg, her pulse 120 beats per minute, her respiratory rate 22 breaths per minute. She has some difficulty fully opening her mouth and protruding her tongue, but there is no anatomical distortion. Her oropharynx is dry, and both tonsils are mildly red but no exudate. Her anterior cervical lymph nodes are tender, especially on the right side. The findings on a cardiovascular examination are normal except for tachycardia, and her lungs are clear. The findings on an abdominal examination are normal, and she has no rash.

What do you think the diagnosis is?

Feedback received in line with the Personalised Feedback Model -
(QUESTIONNAIRE ANSWERED POST PFM ONLY)

The following questionnaire is to help me understand what feedback you have been provided with since your trainer has been providing feedback in line with the Personalised Feedback Model and how useful you have found this feedback to be. In particular I am interested in feedback you have received after making any diagnostic decisions or plans within the clinical interaction.

1. Do you feel as there has been an obvious change in the way you have been provided with feedback after your diagnostic decision making in this placement? –This can be compared to how you were previously provided with feedback in this placement or compared to feedback provided in other similar placements. Please expand on your answer.

2. Do you feel as though being provided with feedback in this way has been effective in helping you to improve in your diagnostic decision making? On a scale of 1 – 5.

Please expand on your answer

1	*2*	*3*	*4*	*5*
Not very effective	*Somewhat effective*	*Not very effective or un-effective*	*Useful*	*Very useful*

3. Thinking back to how you are usually provided with feedback. Has this method been more useful to you to help you improve your diagnostic decision making?

1	*2*	*3*	*4*	*5*
Not very effective	*Somewhat effective*	*Not very effective or un-effective*	*Useful*	*Very useful*

Please expand on your answer: for example, **how has it been more useful**, **what specifically about being provided with feedback in this way has made it more useful?**

4. Thinking about being provided with feedback using this method please rate your agreement with the statements below.

Statement	Agreement. 1- Strongly disagree 5-Neutral 10-Strongly agree
Being provided with feedback in this way has been effective in improving my diagnostic decision making	1 2 3 4 5 6 7 8 9 10
Being provided with feedback in this way has changed the way in which I perform diagnostic decision making	1 2 3 4 5 6 7 8 9 10
This new method has provided more structured feedback	1 2 3 4 5 6 7 8 9 10
I find feedback that takes my confidence into account useful	1 2 3 4 5 6 7 8 9 10
I find feedback that takes the influence of contextual factors on my diagnostic decision making into account useful	1 2 3 4 5 6 7 8 9 10
I find feedback that focuses on the goals I set myself and how I intend to achieve these goals useful	1 2 3 4 5 6 7 8 9 10
I find feedback that encourages me to self observe my own performance and progress useful	1 2 3 4 5 6 7 8 9 10
I believe that my self-confidence has improved after being provided with feedback in this way	1 2 3 4 5 6 7 8 9 10
I believe that the feedback has helped me to self observe and modify my performance during the clinical interaction	1 2 3 4 5 6 7 8 9 10

5. Thinking back to the feedback you were given in the clinical setting and the extra questions you were asked to answer at the beginning and the end of the clinical interaction can you think of any ways in which this method of providing feedback can be improved?

6. What do you feel are the strengths of being provided with feedback in this way?

7. What do you feel are the weaknesses of being provided with feedback in this way?

Ap5.4 Barriers to Participation Questionnaire

1. Please read the following statements below and tick those which apply to your reasoning for not taking part. Please rate how influential this reason was on a scale of 1 (not very influential) to 5 (very influential).

Reasons for not taking part	Please tick yes to all that apply.	For the reasons you ticked yes for, please rate on a scale of 1-5 how influential this reason was. 1= not was influential, 5= very influential				
	Yes	1	2	3	4	5
I did not meet the criteria to take part		1	2	3	4	5
I am too busy		1	2	3	4	5
There was no financial incentive		1	2	3	4	5
I was interested but the questionnaire was too long		1	2	3	4	5
I was interested but did not have the time to spare for the training		1	2	3	4	5
I was interested but the model complicated to use		1	2	3	4	5
I did not think it was a good approach to improve diagnostic decision making		1	2	3	4	5
I did not understand what I was being asked to do		1	2	3	4	5
I did not think it would work		1	2	3	4	5
My feedback does not need improving		1	2	3	4	5
I did not believe I would gain anything from taking part		1	2	3	4	5
I am too busy to take part in research which provided me with no obvious reward		1	2	3	4	5

2. Please list any other reasons not included above which influenced your decision not to take part.

Ap5.5 Ethical Approval and Amendments

Faculty of Medicine and Health Research Office
School of Medicine Research Ethics Committee (SoMREC)

Dear Ms Leggett
Ref no: SoMREC/14/006
Title: Investigating the usefulness, **usability and effectiveness of a Personalised Feedback Model on feedback provided after diagnostic decision making..**
Your research application has been reviewed by the School of Medicine Ethics Committee (SoMREC) and I can confirm that ethics approval is granted based on the documentation received at the date of this letter.

Document	*Version*	*Date received*
SoMRECReviewerProForma Final response from applicant 15-10-14	1	15/10/14
UoL Ethics form Heather Leggett Sep 18th	3	22/10/14
Appendix A-I	2	14/10/14

Please notify the committee if you intend to make any amendments to the original research ethics application or documentation. All changes must receive ethics approval prior to implementation. Please contact the Faculty Research Ethics Administrator for further information (fmhuniethics@leeds.ac.uk)

Ethics approval does not infer you have the right of access to any member of staff or student or documents and the premises of the University of Leeds. Nor does it imply any right of access to the premises of any other organisation, including clinical areas. The committee takes no responsibility for you gaining access to staff, students and/or premises prior to, during or following your research activities.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited.

It is our policy to remind everyone that it is your responsibility to comply with Health and Safety, Data Protection and any other legal and/or professional guidelines there may be.
I wish you every success with the project.

Yours sincerely

Dr Roger Parslow
Co-Chair, **SoMREC**, **University of Leeds**

Dr Ruth Brooke
Co-Chair, **SoMREC**, **University of Leeds**

Amendment 1.

Faculty of Medicine and Health Research Office
School of Medicine Research Ethics Committee (SoMREC)

Dear Heather
Ref no: SoMREC/14/006 _ Amendment 1
Title: Investigating the usefulness, usability and effectiveness of a Personalised Feedback Model on feedback provided after diagnostic decision making.

Your amendment to your research ethics application has been reviewed by the School of Medicine Ethics Committee (SoMREC) and we are pleased to confirm that ethics approval is granted based on the documentation received at the date of this letter and subject to the following condition(s):

- **Trust R&D approve the required change/amendment.**

Document	*Version*	*Date*
Amendment_form.SoMREC 14 006	1	03.03.15

Please notify the committee if you intend to make any further amendments to the original research as submitted and approved to date. This includes recruitment methodology; all changes must receive ethical approval prior to implementation. Please contact the Faculty Research Ethics Administrator for further information (fmhuniethics@leeds.ac.uk)

Ethics approval does not infer you have the right of access to any member of staff or student or documents and the premises of the University of Leeds. Nor does it imply any right of access to the premises of any other organisation, including clinical areas. The committee takes no responsibility for you gaining access to staff, students and/or premises prior to, during or following your research activities.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited.

It is our policy to remind everyone that it is your responsibility to comply with Health and Safety, Data Protection and any other legal and/or professional guidelines there may be.
We wish you every success with the project.

Yours sincerely

Dr Roger Parslow
Co-Chair, **SoMREC**, **University of Leeds**

Dr Ruth Brooke
Co-Chair, **SoMREC**, **University of Leeds**

Amendment 2.

Faculty of Medicine and Health Research Office
School of Medicine Research Ethics Committee (SoMREC)
Room 10.111b, level 10

Dear Heather
Ref no: SoMREC/14/006 _ Amendment 2
Title: Investigating the usefulness, usability and effectiveness of a Personalised Feedback Model on feedback provided after diagnostic decision making.

Your amendment to your research ethics application has been reviewed by the School of Medicine Ethics Committee (SoMREC) and we are pleased to confirm that ethics approval is granted based on the documentation received at the date of this letter and subject to the following condition(s):

☐ **Trust R&D approve the required change/amendment.**

Document	*Version*	*Date submitted*
Amendment 2_form.SoMREC 14 006	1	07/07/2015

Please notify the committee if you intend to make any further amendments to the original research as submitted and approved to date. This includes recruitment methodology; all changes must receive ethical approval prior to implementation. Please contact the Faculty Research Ethics Administrator for further information (fmhuniethics@leeds.ac.uk)

Ethics approval does not infer you have the right of access to any member of staff or student or documents and the premises of the University of Leeds. Nor does it imply any right of access to the premises of any other organisation, including clinical areas. The committee takes no responsibility for you gaining access to staff, students and/or premises prior to, during or following your research activities.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited.

It is our policy to remind everyone that it is your responsibility to comply with Health and Safety, Data Protection and any other legal and/or professional guidelines there may be.
We wish you every success with the project.

Yours sincerely

Dr Roger Parslow
Co-Chair, SoMREC, University of Leeds

Dr Ruth Brooke
Co-Chair, SoMREC, University of Leeds